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anatomy

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19–23 October 2022,
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Ahmet Kağan Karabulut, MD, PhD; Konya, Türkiye

Editor-in-Chief
Nihal Apaydın, MD
Department of Anatomy,
Faculty of Medicine, Ankara University,
06100, Sıhhıye, Ankara, Türkiye
Phone: 0090 312 595 82 48
e-mail: napaydin@gmail.com; napaydin@medicine.ankara.edu.tr

Administrative Office
Güven Mah. Güvenlik Cad. Onlar Ap. 129/2 Aşağı Ayrancı, Ankara, Türkiye
Phone: +90 312 447 55 52-53

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Title page

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    - *Contributed section with editors:* Johnson D, Ellis H, Collins P, editors. Pectoral girdle and upper limb. In: Standring S, editor. Gray's anatomy: the anatomical basis of clinical practice. 29th ed. Edinburgh (Scotland): Elsevier Churchill Livingstone; 2005. p. 799–942.
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20th Turkish Neuroscience Congress

19–23 October 2022, Istanbul, Türkiye

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Editorial

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Welcome Address of the Congress Presidents

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Dear Neuroscientists,

We welcome you to the 20th National Neuroscience Congress organized by Acıbadem University with the support of Brain Research Society-Türkiye (BAD), which will be held at the Acıbadem University Kerem Aydınlar Campus between October 19th to 23rd 2022.

In line with the multidisciplinary nature of Neurosciences, the Brain Research Society has organized since its foundation in 1991 up today many scientific events in various related scientific fields. Surely, the National Neuroscience Congress, as one of the most important activities, has played a leading role in the progress of Neurosciences in Türkiye by providing a platform for exchange of scientific ideas among participants from various disciplines and contributing to the education of young neuroscientists with a large range of courses and many lectures by experts in basic and clinical fields. This year, beside the face-to-face plenary conferences to be held by David Atwell (University College London), György Buzsaki (New York University), Onur Güntürkün (Ruhr University, Bochum), İsmail Hakkı Ulus (Acıbadem University), Burak Güçlü (Boğaziçi University), Hüseyin Boyacı (Bilkent University), Müge Yemişçi Özkan (Hacettepe University), Kaya Bilgüvar (Yale University) and Güneş Ünal (Boğaziçi University), on-line conferences will also be held by Joseph Ledoux (New York University), Miguel Nicolelis (Duke University) and Fuat Balcı (University of Manitoba). Additionally, there will be 3 symposia and 15 panels, which will also partly include international on-line speakers, 9 courses, 90 oral and 60 poster presentations.

After the long and difficult period of the pandemic, we are excited to come together physically and experience an event with high scientific and educational impact, that, we hope, will refresh the interactions and collaborations among the participants. We are looking forward to seeing you all in Istanbul and hope that you will enjoy the scientific program.

Sincerely,

Congress Presidents

Prof. Dr. Özlem Akman
Brain Research Society

Prof. Dr. Güldal Süyen
Acıbadem University

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20th Turkish Neuroscience Congress

19–23 October 2022, Istanbul, Türkiye

Scientific Program

19 October 2022, Wednesday (Courses)

Course 1		
	09.30–17.30	**Microscopy techniques in neuroscience: histochemistry, immunohistochemistry and transmission electron microscopy** Serap Arbak, Serap Şirvancı, Dilek Akakın, Merve Elmas, Deniz Yücel
Course 2		
	09.30–17.30	**Introduction to MATLAB** Ata Akın, Sinem Burcu Erdoğan, Seda Dumlu, Elçim Kırımlı
Course 3		
	09.30–13.00	**Genome analyses in neurological disorders** Eda Tahir Turanlı, Sibel Uğur İşeri, İlker Karacan
Course 4		
	14.00–17.30	**Machine learning applications on the biological data** Emel Timuçin
Course 5		
	09.30–13.00	**Clinical anatomy of the central nervous system: approach with cadaver, model and three-dimensional methods** Abdul Veli İsmailoğlu, Milena Can
Course 6		
	14.00–17.30	**Induction of brain tumors in mouse and follow-up with in-vivo imaging** Samed Özer, Ekin Döngel, Dilan Acar
Course 7		
	09.30–17.30	**SPM course: basic fMRI and effective connectivity analyses** Metehan Çiçek, Gözde Vatansever, Simge Altınok, Burcu Sırmatel, Hazal Şimşek
Course 8		
	09.30–17.30	**Functional connectivity analyses on resting state and task-based fMRI data with CONN software** Ali Bayram, Bernis Sütçübaşı, Elif Kurt
Course 9		
	09.30–13.00	**Advanced morphometric analyses on MRI data with FreeSurfer software** Andaç Hamamcı, Ulaş Ay, Emre Harı, Hüden Neşe

20 October 2022, Thursday

	Hall A	Hall B	Hall C
09.00–09.30	**Opening Ceremony** Güldal Süyen, Özlem Akman		
09.30–11.00	**Panel 1: The neural basis of social cognition and morality: what have we learned from neuropsychology, neuroimaging and non-invasive brain stimulation studies?** **Moderator:** Hakan Gürvit **Speakers:** Aslı Dermirtaş Tatlıdede, Hakan Gürvit, Elif Yıldırım	**Panel 2: Comparative and computational evaluation of symptoms in Parkinson's disease after deep brain stimulation and medication intervention** **Moderator:** Didem Gökçay **Speakers:** Didem Gökçay, Yusuf Özgür Çakmak, Atilla Yılmaz	**Symposium 1: Potential of the functional near infrared spectroscopy (fNRIS) technique in cognitive and clinical neuroscience research: what we can or cannot do?** **Moderator:** Ata Akın **Speakers:** Aykut Eken, Hasan Onur Keleş, Sinem Burcu Erdoğan, Emre Yorgancıgil
11.00–11.15	**Coffee Break**		
11.15–12.15	**Conference 1** **Chair:** Özlem Akman Regulation of cerebral blood flow by capillary pericytes in Alzheimer's disease, Covid-19 and hyperoxia David Atwell	-	-
12.15–13.45	**Lunch Break** **Poster Discussion (P-01–P-31)** **Chairs:** Tamer Demiralp, Devrim Öz Arslan, Mehmet Ergen, Bernis Sütçübaşı, Zeynep Küçük, Ani Kıçik		
13.45–14.45	**Conference 2** **Chair:** Güldal Süyen Microcirculation: new target for neuroprotective therapy Müge Yemişçi Özkan	**Conference 3** **Chair:** Metehan Çiçek Comparative study of the behavioral and neural basis of decision-making and time perception Fuat Balcı	-
14.45–15.00	**Break**		
15.00–16.30	**Panel 3: In-vitro and in-vivo models for the investigation of the molecular mechanisms of neurological diseases** **Moderator:** Selma Yılmazer **Speakers:** Emre Yakşi, Gizem Dönmez Yalçın, Merve Alaylıoğlu, İrem Atasoy	**Panel 4: Trajectories of cognitive aging and their neuropathological basis** **Moderator:** Mustafa Seçkin **Speakers:** Hande Özdinler, Ayça Erşen Danyeli, Tamar Gefen, Daniel T. Ohm	**Panel 5: Predictive coding in the brain – Perception as hypothesis testing?** **Moderator:** Tamer Demiralp **Speakers:** Güven Güzeldere, Anil Seth, Romain Brette
16.30–17.00	**Coffee Break**		
17.00–18.00	**Conference 4** **Chair:** Hakan Gürvit What happened to the 'mental' in 'mental' disorders Joseph E. Ledoux	-	-

21 October 2022, Friday

	Hall A	Hall B	Hall C
09.30–11.00	**Panel 6: Brain microcirculation in health and disease** **Moderator:** Turgay Dalkara **Speakers:** Turgay Dalkara, Yasemin Gürsoy-Özdemir, Şefik Evren Erdener	**Symposium 2: Theory, history, importance and neuromodulation of brain oscillations in cognitive/ affective processes** **Moderators:** Canan Başar-Eroğlu, Görsev Yener **Speakers:** Canan Başar-Eroğlu, Bahar Güntekin, Tuba Aktürk, Deniz Yerlikaya	**Panel 7: Social and biological underpinnings of punishment** **Moderator:** Ozan Erözden **Speakers:** Ozan Erözden, Güçlü Akyürek, Tuna Çakar

10.30–11.00	**Coffee Break**		
11.00–12.00	**Conference 5** **Chair:** Ersin Koylu How do context and expectations shape visual perception? Hüseyin Boyacı	-	-
10.30–11.00	**Lunch Break**		
12.30–13.00	**Satellite Symposium: Neuroimaging techniques with eego systems** Dr. Fabio Barollo alpmed Healthcare Technologies & Solutions	-	-
13.30–15.00	**Oral Presentations 1 (O-01 – O-06)** Nervous system diseases and treatment approaches **Chairs:** Bayram Yılmaz, Yasemin Gürsoy Özdemir	**Oral Presentations 2 (O-07 – O-12)** Behavioral and cognitive neuroscience, neuroimaging **Chairs:** Görsev Yener, Bahar Güntekin	**Oral Presentations 3 (O-13 – O-18)** Molecular and cellular neuroscience **Chairs:** Uğur Özbek, Kaya Bilguvar
15.00–15.10	**Break**		
15.10–16.40	**Panel 8: Gene regulation mechanisms in neurodegeneration** **Moderator:** Erdinç Dursun **Speakers:** Duygu Gezen Ak, Kemal Uğur Tüfekçi, Erkan Kiriş	**Symposium 3: Advances in translational epilepsy therapy discovery** **Moderator:** Özlem Akman **Speakers:** Aristea Galanopoulou, Stéphane Auvin, David Henshall	**Panel 9: The role of offline and online evaluations in understanding dyslexia markers** **Moderator:** Özgür Aydın **Speakers:** Sema Acar Ünalgan, Hazal Artuvan, Esmehan Özer, R. Duygu Temeltürk
16.40–17.00	**Coffee Break**		
17.00–18.00	**Conference 6** **Chair:** Ahmet Ademoğlu Brain machine interfaces: from basic science to neuroprostheses and neurological recovery Miguel A. L. Nicolelis	-	-
18.00–19.00	**Conference 7** **Chair:** Beki Kan Half a century in neuroscience: what I can and can't do with memories İsmail Hakkı Ulus	-	-

22 October 2022, Saturday

	Hall A	**Hall B**	**Hall C**
09.30–10.30	**Panel 10: Why we still cannot treat 1/3 of the epilepsy cases efficiently?** **Moderators:** Filiz Onat, Betül Baykan **Speakers:** Ebru Altındağ, Sibel Uğur İşeri, Nihan Çarçak Yılmaz	**Panel 11: Cognition in Parkinson's and Alzheimer's disease: overlaps and dissociations** **Moderator:** Hakan Gürvit **Speakers:** Hakan Gürvit, Esin Öztürk Işık, Ulaş Ay, Emre Harı	**Panel 12: Obesity, chronobiology and circadian rhythm disorders: a multidisciplinary perspective** **Moderators:** Aliye Tuğba Bahadır **Speakers:** Serpil Çeçen, Belma Haliloğlu, Aliye Tuğba Bahadır
10.30–11.00	**Coffee Break**		
11.00–12.00	**Conference 8** **Chair:** Tamer Demiralp Body, brain and cognition György Buzsaki	-	-

12.00–13.30	**Lunch Break** **Poster Discussion (P-32 – P-62)** **Chairs:** Mehmet Kaya, Duygu Gezen Ak, Erkan Kiriş, Yasemin Keskin Ergen, Ali Bayram, Çiğdem Ulaşoğlu-Yıldız		
13.30–14.30	**Conference 9** **Chair:** Canan Başar-Eroğlu A new view on the neural fundaments of complex cognition Onur Güntürkün	-	-
14.30–14.40	**Break**		
14.40–16.40	**Oral Presentations 4 (O-19 – O-26)** Nervous system diseases and treatment approaches **Chairs:** Nevzat Kahveci, Gizem Dönmez Yalçın	**Oral Presentations 5 (O-27 – O-34)** Neuroimaging, behavioral and cognitive neuroscience **Chairs:** Evrim Gülbetekin, Hasan Onur Keleş	**Oral Presentations 6 (O-35 – O-42)** Behavioral and cognitive neuroscience **Chairs:** Aslı Demirtaş-Tatlıdede, Sinem Burcu Erdoğan
16.40–17.00	**Coffee Break**		
17.00–18.30	**Panel 13: "White rabbit" and "Lucy in the sky": return of the psychedelic drugs** **Moderator:** A. Yağız Üresin **Speakers:** A. Yağız Üresin, Emine Akalın, Bilgin Saydam, R. Ebrar Akıncı, Selçuk Şen	**Panel 14: Molecular mechanisms of neurological disorders – Contemporary experimental approaches** **Moderator:** Vuslat Yılmaz **Speakers:** Erdem Tüzün, Çağhan Kızıl, George Tofaris	**Panel 15: Neurobiology of language** **Moderator:** Mustafa Seçkin **Speakers:** Mustafa Seçkin, Robert S. Hurley, Koray Tarhan

23 October 2022, Sunday

	Hall A	Hall B	Hall C
09.00–11.00	**Oral Presentations 7 (O-43 – O-50)** Molecular and cellular neuroscience **Chairs:** Eda Tahir Turanlı, Güvem Gümüş Akay	**Oral Presentations 8 (O-51 – O-58)** Nervous system diseases and treatment approaches **Chairs:** Ayça Erşen Danyeli, Nurcan Orhan	**Oral Presentations 9 (O-59 – O-66)** Neural networks and computational neuroscience, behavioral and cognitive neuroscience **Chairs:** Tolga Esat Özkurt, Aykut Eken
11.00–11.30	**Coffee Break**		
11.30–12.30	**Conference 10** **Chair:** Neslihan Serap Şengör Temporal summation and masking in the sense of touch Burak Güçlü	-	-
12.30–13.30	**Lunch Break**		
13.30–14.40	**Conference 11** **Chair:** Filiz Onat Genetics and modeling of pediatric brain disease Kaya Bilguvar	**Conference 12** **Chair:** Belma Bekçi Amygdaloid targets of the basal forebrain neuromodulator systems Güneş Ünal	-
14.30–14.45	**Coffee Break**		
14.45–16.45	**Oral Presentations 10 (O-67 – O-74)** Behavioral and cognitive neuroscience **Chairs:** Güneş Ünal, Gökçer Eskikurt	**Oral Presentations 11 (O-75 – O-82)** Neuroimaging and neuromicroscopy, behavioral and cognitive neuroscience **Chairs:** Ata Akın, Ali Bayram	**Oral Presentations 12 (O-83 – O-90)** Nervous system diseases and treatment approaches, behavioral and cognitive neuroscience **Chairs:** Müge Yemişci Özkan, Nihan Çarçak
16.45–17.00	**Closing Ceremony**		

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Conferences

(C-01 — C-12)

C-01

Regulation of cerebral blood flow by capillary pericytes in Alzheimer's disease, Covid-19 and hyperoxia

David Attwell

Department of Neuroscience, Physiology & Pharmacology, University of College London, London, England

It is often assumed that local increases and decreases of tissue blood flow are mediated by relaxation or contraction of arteriolar smooth muscle but in many tissues, including the brain, heart, kidney and pancreas, capillary control of blood flow by contractile pericytes also occurs. Indeed, in the brain, most of the resistance of the intra-cerebral vasculature is located in capillaries, and neuronal activity can increase brain blood flow by dilating capillaries via pericytes. Furthermore, ischaemia leads to pericytes constricting, producing a long-lasting decrease of blood flow after the ischaemia, offering a novel therapeutic target for stroke. Constriction of cerebral capillaries by pericytes also occurs at an early stage of Alzheimer's disease. The SARS-CoV-2 virus causing Covid-19 binds to ACE2 on cerebral pericytes and amplifies angiotensin II - evoked pericyte constriction by decreasing ACE2 function. Hyperoxia, which is often generated clinically when patients are given supplementary oxygen, also constricts cerebral capillaries by promoting pericyte contraction. Thus, awareness of the possibility of pericyte-mediated capillary constriction reveals new therapeutic targets to increase blood flow in numerous neurological pathologies.

Keywords: Blood flow, pericyte, capillary, Alzheimer's disease, Covid-19

C-02

Microcirculation: new target for neuroprotective therapy

Müge Yemişçi Özkan

Hacettepe University, Ankara, Türkiye

Treatment methods for acute ischemic stroke primarily target the opening of occluded cerebral vessels. However, clinical trials and experimental studies demonstrated that despite providing recanalization in the main occluded cerebral vessels, the blood flow might not improve at the microvascular level, and thus the reperfusion of ischemic tissue is often incomplete. Diminishing this incomplete reperfusion caused by the loss of patency of microvessels can be considered a potential target for neuroprotective therapies. Recent experimental studies demonstrated the importance of pericyte cells, which wrap the vessels at the capillary level and are responsible for the regulation of cerebral and retinal microcirculation, in this so-called 'no-reflow phenomenon'. Pericytes are also important for the maintenance of the blood-brain barrier, which is a key component of ischemic stroke pathophysiology. The retina is considered a window to the brain, and studies have demonstrated that cerebral and retinal ischemia are comparable due to their microvascular characteristics. Moreover, the inner blood-retina barrier (BRB) resembles the blood-brain barrier both anatomically and physiologically. Alpha smooth muscle actin is a critical protein that is closely related to the contractile properties of pericytes, and thereby plays an important role in the pathophysiology of both the cerebral and retinal ischemia/reperfusion. Reducing 'no-reflow' by pharmacological treatments or by in vivo alpha-smooth muscle actin-targeted small interfering RNA (siRNA) seems to be an important and viable target for recanalization therapies. Reduced Folate Carrier 1 (RFC1) functions as a

folate transporter in the blood brain barrier, and is one of the utmost discovered genes in cerebral mural cells. Our recent studies have also verified the presence of RFC1 protein in cerebral and retinal endothelial cells and pericytes. Modifying RFC1 levels or function in vivo, by various methods including RFC1-targeted Accell siRNA to knockdown RFC1, and Lenti Virus to overexpress RFC1, highlighted the potential role of RFC1 in preserving BRB integrity in healthy and ischemic microvessels. As the importance of microcirculation is not limited to stroke, the findings in the cerebro-retinal microcirculation under physiological conditions and ischemia would probably have implications in the field of other brain pathologies such as neurodegenerative diseases and would provide opportunities for novel therapeutic approaches in all these disorders.

Keywords: Brain, retina, microvessels, pericyte, RFC1

C-03

Comparative study of the behavioral and neural basis of decision-making and time perception

Fuat Balcı[1,2]

[1]Department of Psychology & Research Center for Translational Medicine, Koç University, Istanbul, Türkiye; [2]University of Manitoba, Department of Biological Sciences, Canada

Interval timing and perceptual decision making are manifested with near identical statistical signatures in humans' and non-human animals' behavioral outputs. For instance, timed responses are time scale invariant and they are best fit by inverse Gaussian distributions while there is a tradeoff between the speed and accuracy of choices. Such correspondences between different species suggest that these cognitive functions are underlain by well-regulated neural mechanisms and point to their high translational value in preclinical and comparative research. In this presentation, I will showcase these core correspondences and how computational approaches can be utilized as analytical interfaces to reinforce the investigation of the behavioral and neural bases of interval timing and choice behavior. To this end, I will particularly focus on the noisy evidence accumulation models as a shared overarching modeling approach.

Keywords: Decision-making, time perception, model

C-04

What happened to the 'mental' in 'mental' disorders

Joseph E. Ledoux

New York University, New York, USA

People often seek help for mental problems because they are suffering subjectively. Yet, for decades, the subjective experience of patients has been marginalized. This is in part due to the dominant medical model of mental illness, which has tended to treat subjective experience as a quaint relic of a scientifically less enlightened time. To the extent that subjective symptoms are related to the underlying problem, it is often assumed that they will be taken care of if the more objective symptoms, such as behavioral and physiological responses are treated. Given that 'mental' disorders are named for, and defined by, their subjective mental qualities, it is perhaps not surprising, in retrospect, that the effectiveness of treatments that have sidelined mental qualities have been disappointing at best. Negative view of about subjective experience took root in psychiatry and allied fields decades ago when there were few avenues for rigorously studying subjective experience. Today, however, research on consciousness is thriving, and offers a viable scientific approach that could help achieve a deeper understanding of mental disorders and their treatment.

C-05

How do context and expectations shape visual perception?

Hüseyin Boyacı[1,2]

[1]İhsan Doğramacı Bilkent University, Ankara, Türkiye; [2]Justus Liebig University, Giessen, Germany

Objective: The light from the three-dimensional world that reaches our eyes creates a pair of two-dimensional neuronal response patterns on our retinas. This complex pattern, however, is not enough for us to precisely understand the external world. Because the neuronal signals that constitute the pattern are sometimes noisy and weak, and they are often ambiguous. To solve the problems caused by these limitations, the visual system is supposed to use our past experiences and prior knowledge together with the retinal input. These past experiences can manifest themselves as context- and expectation-based effects.

Methods: Context can affect the perceived features of objects that are embedded in it. Numerous visual illusions, such as the Ponzo and simultaneous brightness contrast illusion, strikingly demonstrate those effects. In our research on this topic, we studied how context systematically affects the perceived color, lightness, and size of an object embedded in it. Further, using functional magnetic resonance imaging, we found that the neuronal activity in the earliest stages of the visual system reflects the perceived features.

Results: Just as context, expectations can also affect and even shape our perception. For example, expectations can determine where we will direct our attention, help us interpret an ambiguous retinal image, and allow us to make predictions about the near future. In our studies where we investigated expectations based on prior knowledge, we found that those expectations affect low-level perceptual decision processes and that the decisions are delayed when expectations are not met. We showed that the Bayesian theorem and simple cortical predictive models could explain these results.

Conclusion: Overall, our results propose models that can comprehensively explain visual perception in complex settings and the neuronal mechanisms underlying that perception.

Keywords: Visual perception, contextual effects, prior knowledge, expectation, prediction

C-06

Brain machine interfaces: from basic science to neuroprostheses and neurological recovery

Miguel A. L. Nicolelis
Duke University, Durham, NC, USA

In this talk, I will describe how state-of-the-art research on brain-machine interfaces makes it possible for the brains of primates to interact directly and in a bi-directional way with mechanical, computational and virtual devices without any interference of the body muscles or sensory organs. I will review a series of recent experiments using real-time computational models to investigate how ensembles of neurons encode motor information. These experiments have revealed that brain-machine interfaces can be used not only to study fundamental aspects of neural ensemble physiology, but they can also serve as an experimental paradigm aimed at testing the design of novel neuroprosthetic devices. I will also describe evidence indicating that continuous operation of a closed-loop brain machine interface, which utilizes a robotic arm as its main actuator, can induce significant changes in the physiological properties of neural circuits in multiple motor and sensory cortical areas. This research raises the hypothesis that the properties of a robot arm, or other neurally controlled tools, can be assimilated by brain representations as if they were extensions of the subject's own body.

C-07

Half a century in neuroscience: what I can and can't do with memories

İsmail H. Ulus
Acıbadem Mehmet Ali Aydınlar University, Istanbul, Türkiye

I have been working in neuroscience as a "neuropharmacologist" for half a century. I mainly carried out my studies in 3 institutions: (1) Bursa Uludağ University (1974-2009), (2) Acıbadem Mehmet Ali Aydınlar University (2009-2022) and Massachusetts Institute of Technology (MIT, 1975-2010). In my research, I have focused largely on Cholinergic and Catecholamingic systems. My works on the cholinergic system are related to the pharmacological effects of choline and choline compounds, which are the precursors of the neurotransmitter acetylcholine. The contribution of my studies on choline actions can be summarized under the following 6 subjects: (1) Choline increases the synthesis, level and release of the neurotransmitter acetylcholine at 10-60 mM concentrations and increases cholinergic neurotransmission. The effect of choline on cholinergic neurotransmission becomes even more pronounced in cases of stimulation of cholinergic neurons. (2) In choline deficiency, cholinergic neurons are used choline in membrane phospholipids to synthesize acetylcholine. Long-term choline deficiency leads to membrane loss. (3) Central and peripheral administration of choline in experimental animals induces various neuro-endocrine (such as results with increase in circulating noradrenaline, adrenaline, vasopressin, ACTH, prolactin, b-endorphin, insulin, glucagon concentrations), cardiovascular [blood pressure changes, restoration of blood pressure in case of shock (such as in hemorrhagic shock, endotoxin shock, spinal shock), anti-inflammatory (suppressing the inflammation caused by LPS) and metabolic effects (such as elevates blood sugar, decreases free fatty acids). (4) Choline shows direct agonistic effects on muscarinic and nicotinic receptors at 300–3000 mM concentrations. (5) Choline has neuroprophylactic and neuroregenerative effects and stimulates synaptogenesis. (6) The level of blood choline in humans rises by 2–5 times (20–70 mM) in pregnant and lactating women, in newborns and infants (0–2 years old) and dialysis patients and falls by half for 1–3 days following on surgical procedures. My studies on the catecholaminergic system are mainly aimed to determine the central activation of the sympatho-adrenal system under stress and drug treatment at the regional and ganglion level. My findings show that, contrary to general acceptance, the sympatho-adrenal system is stimulated in a selective manner under various stress conditions and in response to drug actions. While hypoglycemia and hypoxia activate only the adrenal medulla; hypercapnia is activating the thoracic region; forced immobilization mainly activates lumbal ganglia; hemorrhage, cold and forced swimming activate cervical and lumbal ganglia; social isolation causes stimulation in stellate and lumbal ganglia. The muscarinic agonist oxotremorine and the dopamine agonist bromocriptine stimulate only in the adrenal gland, while morphine, heroin, d-amphetamine and cocaine stimulate the adrenal gland, as well as stellate and lumbal 1-6-ganglia. In summary, in my 50 years of research, I have tried to contribute to science in 2 areas. I think my contributions are important. According to my own internal calculation, my work with choline is sufficient and satisfactory. Results of these studies were published in high-impact journals and attracted attention. My works have been awarded by reputable institutions (such as Sandoz, Novartis Pharmacology Awards, 1999 TÜBİTAK Science Award). There are two important things I can't do that I regret and sad about that. 1) During my studies on choline, I had some observations indicating that there are subtypes of muscarinic receptors. I could have worked further for characterization of these important observations, I failed to that. 2) I also failed to publish my findings on selective stimulation of the sympatho-adrenal system under stress and in response some drugs.

Keywords: Choline, acetylcholine, CDP-choline, cholinergic neurotransmission, sympathoadrenal activity, stress

C-08

Body, brain and cognition

György Buzsáki

NYU Neuroscience Institute, New York University, Langone Medical Center, New York, USA

The evolutionary demands on the nervous system have simultaneously applied pressure upon the regulation and prediction of internal homeostatic requirements as well as on the interaction of the organism with the external environment. Thus, seemingly disparate neural computations, such as metabolic homeostasis/allostasis and memory-guided behaviors, have co-evolved at every step within the same brain circuits. The hippocampal formation has been implicated in both cognitive functions as well as the sensing and control of endocrine states. Several years ago, we discovered a specific electrophysiological pattern in the hippocampus, known as sharp wave ripples (SPW-R), which can consolidate and transfer learned memories from the hipppocampus to the neocortex. Recently, we found that clusters of SPW-Rs reliably predicted a decrease in peripheral glucose concentrations within ~10 minutes. This correlation was not dependent on circadian, ultradian, or meal-triggered fluctuations, it could be mimicked with optogenetically induced ripples in the hippocampus, but not in the parietal cortex, and was attenuated to chance level by pharmacogenetically suppressing activity of the lateral septum, the major conduit between the hippocampus and hypothalamus. Thus, our findings demonstrate that mnemonic and metabolic processes are regulated simultaneously within an organism and that two seemingly distinct processes—cognition and whole-body metabolism—are linked together by hippocampal SPW-Rs. Our observations offer a mechanism for the well-supported link between sleep disruption and blood glucose dysregulation seen in type 2 diabetes and obesity. Book: The Brain from Inside Out (Oxford University Press, 2019).

C-09

A new view on the neural fundaments of complex cognition

Onur Güntürkün

Ruhr University, Bochum, Germany

Is it possible that the ability for higher cognition independently arose several times in during evolution? This question keeps me awake in the night. If different species with different brain anatomies have independently evolved the ability for complex cognition, this could imply that there are different neural mechanisms to become smart. Neuroscientists usually assume that the neocortex is a prerequisite for complex cognition and that cortex size correlates with intelligent behavior. Birds have much smaller brains and no neocortex. This should cast a dim prospect on their cognitive abilities. But studies of the last two decades revealed that especially corvids and parrots are cognitively on par with apes. In fact, there is not a single cognitive ability demonstrated in chimps (brain weight 400 g) that meanwhile was not also demonstrated in corvids (brain weight 12 g). So, neither the size nor the existence of the neocortex seems to guarantee top scores in cognition. In my talk I will take you on a journey of about 25 years in which it became clearer which neural features matter for intelligence. I will present and review studies on humans, apes, and birds to then conclude what I think really seems to matter when it comes to build brains with high cognitive abilities. Astoundingly, although bird and mammalian brains look so different, we will see that both taxa independently use similar neural solutions to become smart. It is likely that evolution does not lack creativity; it is just facing a severe limitation of degrees of freedom when wiring a vertebrate brain for sophisticated cognition.

Keywords: Neocortex, intelligence, connectome, evolution

C-10

Temporal summation and masking in the sense of touch

Burak Güçlü

Institute of Biomedical Engineering, Boğaziçi University, Istanbul, Türkiye

Perceptual effects of sensory stimuli presented in a temporal sequence are largely dependent on behavioral tasks and stimulus features. In order to understand the short-term mechanisms of such effects, we focus on vibrotactile temporal summation and forward masking. In temporal summation, extending the stimulus duration or applying repetitive stimuli generally decreases detection thresholds. However, if the prior stimulus in a pair is more intense, it may suppress the detection of the second stimulus, which is commonly defined as forward masking. In this talk, neurophysiological and psychophysical findings from the literature are discussed after a brief introduction to the tactile system. Next, spike and field-potential recordings in the rat S1 cortex and human psychophysical results from our laboratory are presented in relation to computational models which may explain similar temporal effects. Some of our novel results are especially promising to improve somatosensory feedback in neuroprostheses.

Keywords: Vibrotactile, touch, S1 cortex, psychophysics, neuroprosthesis

C-11

Genetics and modeling of pediatric brain disease

Kaya Bilgüvar[1,2]

[1]Acıbadem Mehmet Ali Aydınlar Üniversitesi, Türkiye; [2]Yale School of Medicine, New Haven, CT, USA

Since the sequencing of first human genome approximately 20 years ago, genetic research has witnessed substantial progress.

Specifically, advances in next-generation sequencing technologies enabled researchers to ask and answer previously inaccessible questions in multiple domains of biology and medicine. The outer surface of the human brain, cortex, arguably represents the most human and even individual specific tissue developmentally. The intricate organization of the cortex with gyri and sulci are governed by a complex series of processes, and perturbations in these processes lead to structural and functional abnormalities. Severe intellectual disability, epilepsy or neuropsychiatric disorders are among the common consequences of these disruptions from which the patients usually suffer lifelong. In this presentation, we will be presenting our experience over the last 15 years in the identification and modelling of genetic defects underlying developmental disorders of the nervous system.

Keywords: Next-generation sequencing, developmental brain disorders, genetics, IPSCs, organoids

C-12

Amygdaloid targets of the basal forebrain neuromodulator systems

Güneş Ünal

Behavioral Neuroscience Laboratory, Boğaziçi University, Istanbul, Türkiye

Basal forebrain is a collection of neuromodulator nuclei composed of heterogeneous neuronal populations that innervate the cerebral cortex and several subcortical limbic areas. Discovered in the neuromuscular junction as a neurotransmitter, acetylcholine is utilized in the basal forebrain as a widespread neuromodulator that targets a large portion of the cerebral mantle. The contribution of acetylcholine to hippocampal network oscillations and resulting cognitive functions is well-known. However, its role in the affective processes and implicit memory orchestrated by another major limbic structure, the amygdala, remains to be fully elucidated. Furthermore, in addition to the acetylcholine that is well-associated with synaptic plasticity and explicit memory, the basal forebrain contains substantial GABAergic, glutamatergic and peptidergic neuronal groups. Contemporary research suggests that these neurochemicals that innervate the same structures with cholinergic axons perform complimentary functions in their target limbic structures. Our recent neural tracing and immunohistochemistry experiments in adult Wistar rats revealed dense GABAergic cell groups that target the basolateral amygdala from the ventral pallidum and substantia innominata nuclei of the basal forebrain. The so-called output regions of the amygdaloid circuitry, the central amygdala nucleus and the bed nucleus of the stria terminals (BNST), receives relatively less but significant basal forebrain projections. As part of our behavioral work, bilateral GABAergic (GAT1-Saporin) or cholinergic (192-IgG-Saporin) immunotoxin injections into the ventral pallidum led to antidepressant effects in the forced swim test. No difference was found in general locomotor activity or anxiety-like behavior. However, both immunotoxin lesions improved extinction of conditional fear memory in a novel context. These anatomical and behavioral results suggest that ventral pallidal GABAergic neurons constitute potential therapeutic targets in the treatment of depressive disorders.

Keywords: Basal forebrain, amygdala, BNST, neuromodulation, GABA

Symposia

(S1 — S3)

Symposium 1

Potential of the functional near infrared spectroscopy (fNRIS) technique in cognitive and clinical neuroscience research: what we can or cannot do?

S1-1

Current approaches in the analysis of fNIRS data: issues to be considered in data analysis, preprocessing steps. Cases to be considered in statistical analysis.

Aykut Eken

Department of Biomedical Engineering, TOBB University of Economics and Technology, Ankara, Türkiye

In fNIRS studies, it is common to obtain false positive results due to noise or artifacts caused by experimental or physiological reasons. For this reason, it is necessary to separate the hemodynamic response from the non-neuronal response by various pre-processing techniques and to apply the correct statistical approaches after these pre-processing techniques. In this symposium, current approaches to the analysis of fNIRS signals will be presented. Approaches used to determine signal quality, artifacts that may arise from the experiment, characteristics of physiological noise such as heartbeat, respiration and mayer waves and approaches to eliminate them, the use of short channel separation and alternative methods to eliminate cranial blood flow, approaches to eliminate motion artifacts, general linear model and methods for statistical inference (t-test, ANOVA) will be discussed in detail.

Keywords: fNIRS, signal processing, motion artifacts, general linear model

S1-2

What to do in fNIRS studies? What not to do?

Hasan Onur Keleş
Department of Biomedical Engineering, Ankara University, Ankara, Türkiye

In neuroscience, the use of functional near-infrared spectroscopy (fNIRS) is increasing rapidly. Today, fNIRS studies are performed in different patient groups with different applications and experimental paradigms. With the rapid growth and the diversification of research methods and applications, some inconsistencies are found in fNIRS studies. In this symposium, We will talk about the the reliability and traceability of fNIRS studies and encourage best practices.

Keywords: fNIRS, reliability, traceability

S1-3

Physical and physiological principles of fNIRS signal formation

Sinem Burcu Erdoğan
Acıbadem Mehmet Ali Aydınlar University, Istanbul, Türkiye

Functional Near Infrared Spectroscopy (fNIRS) is a relatively novel, optical brain imaging technology which has gained increasing interest in neuroscience research thanks to its ability for noninvasive, continuous and real time measurement of the cortically induced local changes in oxygenated hemoglobin (HbO) and deoxygenated hemoglobin (HbR) concentration levels in naturalistic settings. Over the last two decades, fNIRS systems have received increasing attention in cognitive, social, behavioral and clinical neuroscience applications thanks to their: (1) portability, (2) non-invasive nature, (3) modest equipment size, (4) robustness to electrogenic or motion artifacts, (5) low operating cost, (6) quick set-up time and calibration, (7) ability to collect biological information at any desired frequency and duration, and (8) ease of application in ecologically valid settings to a broad range of patient populations involving children and elderly adults. Overall, these features have also made fNIRS an ideal candidate for studying the neural basis of cognition as well as for developing affective BCIs which can decode feelings, intents and/or preferences of subjects from measurements of neuronally induced bio-signals. In the first session of this panel, we aim to provide a comprehensive understanding of the physical and physiological principles of fNIRS signal formation and the state-of-the art methods and models used for fNIRS analysis. We will cover the computational and conceptual aspects of improving signal quality through removal of systemic physiological effects and motion artifacts and highlight strategies for optimizing experimental design. We will also discuss some of the open challenges and the potential of fNIRS for cognitive, clinical and social neuroscience research with a particular focus on the imaging capability in clinical and naturalistic daily environments.

Keywords: fNIRS, neuroscience, functional neuroimaging

S1-4

fNIRS and brain-computer interface applications

Emre Yorgancıgi
Acıbadem Mehmet Ali Aydınlar University, Istanbul, Türkiye

Functional near-infrared spectroscopy (fNIRS) is a promising noninvasive brain imaging technique which measures hemodynamic activity of cerebral blood flow with two different wavelength of infrared light. fNIRS method has several advantages such as portability, affordability and low susceptibility to noise. A brain-computer interface (BCI) is a special communication system that allows the use of brain activity to control computers and machines as external devices. BCI applications can bypass the peripheral nervous system, so provide a means of communication for people suffering from severe motor disabilities or in a persistent vegetative state. The most common brain areas for BCI applications with fNIRS device are the primary motor cortex and the prefrontal cortex. At the motor cortex, motor imagery tasks are preferred to motor execution tasks since possible proprioceptive feedback could be avoided. For the prefrontal cortex, fNIRS can be showed a significant advantage due to no hair-surface during detecting the cognitive tasks like mental arithmetic, music imagery and emotion processing. There are 5 main steps for a basic fNIRS-BCI scheme: 1) Hemodynamic signal acquisition, 2) Preprocessing and signal enhancement, 3) Feature extraction, 4) Classification task, 5) Control interface

Keywords: fNIRS, brain-computer interface, classification task

Symposium 2

Theory, history, importance and neuromodulation of brain oscillations in cognitive/affective processes

S2-1

An overview of brain oscillations: from experimental research to neuropsychiatric disorders

Canan Başar-Eroğlu
Department of Psychology, Izmir University of Economics, Izmir, Türkiye

Since the 1980s, oscillations in the brain have been the subject of interdisciplinary studies. The first generally accepted explanation of oscillations is the resonance principle, which states that delta (0.5-3 Hz), theta (4-8 Hz), alpha (8-13 Hz), beta (18-30 Hz) and gamma (35-45 Hz) oscillations underlie communication in the brain. Many years of research have shown the relationship between all these frequencies and cognitive processes. For example, delta frequencies are involved in attention, decision-making and goal setting, theta oscillations are especially involved in top-down processing, selective attention, working memory, alpha and gamma oscillations are involved in

the formation of memories, sensory motor integration and movement preparation. The beginning of oscillatory research was made possible in the 70s, mostly with animal experiments. Between 1980 and 1990, there was a huge increase in the recording and analysis of both event-related potentials and event-related oscillations to measure cognitive processes in healthy humans. Later works investigated the important correlations of EEG-Oscillations to cognitive processes. It was important to know not only their correlations, but also the causality. Recently, new studies are applying rhythmic sensory stimulation to modulate brain oscillations and altered cognitive functions. The transcranial alternative current stimulation-modulation (tACS) might be serve as therapeutic method for the neuropsychiatric disorders.

Keywords: Neuromodulation, brain oscillations, EEG, neuropsychiatric disorders

S2-2

Investigation of emotional facial expression perception in different cognitive disorders by EEG brain oscillations

Bahar Güntekin[1], Tuba Aktürk[2], Ebru Yıldırım[2], Hakan Uzunlar[3], İlayda Kıyı[4], Lütfü Hanoğlu[5], Görsev Yener[6]

[1]Department of Biophysics, School of Medicine, Istanbul Medipol University, Istanbul, Türkiye; [2]Program of Electroneurophysiology, Vocational School, Istanbul Medipol University, Istanbul, Türkiye; [3]Department of Neuroscience, Graduate School of Health Sciences, Istanbul Medipol University, Istanbul, Türkiye; [4]Department of Neurosciences, Institute of Health Sciences, Dokuz Eylül University, Izmir, Türkiye; [5]Department of Neurology, School of Medicine, Istanbul Medipol University, Istanbul, Türkiye; [6]Faculty of Medicine, Izmir University of Economics, Izmir, Türkiye

Objective: The research on functional correlates of brain oscillations during perception of facial expressions has shown that "angry expressions" elicited stronger beta and gamma oscillatory responses than "happy" and "neutral" expressions in healthy controls. Furthermore, angry and happy facial expressions elicited higher delta and theta responses than neutral facial expressions. Dementia patients have difficulties in the identification of facial expressions. This study aimed to investigate the effect of impaired facial expression perception on EEG-event-related oscillations in different types of dementia patients.

Methods: EEG recordings were performed with a 32-channel EEG device. 25 patients with Mild Cognitive Impairment (aMCI), 25 patients with Alzheimer's disease (AD), 21 patients with Parkinson's-Mild Cognitive Impairment (PD-MCI), 20 patients with Parkinson's Dementia (PD-D), 25 healthy elderly controls were included in the study. "Angry", "happy," "neutral" facial expressions were shown to the subjects during EEG recordings. Event-related power spectrum analysis, phase-locking, and event-related coherence analysis in delta (0.5-3.5 Hz), theta (4-7 Hz), alpha (8-13 Hz), beta (15-28 Hz), gamma (28-48 Hz) frequency bands were performed.

Results: The present study showed that as cognitive impairment increased, facial expression perception was impaired, this impairment was mainly reflected in delta, theta, alpha responses. The decreased event-related power, phase locking and coherence were found in delta, theta, and alpha bands as the cognitive decline increased. The most abnormal event-related oscillatory responses during facial expression recognition were found in patients with PH-D compared to all other groups.

Conclusion: The present study showed that facial expression perception was affected by increased cognitive impairment in patients with different types of dementia. This impairment was represented by a decreased delta, theta, and alpha responses. Impaired facial expression perception, one of the crucial processes of social life, can be expected to negatively affect patients' social lives.

Funding: This work (grant number 218S314) was supported by TUBITAK.

Keywords: EEG, brain oscillations, facial expression perception, mild cognitive impairment, dementia

S2-3

The use of neuromodulation in brain oscillations studies

Tuba Aktürk[1], Lütfü Hanoğlu[2], Bahar Güntekin[3]

[1]Program of Electroneurophysiology, Vocational School, Istanbul Medipol University, Istanbul, Türkiye; [2]Department of Neurology, School of Medicine, Istanbul Medipol University, Istanbul, Türkiye; [3]Department of Biophysics, School of Medicine, Istanbul Medipol University, Istanbul, Türkiye

Objective: Neuromodulation may be conceptualized as any method capable of affecting the ongoing, normal functioning of the brain via external interventions. Non-invasive brain stimulation (NIBS) methods are one of the neuromodulation techniques. Although all forms of NIBS methods can modulate brain activity and therefore cognition-behavior in general, the underlying working mechanisms are different and therefore the selection of the appropriate method is important to achieve the desired change in brain activity and behavior.

Methods: In the scope of the current study's focus on the functional role of neural oscillatory activity for cognition in healthy individuals, transcranial alternating current stimulation (tACS) was used, which allows rhythmic stimulation at a certain frequency to specifically modulate the oscillatory activity of the brain. Here, EEG-informed individualized theta frequency tACS was used to modulate brain oscillations and related behavior, and assess after effects on memory performance and/or theta brain oscillations. The 46 healthy young-adult participants were included in the study and randomly assigned to three groups:

sham, stimulation at ITF, and stimulation at ITF-1 Hz. TACS stimulation electrodes were placed on the left frontoparietal area and tACS was applied at the frequency calculated over the ITF. During pre-tACS and post-tACS EEG recordings, visual and auditory memory tasks were applied to the participants.

Results: Results showed that in healthy participants, electrical stimulation via tACS at individualized frequencies calculated from each participant's own EEG data might influence their behavioral performance. This effect remained even after tACS stimulation was stopped (after effect).

Conclusion: These findings seem to be important in terms of developing potential treatment approaches for the pathologies in which cognitive performances are affected and deterioration pattern is known to be reflected in brain oscillations (osilopathies), in addition to the scientific perspective it provides in terms of understanding the rhythms of cognition.

Keywords: Neuromodulation, brain oscillations, memory, EEG, theta

S2-4

Brain oscillations and volumetric magnetic resonance imaging as a cognitive parameter in obstructive sleep apnea

Deniz Yerlikaya[1], Behice Bircan[2], İbrahim Öztura[3], Görsev Yener[4]

[1]Department of Neurosciences, Institute of Health Sciences, Dokuz Eylül University, İzmir, Türkiye; [2]Department of Neurology, Çiğli Regional Training Hospital, Izmir, Türkiye; [3]Department of Neurology, Dokuz Eylül University Medical School, İzmir, Türkiye; [4]Izmir University of Economics, Faculty of Medicine, Izmir, Türkiye

Literature suggests that patients with Obstructive Sleep Apnea Syndrome (OSAS) may develop cognitive impairment due to intermittent hypoxemia and sleep fragmentation over time. OSAS has also been reported as a risk factor for mild cognitive impairment and Alzheimer's disease (AD). Previous studies showed that electrophysiological methods can be a more sensitive measurement tool to detect early cognitive impairment in OSAS when compared to neuropsychological testing. In studies investigating resting state EEG and event-related potentials (ERP), a general slowing in EEG and decreased amplitudes of attention and memory-related ERP components have been reported. Investigating the event-related oscillations (EROs) in the time or time-frequency domain may provide more detailed information about the electrophysiological changes in OSAS. This study included 74 patients with severe OSAS aged between 18-55 years and 45 healthy controls. Participants underwent neuropsychological testing, EEG recordings using the auditory and visual classical oddball paradigm, and magnetic resonance imaging (MRI). EROs were investigated with three analysis techniques: selective filtering, event-related spectral perturbation (ERSP) and inter-trial coherence (ITC). Cortical and subcortical grey matter volumes were measured for the MRI analysis. OSAS patients showed decreased event-related delta and theta power. This decrease also showed a positive correlation with hypoxemia severity. Both a decrease and an increase in power and inter-trial phase coherence were found in higher frequencies compared to healthy controls. Moreover, when OSAS group was divided into subgroups according to their hypoxemia severity, it was found that the volumetric changes became more pronounced in the subgroup with severe hypoxemia. Considering these findings, it can be suggested that intermittent hypoxemia has a role in the functional and structural changes observed in OSAS cases.

Keywords: Obstructive sleep apnea syndrome, EEG, event related oscillations, magnetic resonance imaging, neuropsychological evaluation

Symposium 3
Advances in translational epilepsy therapy discovery

S3-1

Search for biomarkers and treatments for post-traumatic epilepsy

Aristea S. Galanopoulou

Albert Einstein College of Medicine, New York, USA

Post-traumatic epilepsy (PTE) is one of the common types of epilepsy that develops over time after traumatic brain injury. PTE development may occur over years in humans. Efforts to develop biomarkers predicting or monitoring PTE development have yielded several candidates in humans: genetic, imaging, EEG, peripheral blood biomarkers. However, there is no current validated biomarker for post-traumatic epileptogenesis. In this presentation, the recent advances in biomarker development will be summarized, along with an update from the preclinical findings from the EpiBioS4Rx center without wall which aims at identifying biomarkers and treatments for post-traumatic outcomes, including PTE.

Funding: Supported by NINDS U54 NS100064 (EpiBioS4Rx), US Department of Defense (W81XWH-18- 1-0612).

Keywords: Post-traumatic epilepsy, biomarkers, EEG, seizures

S3-2

Developmental and epileptic encephalopathies: a needed translational approach

Stéphane Auvin

Hôpital Robert-Debré, Paris, France

Epileptic encephalopathy is a specific epileptic condition in which epileptic activity itself contributes to severe cognitive

and behavioural impairments above and beyond what might be expected from the underlying pathology alone. These impairments can worsen over time. This concept has been continually redefined since its introduction. To take into an account the cognitive impairment that is related to the underlying cause (e.g. somegenetic cause), the terms 'developmental and epileptic encephalopathies' have been introduced. During this talk, we will give an overview of the syndromes classified in the DEE group by the 2022 ILAE classification. We will illustrate how a translational approach could help us to have a better understanding of these epilepsies. Finally, we will stress the unmet needs in this field of epilepsy research.

S3-3

MicroRNAs as therapeutic targets for acquired and genetic epilepsies

David Henshall

University of Medicine and Health Science, Dublin, Ireland

Epilepsy is a common brain disease characterised by recurring seizures. Despite the availability of more than 20 medicines, one third of patients do not achieve seizure control. There is an urgent need for new treatments. MicroRNAs are small noncoding RNAs that provide a critical layer of gene expression control. Individual microRNAs variably exert effects across networks of genes via sequence-specific binding to mRNAs, fine-tuning protein levels. This helps coordinate the timing and specification of cell fate transitions during brain development and maintains neural circuit function and plasticity by activity-dependent (re)shaping of synapses and the levels of neurotransmitter components. MicroRNA levels have been found to be altered in tissue from the epileptogenic zone resected from adults with drug-resistant focal epilepsy and this has driven efforts to explore their therapeutic potential, in particular using antisense oligonucleotide (ASOs) inhibitors termed antimirs. Perhaps uniquely, microRNAs offer a means by which multiple gene pathways can be adjusted to restore brain excitability. Here, I review the latest progress towards a microRNA-based treatment for temporal lobe epilepsy. I also look at whether microRNA-based approaches could be used to treat genetic epilepsies, correcting individual genes or dysregulated pathways. Finally, I present a newly discovered microRNA which may offer a dual ability to treat common as well as rare epilepsies.

Keywords: Hippocampus, drug-resistant epilepsy, antisense oligonucleotides

Panels

(PN1 — PN15)

Panel 1

The neural basis of social cognition and morality: what have we learned from neuropsychology, neuroimaging and non-invasive brain stimulation studies?

PN1-1

What have we learned from tractography and noninvasive brain stimulation studies?

Aslı Demirtaş-Tatlıdede

Department of Neurology, Faculty of Medicine, Bahçeşehir University, Istanbul, Türkiye

Three large-scale neural networks have been identified to underlie the process of social interactions. These include (1) a highly developed network of face processing and perception for social interaction, (2) a network of mirroring that we use to quickly grasp and respond appropriately to one's goals and feelings, and (3) a theory of mind network necessary to make accurate inferences about other people's mental states and predict the behavior of others. The extensive white matter pathways connecting these networks are critical as they are involved in the long-range communication of key regions associated with social cognition. In the right hemisphere, three major white matter pathways, namely, the inferior longitudinal fascicle (ILF), the inferior frontooccipital fascicle (IFOF), and the superior longitudinal fascicle (SLF), are associated with face processing. SLF is also defined as the primary fiber pathway for the mirroring network. The cingulum and arcuate fascicle are thought to be essential for theory of mind and mentalization abilities. In addition, the white matter pathways including the extreme capsule and arcuate fascicle, were associated with an individual's social network dimension. Non-invasive brain stimulation (NBS) includes to a group of novel techniques, primarily comprising transcranial magnetic stimulation and transcranial electric stimulation. These techniques are employed to modulate the activity in targeted brain areas and distributed networks and thus provide important information into the neu-

ral mechanisms underlying how we behave. In addition to neuropsychology and neuroimaging studies, the use of NBS has become a promising method for understanding the people's social minds and studying social cognition as well as morality. NBS studies help in demonstrating the causal role of several brain regions, and connectivity between those areas involved in social processing. Specifically, NBS has been used to explore the three large scale networks of social cognition: (1) social perception via facial identity processing, (2) mirror responses and associative learning and (3) causal link between the temporoparietal junction and self–other control. In this talk of the panel, the networks engaged in the modulation of social processing will be discussed through the insight obtained from tractography and noninvasive brain stimulation studies.

Keywords: Social cognition, morality, tractography, noninvasive brain stimulation

PN1-2

Functional connectivity networks in social cognition

Hakan Gürvit

Behavioral Neurology and Movement Disorders Unit, Department of Neurology, Istanbul Faculty of Medicine, Istanbul University, Istanbul, Türkiye

The dual origin hypothesis of the evolution of the cortex in evolutionary neurobiology ("The Dual Origin Hypothesis"-DOH) proposes the existence of two cortical sectors, one dorsal and the other ventral, starting from the most primitive three-layered allocortical structures and ending in the most recent six-layered isocortex. The allocortex, the origin of these two sectors, is also divided into archicortex and paleocortex. The typical archicortex is the hippocampal formation, and the paleocortex is the piriform cortex. By the names of its origins, the dorsal-archicortical sector is called hippocampocentric (HS), and the ventral-paleocortical division is called olfactocentric (OS). The amygdala is classified as corticoid, with subcortical nuclear cytoarchitectony as well as partial laminarization. It is also an older structure than the allocortex. With its connectivity pattern, the amygdala can be seen as the origin of the ventral-OS sector. The cerebral topography of the neural networks belonging to the dorsal-HS sector implies that it is primarily related to those mental functions belonging to cognitive domains (i.e., episodic memory, executive, visuo-spatial, language, etc.). These functions are also called "cold" functions in the popular language. The ventral-OS sector, in contrast, contains networks related to emotions and motivation gathered under the heading of social cognition. These functions are also called "hot" functions. The "cold" networks of functional connectivity are well characterized, and their parcellation atlases covering the entire cerebral topography have been published. On the other hand, cognitive neuroimaging characterizations of functional connectivity networks belonging to "hot" functions have lagged behind, parallel to the delay in classifying "hot" functions under the heading of social cognition and incorporating them into clinical neuropsychology. In this panel talk, the point reached in this field of social cognitive functional connectivity networks neuroimaging will be discussed in the light of what is known about changes in the healthy brain, aging, and disease (schizophrenia, autism, and degenerative diseases).

Keywords: Social cognition, functional connectivity networks, dual origin hypothesis

PN1-3

What have we learned from clinical neuropsychology?

Elif Yıldırım

Department of Psychology, Işık University, Istanbul, Türkiye

Social skills, which also exist in non-human species, emerge at the age of two in the developmental process of humans. These skills are critical for many of the behaviors people perform in their daily lives, and therefore "social cognition", which includes higher-level complex cognitive functions, is one of the core cognitive functions. Although the functions under social cognition are conceptualized with different dimensions in different studies, the most frequently examined social cognitive functions are emotion recognition, the Theory of Mind, empathy, and social/moral decision-making. Large-scale brain networks, including brain regions such as the amygdala, orbitofrontal cortex, medial prefrontal cortex, anterior cingulate cortex, superior temporal sulcus, temporoparietal space, temporal poles, and insula, are implicated in these social cognitive functions. Large-scale brain networks, including brain regions such as the amygdala, orbitofrontal cortex, medial prefrontal cortex, anterior cingulate cortex, superior temporal sulcus, temporoparietal junction, temporal poles, and insula, are neural bases of social cognition. Studies have shown that social cognitive impairments are evident in psychiatric diseases such as schizophrenia, bipolar disorder, and personality disorders, neurodegenerative diseases such as frontotemporal dementia (FTD) and Alzheimer's disease (AD), acute onset neurological conditions such as traumatic brain injury and stroke, and neurodevelopmental disorders such as autism spectrum disorders (ASD) and attention deficit and hyperactivity disorder. However, it is suggested that distant patterns of social cognitive impairment may exist in different clinical presentations and that these patterns may be effective in the stages of diagnosis and treatment. In this respect, clinical neuropsychology studies on social cognitive impairments are crucial in understanding the nature of diseases. This talk aimed to discuss the findings of studies examining social cognitive functions in FTD, AD, schizophrenia, ASD, and personality disorders with many different tests and tasks.

Keywords: Social cognition, neuropsychology, psychotic disorders, neurodegenerative disorders

Panel 2

Comparative and computational evaluation of symptoms in Parkinson's disease after deep brain stimulation and medication intervention

PN2-1

Change of facial expressions in Parkinson's disease after medical intervention

Didem Gökçay[1], Yusuf Özgür Çakmak[2], Can Ölçek[1], Michael Okun[3], Dawn Bowers[3], Rachel Schade[3], Atilla Yılmaz[4]

[1]Department of Health Informatics, Middle East Technical University, Ankara, Türkiye; [2]Department of Anatomy, School of Biomedical Sciences, University of Otago, Dunedin, New Zealand; [3]Department of Neurology, University of Florida, Gainesville, FL, USA; [4]Department of Neurosurgery, Unit of Neuromodulation, Ataşehir Medicana International Hospital, Istanbul, Türkiye

Objective: It is known that Parkinson's patients have reduced mimics compared to healthy control groups. In this study, we investigated whether medication or deep brain stimulation alleviated the loss of facial expressivity of the patients.

Methods: A patient group with 32 subjects agreed to participate and repeated 4 different facial expressions (happy, angry, fearful, disgusted) twice, during on and off medication. Meanwhile their faces were captured on video with a digitized system. On the other hand, another patient group consisting of 18 subjects received deep brain stimulation at 4 different frequencies (60, 90, 133, 230 Hz), and made 4 different facial expressions (happy, angry, sad, neutral) afterwards. Their pictures were taken immediately after each expression. In both of these studies, each facial expression was subtracted arithmetically from a previously chosen comparison picture, and the entropy of the remaining picture was calculated.

Results: The facial expressions in the Levadopa study was found to be more significant in the on medication condition compared to off medication. Among the expressions, happy was the most expressive and fastest, but it was not statistically significant when compared to others. The facial expressions in the deep brain stimulation study was found to be significantly more expressive for all frequencies, when compared to the condition with no stimulation. Futhermore, 230 Hz is found to be the frequency in which the facial expressiveness was the highest.

Conclusion: Both Levadopa and deep brain stimulation improved the facial expressivity of the Parkinson's patients significantly.

Keywords: Parkinson's disease, facial expressions

PN2-2

Wearable neuroprosthetics in Parkinson's disease: stimulators and sensors

Yusuf Özgür Çakmak

Department of Anatomy, School of Biomedical Sciences, University of Otago, Dunedin, New Zealand

PN2-3

Deep brain stimulation – Past, present, future

Atilla Yılmaz[1], Halit Anıl Eray[2]

[1]Department of Neurosurgery, Unit of Neuromodulation, Ataşehir Medicana International Hospital, Istanbul, Türkiye; [2]Department of Neurosurgery, Faculty of Medicine, Ankara University, Ankara, Türkiye

Deep brain stimulation is an effective treatment method that is applicable especially to the movement disorders and to other diseases concerning Neurology and Psychiatry. In addition to current applications approved by FDA such as Parkinson disease, dystonia, tremor, epilepsy and obsessive-compulsive disease (OCD), there are ongoing studies for treatment of depression and Alzheimer diseases at phase III and for schizophrenia and obesity at phase II. In movement disorders, Globus Pallida Interna, Subthalamic nucleus, thalamus and other basal ganglia structures are targeted whereas in epilepsy, OCD and major depression Anterior Thalamic nucleus, Nucleus Accumbens and Pedinculopontine Nucleus are choices of target. Even though first DBS surgery was performed in 1987, roots of this procedure go earlier. In 1900s, discovery of some damaged regions of the brain may help to alleviate movement disorders features has led to development of the stereotactic frames and selective lesioning and then deep brain stimulation with discovery of inhibitory effects of the electrical current. The exact mechanism of action remains a debate, it is now known that creating an electromagnetic field inside basal ganglia circuits via DBS leads, causes an output inhibition which provides a successful treatment for Parkinson disease. The parameters of electrical current; amplitude, frequency and length wave affecting specific subcortical nuclei, is controlled via external remote control. Studies have shown that DBS for movement disorders helps not only improve motor symptoms but also improves non-motor symptoms. In this matter, we conducted some studies that showed improvement in somatosensory connections of patients with Parkinson disease, reduction of the middle cerebral artery pulsativity that in turn increase the cerebral blood perfusion and no causative relation to the postural stability worsening. DBS is effective treatment for movement disorders and for other indications to come. Also, brain-computer interface models benefit from DBS surgeries and datas provided by them.

Keywords: Deep brain stimulation, DBS, neuromodulation

Panel 3

In-vitro and *in-vivo* models for the investigation of the molecular mechanisms of neurological diseases

PN3-1

The role of astroglia-neuron interactions in generation and spread of seizures

Emre Yaksi

Kavli Institute for Systems Neuroscience, Trondheim, Norway

Astroglia-neuron interactions are involved in multiple processes, regulating development, excitability and connectivity of neural circuits. Accumulating number of evidences highlight a direct connection between aberrant astroglial genetics and physiology in various forms of epilepsies. Using zebrafish seizure models, we showed that neurons and astroglia follow different spatiotemporal dynamics during transitions from pre-ictal to ictal activity. We observed that during pre-ictal period neurons exhibit local synchrony and low level of activity, whereas astroglia exhibit global synchrony and high-level of calcium signals that are anti correlated with neural activity. Instead, generalized seizures are marked by a massive release of astroglial glutamate release as well as a drastic increase of astroglia and neuronal activity and synchrony across the entire brain. Knocking out astroglial glutamate transporters leads to recurrent spontaneous generalized seizures accompanied with massive astroglial glutamate release. We are currently using a combination of genetic and pharmacological approaches to perturb astroglial glutamate signalling and astroglial gap junctions to further investigate their role in generation and spreading of epileptic seizures across the brain.

Keywords: Zebrafish, epilepsy, seizure, astroglia

PN3-2

The regulation of endoplasmic reticulum stress pathway by sirtuin 4 (SIRT4) in glia cells

Gizem Dönmez Yalçın

Department of Medical Biology, Faculty of Medicine, Aydın Adnan Menderes University, Aydın, Türkiye

Endoplasmic reticulum (ER) stress is the response that occurs after the dysfunction of ER and its structure. Activated UPR triggers a stress response using ER membrane proteins such as PERK, IRE-1, GRP78, ATF5 ve ATF6. Sirtuins are enzymes that carry out post-translational modifications such as deacetylation and ADP- ribosylation. In our previous study, we identified Calreticulin as a SIRT4-interacting protein via mass spectrometry. Calreticulin binds to misfolded proteins, prevents them from leaving ER resulting in reduction of ER stress. In our study, we aimed to investigate the interaction between SIRT4 and Calreticulin during ER stress in glia cells (IHA-immortalized human astrocytes). SIRT4 gene was silenced with lentiviral particles using 4 MOI (Multiplicity of Infection). In SIRT4-silenced cells, when treated with 2.5 µg/ml Tunicamycin for 16 h, the increase in the expressions of ATF6, GRP78 and the ratio of spliced/unspliced XBP1 mRNA were reduced. This shows that silencing SIRT4 may decrease ER stress. SIRT4-Calreticulin interaction was shown both in control and ER-stress induced glia cells. Additionally, this interaction did not change with the ER stress. SIRT4 only ADP-ribosylates Calreticulin during ER stress. Normally, SIRT4 ADP-ribosylates and deactivates Calreticulin during ER stress condition. When SIRT4 is silenced, the ADP-ribosylation level of Calreticulin decreases resulting in the activation of Calreticulin and the reduction of ER stress. In summary, SIRT4 inhibitors may be investigated as protective agents or drug candidates in neurodegenerative diseases where ER stress mostly underlies as one of the molecular mechanisms.

Keywords: ER stress, SIRT4, calreticulin

PN3-3

The effects of stress and Alzheimer's-like pathology on glucocorticoid receptors in organotypic brain slice cultures

Merve Alaylıoğlu[1], Erdinç Dursun[1], Selma Yılmazer[2], Duygu Gezen-Ak[1]

[1]Department of Neuroscience, Institute of Neurological Sciences, Istanbul University-Cerrahpaşa, Istanbul, Türkiye; [2]Department of Medical Biology and Genetics, Faculty of Medicine, Haliç University, Istanbul, Türkiye

Objective: Stress is accepted as an important risk factor for Alzheimer's disease (AD). High levels of cortisol,which is the stress hormone, in the cerebrospinal fluid (CSF), plasma and serum of Alzheimer's patients and the decrease in hippocampus volume and declarative memory disorders in patients with major depression and chronic corticosteroid treatment give rise to thought for a possible relationship between AD and stress. This suggests that the increase in glucocorticoid levels,which occurs as a result of stress, may participate in the formation of pathological mechanisms seen in AD,and raises the question of whether stress triggers the pathways that cause neurodegeneration or not.

Methods: In the study;in organotypic brain slice cultures, which allows to obtain results closest to in vivo models by protecting tissue architecture and microenvironment,circadian rhythm and stress models with corticosterone application and Alzheimer-like model with amyloid beta 1-42 (Aβ1-42) peptide application were generated.The effects of these treatments on

glucocorticoid receptor (GR) and mineralocorticoid receptor (MR) expressions,which are corticosteroid receptors,were investigated at both mRNA and protein levels.Regional localizations of these proteins in the brain were also examined by immunofluorescence method.

Results: As a result of our study,we found that GR and MR expression levels and their localizations in the hippocampus region changed both in circadian rhythm and stress models created by corticosterone applications and in AD-like models created by amyloid beta 1-42 application, and we determined that these changes differ depending on the dose.When we evaluate the findings of corticosterone and Aβ1-42 applications we obtained in our study together,we observed that GR protein level,and GR localization in the hippocampus,especially in the stratum pyramidalis region,were similarly affected.

Conclusion: Our findings point out that the increase in corticosterone caused by stress may be involved in the formation of pathological mechanisms seen in AD.

Support: The study was supported by Istanbul University-Cerrahpaşa Scientific Research Projects Unit.Project No:25555.

Keywords: Alzheimer's disease, stress, glucocorticoid, organotypic brain slice culture

PN3-4

Low-dose ketamine rapidly releases BDNF from mossy fiber terminals

İrem Atasoy

Department of Anesthesiology, Weill Cornell Medicine, Cornell University, New York, NY, USA

Brain-derived neurotrophic factor (BDNF) is a key modulator of synaptic plasticity and strength required for the rapid effects of fast-acting antidepressants. BDNF is highly abundant in mossy fiber terminals, but it is unclear whether these granule cell boutons are involved in the acute BDNF signaling necessary for antidepressant actions. Ketamine is non-competitive NMDA receptor antagonist that produces rapid and sustained antidepressant effects and presynaptic NMDA receptors promote BNDF release from mossy fiber terminals. In this study, we investigate the role of presynaptic NMDA receptors on mossy fiber terminals in the rapid, direct release of BDNF by ketamine. Dissociated hippocampal neurons were used to examine the actions of ketamine on BDNF release from mossy fiber terminals using optogenetic sensors and pharmacological modulators of NMDA receptors. This project will further our understanding of ketamine's molecular and cell-type specific mechanisms of antidepressant actions.

Keywords: BDNF, ketamine, mossy fiber terminals, NMDAr

Panel 4

Trajectories of cognitive aging and their neuropathological basis

PN4-1

Neuropathological basis of aging related dementias: let's ask neurons

Hande Özdinler

Northwestern University, Evanston, IL, USA

Dementia is one of the most common neurodegenerative conditions, and yet the molecular and cellular basis of its cause and progression remain elusive. Frontotemporal dementia (FTD) and especially FTD with amyotrophic lateral sclerosis (FTD/ALS) are one of the most dreadful diseases affecting both the cognition and the motor function of patients. TDP-43 protein, and accumulation of the phosphorylated form of TDP-43 inside the neuron is suggested to be one of the proteinopathies that is vastly observed in a broad spectrum of dementia patients, including the FTD and the FTD/ALS patients. Why TDP-43 pathology occurs and why do these protein aggregations cause neuronal vulnerability and degeneration especially in distinct neuron populations? Many questions remain to be answered. In our laboratory, we investigate the impact of TDP-43 pathology on neuronal vulnerability and progressive degeneration using model systems that are developed based on the mutations that are detected in FTD/ALS patients and that faithfully recapitulate the human condition and the pathology at a cellular level. In neurodegenerative diseases not all neurons degenerate at the same time and to the same extent. There is selective vulnerability, sparing some neuron populations and making others profoundly vulnerable to degeneration. What is the cellular and molecular basis of this selective vulnerability? What do the neurons that raise the red flag first tell us about the problems they face, and how can we help them? Here, I will discuss how vulnerable neurons react to TDP-43 pathology and how It contributes to their vulnerability. Diseased neurons reveal important information, and we need to find ways to learn directly from them.

Keywords: FTD, FTD/ALS, TDP-43

PN4-2

The importance of post-mortem brain neuropathologic evaluation for dementia practice

Ayça Erşen Danyeli

Department of Pathology, School of Medicine, Acıbadem Mehmet Ali Aydınlar University, Istanbul, Türkiye

Diagnosis of dementia related neurodegenerative diseases such as Alzheimer's disease, Lewy bodies and dementia, vascular

dementia, Parkinson's disease, frontotemporal lobar degeneration, and others are currently based on established clinical criteria, which are far from making a definitive diagnosis, because they are characterized by a complex set of neuropathological features, often with marked overlapping pathologies. Also, it is well known that there is only a moderate relationship between some clinical diagnosis and subsequent neuropathological diagnosis. Brain bank and subsequent histopathological evaluation of the human brain in a systematic manner in large groups has had an important role in advancing our understanding of the pathogenesis of neurodegenerative diseases and age-related changes in the brain, while providing additional opportunities to other researches who can use these material and data. The postmortem brain examination with these purposes, provides the accurate diagnosis of the participant whom the clinicians followed longitudinally with all available clinical, neuropsychological, radiological and laboratory data, giving the chance to correlate all these data with the neuropathological findings, since no fluid and imaging biomarker is currently able to provide a definitive diagnosis. These findings are also very crucial for us to provide more accurate information for families. Nowadays, providing a single umbrella diagnostic terminology for these diseases is not satisfactory; determining the subgroups of these diseases is also essential. Brain banking is a multifaceted joint effort that involves multiple subspecialties, with not only scientific, but also financial, social and educational aspects and ultimately depends on the participation of the patients and families. We hope that sharing our experiences and challenges will provide encouragement and a model to build on, both for ourselves and other involved in the diagnosis of and research on the diseases of the brain.

Keywords: Dementia, post-mortem, neuropathology

PN4-3

Postmortem histological features of cognitive superaging

Tamar Gefen

Northwestern University, Evanston, IL, USA

The human brain as it ages over time can follow a number of possible trajectories—some individuals age "abnormally" while others age "successfully". My work integrates longitudinal clinical and neuropsychological information obtained during life with microscopic pathology collected on the autopsied brain at death. During this talk, I will highlight some exciting findings from the Northwestern University SuperAging Program that contribute to understanding the "SuperAging" trajectory with a focus on histological features based on brain autopsy.

Keywords: Aging, superaging, histopathology

PN4-4

Distinct cytoarchitectonic features of clinical frontotemporal dementia due to tauopathies and TDP-43 proteinopathies

Daniel T. Ohm

Department of Neurology, Perelman School of Medicine, Penn Digital Neuropathology Laboratory, University of Pennsylvania, Philadelphia, PA, USA

Frontotemporal dementia (FTD) is a heterogeneous spectrum of age-related neurodegenerative clinical disorders characterized by impairments in social cognition, executive function, or language. FTD is typically caused by either tauopathies or TDP-43 proteinopathies that are not yet diagnosable during life. The neurons and microcircuits that selectively degenerate in FTD with tau (FTD-tau) and FTD with TDP-43 (FTD-TDP) pathology are poorly understood, but may be informative to the development of anatomically-grounded diagnostics and neuroprotective therapeutics lacking in FTD. To address this gap in knowledge, I use high-throughput digital segmentation methods and multivariate statistics to analyze histopathologic changes in postmortem cytoarchitecture to determine their clinical relevance in the FTD spectrum. In a large autopsy cohort of FTD-tau and FTD-TDP participants with similar clinical presentations including behavioral variant FTD and primary progressive aphasia, I will present evidence of proteinopathy-specific patterns of pathologic burden in distinct neural pathways associated with the locus coeruleus (LC) or the cell layers of the isocortex. First, I will demonstrate that degeneration of noradrenergic neurons in the LC is a prominent, unifying feature of tauopathies that is similar to Alzheimer's disease but distinct from minimal changes measured in the LC of FTD-TDP and healthy controls. Second, I will show that independent of isocortical region or clinical syndrome, significant tau burden in lower layers enriched for long-range projection neurons is unique to FTD-tau whereas TDP-43 burden is consistently restricted to relatively upper layers in FTD-TDP. Taken together, these data suggests that clinically similar FTD syndromes may be associated with the neurodegeneration of partially distinct microcircuits due to the underlying tau or TDP-43 proteinopathy. My future work will use the anatomical framework of laminar cytoarchitecture to compare FTD-tau and FTD-TDP with the goal of identifying the select neurons and corresponding laminar circuits that influence large-scale networks and clinical symptomology in FTD.

Keywords: Frontotemporal dementia, tau, TDP-43, cytoarchitecture, microcircuits

Panel 5
Predictive coding in the brain – Perception as hypothesis testing?

PN5-1

The contribution and prospects of "predictive coding" for brain sciences

Güven Güzeldere

"Predictive Coding", a method used by image processing in computational systems has recently been adapted by and become very fashionable in brain sciences. Some claim that it uniquely explains previously collected data (for instance in binocular rivalry research) provides a unifying theoretical framework that connects the underlying processes of perception, attention, and cognition in the brain, and, as such, stands to revolutionize cognitive sciences. In this presentation, I will try to dissect the various claims put forth on behalf of predictive coding, in order to assess them individually and more rigorously, by examining such questions as:

- What exactly is predictive coding used for in image processing?
- What does it mean for the brain to be predictive?
- What does it mean for the brain to code anything?
- Does predictive coding better explain presently collected data?
- What are the prospects of predictive coding for cognitive and brain sciences?

Keywords: Predictive coding, image processing, modelling, perception, cognitive and brain sciences.

PN5-2

Real problems and beast machines: predictive processing and conscious experience

Anil Seth

Sussex Centre for Consciousness Science, School of Engineering and Informatics, University of Sussex, Brighton, UK

Consciousness is, for each of us, the presence of subjective experience. Without consciousness there is no world, no self: there is nothing at all. In this talk, I will illustrate how the framework of predictive processing (or active inference) can help bridge from mechanism to phenomenology in the science of consciousness – addressing not the 'hard problem', but the 'real problem'. I will advance the view that predictive processing, precisely because it is not itself a theory of consciousness, is an excellent theoretical resource for consciousness science. I will illustrate this view first by showing how conscious experiences of the world around us can be understood in terms of perceptual predictions, drawing on examples from psychophysics and virtual reality. Then, turning the lens inwards, we will see how the experience of being an embodied self rests on control-oriented predictive (allostatic) regulation of the interior of the body. This approach implies a deep connection between mind and life, and provides a new way to understand the subjective nature of consciousness as emerging from systems that care intrinsically about their own existence. Contrary to the old doctrine of Descartes, we are conscious because we are beast machines.

PN5-3

A critical look at predictive coding theory

Romain Brette

Institute de la Vision, Paris, France

Predictive coding theory started its career in neuroscience as a type of efficient coding theory, in other words, a compression scheme. Since then, its scope has been widely extended to a general theory of perception, and even action. A major issue with predictive coding is "coding", which means a fixed relation between a variable and an object property. But a perceptual scene is made of a flexible arrangement of various kinds of objects: this cannot be encoded in a set of variables. Perception is not a parameter optimization problem. The other major issue is with "prediction", and its relation with action. Predictive coding implements a very specific sense of prediction: some quantity that can be compared to the input, with the metric of the input space. But predictions useful for an organism are typically of a very different kind: I predict that it will rain, so I will take an umbrella. This kind of prediction does not involve producing wetness signals. The relation of prediction with action is anticipation: acting as a function of a potential future. Anticipation is a hallmark of life that can be seen even in single cells: producing something required for a future reaction, or acting so as to avoid a predicted event that would otherwise happen (as in: I will get wet). Predictive coding does not fit these cases. In other words, compression is not anticipation.

Keywords: Anticipation, predictive coding, theory

Panel 6
Brain microcirculation in health and disease

PN6-1

Role of pericytes in regulation of microcirculation in health and disease

Turgay Dalkara

Institute of Neurological Sciences and Psychiatry, Hacettepe University, Ankara, Türkiye

Pericytes located over the first- to fourth branch-order capillaries off the arteriole, all of which exhibit high vascular cover-

age and α-smooth muscle actin (α-SMA) expression regulate the cerebral/retinal blood flow by contracting or relaxing. There is skepticism whether or not the mid-capillary pericytes on downstream (9 fourth branch-order) capillaries, which show the morphological characteristics of mesh or thin-strand pericytes, could contribute to blood flow regulation, because their thin processes provide only limited mural coverage and express little or no α-SMA. However, minor diameter changes in downstream capillaries can strikingly facilitate the changes in blood flow because most of the vascular bed resistance originates from small capillaries. Recent studies show that pericytes including mid-capillary ones express several actin isoforms and myosin heavy chain type 11, the partner of α-SMA in mediating contraction, suggesting the presence of a contractile capacity in downstream pericytes. Supporting this, a small and slowly developing luminal narrowing induced by vasoconstrictive agents or electrical as well as optogenetic stimulation of the downstream capillaries has been demonstrated. Capillary constriction was associated with an increase in pericyte calcium, which rapidly propagated to upstream pericytes via gap junctions. Rapid signal transmission from downstream pericytes, which have an ideal position to monitor neuronal activity, to up and downstream endothelial and mural cells via gap junctions or intercellular tunnels can orchestrate timing of capillary diameter changes along the arteriolovenular axis to provide an optimal blood flow for the active synapses nearby downstream capillaries. Pathological processes such as ischemia and amyloid accumulation can disrupt this vital pericyte function and lead to impaired neurovascular coupling and tissue perfusion.

Keywords: Cerebral blood flow, microcirculation, capillaries, pericytes, smooth muscle actin

PN6-2

Brain microcirculation in health and disease

Yasemin Gürsoy-Özdemir

Koç University, Istanbul, Türkiye

Brain microcirculation is affected by systemic diseases like hypertension and diabetes. In this talk, findings on the blood-brain barrier and extracellular matrix around it will be discussed. Especially differences between type-1 diabetes and metabolic syndrome regarding structural and cognitive differences will be presented. As the last title, changes in the perivascular extracellular matrix and blood-brain barrier will be discussed in two different experimental allergic encephalomyelitis models, namely MOG and PLP induced models respectively. These two models present significant differences and they will be presented.

Keywords: Blood brain barrier, extracellular matrix, perivascular cells

PN6-3

Capillary flow stalls in brain microcirculation: cellular causes and consequences

Şefik Evren Erdener

Institute of Neurological Sciences and Psychiatry, Hacettepe University, Ankara, Türkiye

Abnormal increase in capillary flow heterogeneity and appearance of capillary dysfunction can strongly depend on the complex flow kinetics of plasma and blood cells in the highly narrow vascular lumen, as a result of variable partitioning of different fluid compartments with respect to capillary network geometry. In vivo microcirculation imaging on live animals shows that, even in perfused capillaries, flow can become highly irregular and turbulent, with cessation and stalls in blood cell flux. In various pathological conditins, because of changes in erythroctes, leukocytes, endothelium and glycocalyx and other related structures, these flow stalls can significantly increase in frequency and duration, resulting in prominent fluctations in tissue oxygenation. In this presentation, the physical interactions between flowing blood components and the neurovascular unit will be discussed, elaborating on how and why flow stalls can be modified in acute and chronic neurodegenerative conditions and how these can affect the overall microcirculation kinetics.

Keywords: Brain, microcirculation, capillary flow, stalls, erythrocytes

Panel 7

Social and biological underpinnings of punishment

PN7-1

Evolutionary roots and neural underpinnings of altruistic punishment

Ozan Erözden

Law Faculty, MEF University, Istanbul, Türkiye

Human societies rely on large scale cooperation among genetically nonrelated individuals. This type of complex cooperation became a stable strategy in the evolutionary process thanks to a specific cognitive ability called normative cognition, which implies the presence of a set of mental faculties: a- the capacity to learn norms; b- the capacity to assess the results of one's own behavior in terms of norm complying or violating; c- the capacity to assess other individuals' mental states (beliefs, desires) and behavior in the context of these norms; d) the capacity to react to norm violations in order to appropriately sanction defection, even when the punishers are not themselves the victims of the violations. The latter point, called 'altruistic (or third-party) punishment', is a human universal, as it is present in every human culture. Modern justice systems are

arguably rooted on this prosocial behavior. During the last two decades several research has been carried out to explore the neural underpinnings of altruistic punishment. The findings indicate that three neural networks, namely salience network, default mode network and central executive network are involved in the process of altruistic punishment. In this presentation I try to summarize the literature on the neurophysiology of altruistic punishment, as well as basic theories on evolutionary roots of normative cognition.

Keywords: Altruistic punishment, normative cognition, salience network, default mode network, central executive network

PN7-2

Intellectual fundamentals of punishment in modern societies

Güçlü Akyürek

MEF University, Faculty of Law, Istanbul, Türkiye

In criminal law, which is one of the oldest fields of law, the main issue is to determine crime and punishment. In ancient times, humans aimed to take revenge and collectively punished individual crimes. Then, they tended toward subjective mens rea /liability in modern times. Human's free will and in this context, the fault principle came into prominence and two essential groups of punishment theories showed up. The first group tends toward the past (retributive theories) and aims at repression or the justice. The second group tends toward the future (utilitarian theories) have aim at general and/or specific deterrence, rehabilitation/resocialization. Besides these theories basically focusing on the perpetrator of crime, there is a relatively new theory considering the victim and aiming to compensate his/her material/moral damage and to make a "reinstatement": restorative justice theory.

Keywords: Punishment, repression, general/specific deterrence, resocialization, restorative justice

PN7-3

The neural underpinnings of third-party punishment with respect to the degree of belief in free will

Tuna Çakar

MEF University, Istanbul, Türkiye

Free will belief is one of the common traits shared by all (Sarkissian et al. 2010) and there has been much scholarly research on the social function of BFW, particularly its alleged impact on prosocial behavior especially since the 1980s. On the other hand, third-party punishment, also known as altruistic punishment, is a particular sort of prosocial conduct that is thought to be essential for the evolutionary stability of solidarity and cooperation in large organizations made up of genetically unrelated members (Buckholtz and Marois, 2012). Even though this has been a research topic for several behavioral studies, there is a single empirical study (Krueger et al., 2014) that elaborates the problem from the standpoint of the influence of BFW on TPP in this literature (Viney et al. 1982; Viney et. al. 1988; Stroessner and Green 1990; Haynes et al. 2003). This particular session is devoted to the presentation and discussion of the results of an experimental neuroscience study that aims to comprehend the brain underpinnings of third-party punishment and the impact of BFW. Through the use of optical brain imaging, we sought to investigate how BFW affected third-party punishment in high- and low-affect situations in this study (fNIRS). The obtained empirical findings and associated statistical analyses indicate that during high affect scenarios, participants with higher degrees of BFW exhibit more neural activity in their right DLPFC regions (hbo and hbt measures), whereas participants with lower degrees of BFW exhibit more neural activity in their medial PFC regions (hbo and hbt measures).

Keywords: Belief in free will, third-party punishment, prefrontal cortex, optical brain imaging method

Panel 8
Gene regulation mechanisms in neurodegeneration

PN8-1

Mitochondrial DNA and amyloid beta

Duygu Gezen Ak, Zuhal Yurttaş, Tugay Çamoğlu, Erdinç Dursun

Department of NeuroscienceInstitute of Neurological Sciences, Istanbul University-Cerrahpaşa, Istanbul, Türkiye

Mitochondrial functions were accepted to be main pathways of neurodegeneration that were intially disrupted in neurodegenerative disorders. It has been shown that amyloid beta (Aβ) can be localized in mitochondria. Although its roles have been widely investigated in pathological conditions, information about the presence and functions of Aβ in mitochondria at endogenous levels is very limited. The information obtained from our previous studies has provided us with clues that Aβ may interact directly or indirectly with transcription factors and affect mitochondrial DNA (mtDNA) transcription. In addition, our studies have shown that endogenous Aβ1-42 can be localized in the cytoplasm, nucleus and mitochondria in different cell types, and can migrate to different subcellular areas within the cell under certain conditions. This migration movement is at first glance very similar to the response of some direct transcription factors to a signal. Although we have shown for the first time in the literature that Aβ1-42 can be changed sharply in response to antibiotics, this movement may be triggered in the presence of certain stimuli and allow it to reach DNA, and mtDNA may also be among its targets. In the light of this information, we suggest that endogenous Aβ fragments may interact directly with mtDNA or affect RNAs

or transcription factors in mitochondria and alter the mtDNA transcription profile. Uncovering the physiological roles of this peptide in mitochondria will enable us to better understand the effects of pathological protofibrils or fibril forms of peptides on accumulated mitochondrial damage in the progressive neurodegeneration process. In this talk, clues to these possible interactions will be discussed by presenting data obtained from immunofluorescence, immunoprecipitation (mtDNA-, protein-), qRT-PCR experiments in mitochondria of different cell types. This work was supported by TUBITAK (Project No: 219Z179).

Keywords: Amyloid beta, mtDNA, neurodegeneration

PN8-2

Non-coding RNAs in small neuron-derived extracellular vesicles of Alzheimer's disease

Kemal Uğur Tüfekci

Center for Brain and Neuroscience Research, Izmir Democracy University, Izmir, Türkiye

Alzheimer's disease (AD) is a chronic and progressive neurodegenerative disease that is the most common cause of dementia worldwide. Although amyloid plaques and neurofibrillary tangles are defined as the distinguishing features of the disease, the only valid diagnostic method is post-mortem imaging of brain sections. Small extracellular vesicles (EVs) are released into the extracellular space and play a variety of roles in healthy and pathological conditions, including cell-to-cell communication. EVs are released from more than one cell type, and when released from neurons, they can pass from the brain to the blood with the non-coding RNAs they contain. Non-coding RNAs are a type of RNA that does not code for proteins but regulates protein expression post-transcriptionally. In the studies conducted by our team, non-coding RNA (tRNA fragments-tRF and microRNA) in the content of neuronal EVs were profiled and the changes of non-coding RNAs in neurons that may have roles in intercellular communication were analyzed.

Keywords: Alzheimer's disease, small extracellular vesicles, microRNA, tRNA fragments

PN8-3

Investigation of the effect(s) of upregulated TrkA signaling pathway in an in vitro model of Alzheimer's disease

Erkan Kiriş

Middle East Technical University, Ankara, Türkiye

Objective: Neurotrophins (NGF, BDNF, NT-3, and NT-4/5), which play crucial roles in the normal functioning of the nervous system in adults, exert their effects through receptor-mediated signaling pathways. NGF-TrkA signaling pathway has been shown to be critical in neuroprotection against Alzheimer's Disease (AD). However, specific activation of neurotrophin signaling pathways has been shown to be challenging. We have previously demonstrated that a conserved amino acid region (KFG) in Trk receptors controls the level and activity of the TrkA receptor. Mechanistically, we and others showed that this region is critical for receptor ubiquitination. Deleting this region from the TrkA receptor increases receptor level and signal pathway activation. Using the KFG model system, we investigated the importance of the upregulated TrkA signaling in basal forebrain cholinergic neurons (BFCN) in an in vitro AD model system.

Methods: We utilized directed differentiation to generate BFCNs from WT and TrkA-KFG, in which the KFG region in TrkA is deleted, mouse embryonic stem cells (mESCs). Using WT and TrkA-KFG BFCN neurons, we investigated the effects of upregulated TrkA signaling pathways on cellular events and neurotoxicity caused by Amyloid Beta 42 (Aβ42) oligomers.

Results: WT and TrkA-KFG mESCs were differentiated into BFCNs and characterized by western blot and immunocytochemistry, using specific markers. Then, Aβ42 oligomers were utilized to generate an in vitro AD model system using these neurons. Our MTT cell viability and LDH cytotoxicity analyses showed that TrkA-KFG BFCNs were statistically significantly more resistant to death caused by Aβ42 treatment than WT neurons. In addition, the negative effect of Aβ42 oligomers on synaptic density was also less in TrkA-KFG BFCNs. Mechanistically, our studies suggest that the protection observed in TrkA-KFG BFCNs may be mediated through the MAPK/ERK signaling pathway.

Conclusion: This study suggests that modulating specific Trk receptor domains to make the receptors more sensitive in specific neuronal types may provide protection against AD and open new avenues for future research. This research was supported by TUBITAK (No:118Z805).

Keywords: Alzheimer's disease, basal forebrain cholinergic neurons (BFCN), neurotrophin signaling, nerve growth factor

Panel 9

The role of offline and online evaluations in understanding dyslexia markers

PN9-1

Online evaluations of reading in dyslexia diagnosis: auditory mismatch negativity (MMN) event related potential (ERP)

Sema Acar Ünalgan

Department of Speech and Language Therapy, Faculty of Health Sciences, Izmir Bakırçay University, Izmir, Türkiye

MMN is a widely studied ERP in dyslexia research as auditory MMN responses obtained with speech stimuli presented by pas-

sive oddball paradigm are interpreted as automatic responses to phoneme discrimination. It is recognized as a suitable neurophysiological tool for investigating online phonological processing in infants and children. Different from their peers with typical development, school-age children with dyslexia show differences in their MMN responses such as low MMN amplitude values, differentiation in polarity, late latencies, and/or absence of MMN responses. Evidence from auditory MMN studies with speech stimuli is interpreted as neurophysiological evidence of the Phonological Disorder Theory, which suggests that problems in phonological processing might be the underlying cause of reading problems in dyslexia. It is argued that problems in storing phonemes and/or recalling phonemes during grapheme-phoneme matching might cause reading problems in dyslexia. On the other hand, MMN studies with tonal stimuli requiring rapid acoustic changes to be distinguished reported low amplitude values in participants with dyslexia. These findings support the Rapid Auditory Processing Theory, which suggests that auditory processing problems might be the underlying cause of reading problems in dyslexia. In preschool, distinguishing F2 formant transition difference in /ba/ and /ga/ syllables is defined as a biomarker of future reading skills: Children with insufficient phonological processing skills in preschool could not physiologically distinguish the difference between /ba/ and /ga/ stimuli in electrophysiological measurements. It is, therefore, stated that they have problems in reading words/pseudowords, reading texts and reading comprehension at school age. These studies show that auditory MMN responses provide electrophysiological biomarkers related to phoneme discrimination processes of reading. In our MMN study, which is one of the first studies in Turkish we know, the preliminary results indicated that MMN responses obtained with /ba/ and /ga/ stimuli may predict the diagnosis of dyslexia.

Keywords: MMN, dyslexia diagnosis, phoneme discrimination, online evaluations, reading

PN9-2

Online evaluations associated with reading in dyslexia diagnosis: visual ERP Studies

Hazal Artuvan Korkmaz

Department of Physiology, Faculty of Medicine, Ankara University, Ankara, Türkiye

The visual system forms the early steps of decoding written symbols (letters and words) and accessing the meaning. Given the reading-related visual ERP studies, it has been observed that P1 component has been mostly evaluated for early-visual processing, N170 for letter/syllable analysis, and N2 or P3 for lexical access. These studies commonly reported that individuals with dyslexia and typically reading individuals differ in terms of visual ERP latency and amplitudes. The visual ERP components obtained by word stimulus have been thus proposed as an objective and online marker to distinguish children with dyslexia from the typically developing ones. It is known that there is left hemispheric lateralization in reading, similar to language lateralization. With the acquisition of reading, activations begin to be taken in the visual word forming area located in the left occipito-temporal region, which is responsible for sublexical (nonsense/pseudoword) and lexical (meaningful/real word) decoding. Furthermore, the degree of lateralization increases by improvement in reading skills. However, it has been reported that there are differences in reading-specific left lateralization in individuals with dyslexia and that there is no hemispheric asymmetry as expected. Our studies in Turkish have shown that healthy slow readers have a slower right-to-left interhemispheric transfer in the parietal region than fast readers. However, there is no such a study in Turkish with individuals with dyslexia. Considering the hypotheses of visual deficit, magnocellular deficit, and impaired interhemispheric integration in dyslexia, visual EEG applications may be convenient tools for objective and online evaluation of these effects during reading. Our aim in the panel is to discuss the candidates of online-process biomarkers that can help objective diagnose dyslexia within the scope of visual EEG studies in individuals with dyslexia.

Keywords: Dyslexia, EEG, visual ERP, interhemispheric transfer time, lateralization in reading

PN9-3

Online-processes assessments of reading in dyslexia: can eye-tracking be a biomarker in diagnosing dyslexia?

Esmehan Özer

Kırıkkale University, Kırıkkale, Türkiye

In the eye-tracking system, eye movements are monitored with a high-resolution camera using corneal reflection, and then the location of the eye and where the eye looks are calculated with mathematical models. Reading takes place through a series of fixation and saccade eye movements. With eye-tracking devices, the fixations and the saccades of the readers are reached during reading and the relevant eye-movement parameters are revealed. Thus, the cognitive processing of the readers or the reading material are examined. Eye tracking is widely used in various languages as an online-process technique in examining the reading skills and performance of individuals with dyslexia. Studies show that individuals with dyslexia and typically developing individuals differ in their reading skills and performance. At the same time, in recent years, machine learning has been applied by reaching various eye-movement parameters such as the number and duration of fixation and the number and duration of saccades of the readers during text reading. Thus, studies are carried out to detection individuals with dyslexia risk at the earliest period and to implement intervention programs effectively, and biomarkers are tried to be determined. In this context, eye movements of readers with dyslexia during text reading have begun to be exam-

ined in Turkish, which has a transparent orthography with eye tracking as an online-process technique. In this presentation, it will be discussed that the eye-movement parameters of individuals with dyslexia, which are reached during text reading, can be biomarkers in order to diagnose individuals with dyslexia at the earliest period and to apply effective intervention programs to these individuals.

Keywords: Dyslexia, eye-tracking, reading, diagnosis-assessment, biomarker

PN9-4

Offline process evaluations associated with reading in dyslexia

Rahime Duygu Temeltürk

Department of Child and Adolescent Psychiatry, Faculty of Medicine, Ankara University, Ankara, Türkiye

Dyslexia is one of the most common neurodevelopmental disorders in childhood. Dyslexia is categorized under "Specific Learning Disorder (SLD)" with dysgraphia (impairment in written expression) and dyscalculia (impairment in mathematics) according to the Diagnostic and Statistical Manual of Mental Disorders-5 (DSM-5). Dyslexia, also known as reading disorder, accounts for about 80% of all SLD cases. It is reported that dyslexia is observed at a rate of 5-15% in the community. Dylexia diagnosis can be made when considering the chronological age, measured intelligence level and education of the person in the individually administered standard tests, the reading skills are significantly lower than expected, and the scores are at least 1.5 standard deviations below the average in the evaluations despite the intervention for at least 6 months of reading difficulties. For dyslexia, which is a clinical diagnosis, evaluation is made with culture-adapted standard tests that measure the reading and reading comprehension skills of individuals. Psychometric evaluations of individuals diagnosed with dyslexia begin with the Specific Learning Disorders-Clinical Observation Battery (SLD-COB) given in addition to the intelligence tests (Wechsler Intelligence Scale for Children/WISC-R, WISC-IV) routinely administered in clinics. TODİL (Test of Language Development-Primary), TEDİL (Turkish Early Language Development Test) and TİFALDİ (Turkish Expressive and Receptive Language Test) for the evaluation of basic language skills, SOBAT (Oral Reading Skills and Comprehension Test) and OYAB (Literacy Assessment Battery) for reading skills are used. Individuals with dyslexia are evaluated in terms of phonological awareness (Test of Early Literacy, Turkish Phonological Awareness Test), rapid automatized naming (Turkish Rapid Automatized Naming Test, Rapid Naming Test) and working memory (Working Memory Scale) for further stage. All these evaluations are valuable in terms of providing offline-process evidence regarding the reading performance of individuals with dyslexia. In this presentation, routine psychiatric assessment and applied psychometric test/batteries will be explained within the scope of offline-process evaluations related to reading in dyslexia.

Keywords: Dyslexia, reading, offline-process, psychiatric assessment, psychometric test

Panel 10
Why we still cannot treat 1/3 of the epilepsy cases efficiently?

PN10-1

Definition of drug-resistant epilepsy, clinical dilemmas, clues

Ebru Altındağ

Department of Neurology, Istanbul Florence Nightingale Hospital, Istanbul, Türkiye

Epilepsy is a frequent, chronic neurological disease that affects approximately 70 million people worldwide. Despite more than 20 anti-seizure drugs (ASD) available today, epileptic seizures cannot be controlled in 1/3 of these patients and defined as drug-resistant epilepsy (DRE). DRE is an important health problem due to its cognitive and psychosocial consequences that adversely affect quality of life, as well as increased mortality risk and socioeconomic burden for individuals and society. For these reasons, the development of effective treatments for DRE is an urgent clinical need. The different clinical and prognostic features of epilepsies and mechanisms of DRE and epileptogenesis are still not well-known and cause the most important difficulties in the development of effective and novel treatments. In this talk, our current understanding of the clinical diagnosis, challenges and importance of DRE, as well as newly understood immunological etiological mechanisms will be reviewed. We will discuss how we can overcome the problem of effectively treating DRE through the current state of ASD development programs.

Keywords: Anti-seizure drug, pharmacotherapy, drug-resistant epilepsy

PN10-2

What have we learned from genetics in resistant epilepsies?

Sibel Uğur İşeri

Department of Genetics, Aziz Sancar Institute of Experimental Medicine, Istanbul University, Istanbul, Türkiye

Epilepsy is a common neurological disorder, that often responds to treatment. Nevertheless, treatment resistant epilepsies are a major concern in patient care in epilepsy clinics. Resistant epilepsies like all complex conditions can be related to a number of mechanisms, including environmental and genetic factors, as well as epilepsy subtype and the applied treatment protocol. Recently

by the help of cutting edge genomic technologies, genetic variations associated with drug resistant epilepsy have been revealed in voltage-dependent sodium/potassium channel genes and in genes encoding proteins involved in various metabolic pathways. Detection of genetic variations that play a role in the regulation of resistance mechanisms in epilepsy will be useful in planning personalized treatment approaches, utilizing efficient medication and better understanding the physiological processes underlying this common condition.

Keywords: Resistant epilepsy, genome technologies, genetic variations

PN10-3

Overview of drug-resistant epilepsies through experimental models

Nihan Çarçak Yılmaz

Department of Pharmacology, Faculty of Pharmacy, Istanbul University, Istanbul, Türkiye

Drug resistance provides a major challenge in the pharmacotheraphy of epilepsy. In this talk, we will review the experimental models of drug resistance that have significantly contributed to our current understanding of the molecular, genetic, and structural mechanisms of drug resistance in epilepsy. Here, we will also discuss the development of a valid animal model for drug-resistant seizures that occurs in the setting of autoimmunity such as in autoimmune encephalitis. Autoimmune epilepsy is a subset of epilepsy characterized by immune-mediated neuroinflammation and antibody-induced hyperexcitability resulting in a variety of neurological symptoms, including psychiatric disturbance, cognitive dysfunction, and persistent drug-resistant seizures. Models of drug resistant epilepsies are not only considered key tools for the identification of the pathophysiological mechanisms of therapeutic failure but also for the selection of novel drug candidates targeting difficult to-treat epilepsy with refractoriness to available anti-seizure drugs.

Keywords: Drug-resistant epilepsy, in-vivo experimental model, autoimmune epilepsy

Panel 11

Cognition in Parkinson's and Alzheimer's disease: overlaps and dissociations

PN11-1

Looking at Alzheimer's and Parkinson's diseases from the perspective of the "dual origin hypothesis"

Hakan Gürvit

Department of Neurology, Behavioral Neurology and Movement Disorders Unit, Istanbul Faculty of Medicine, Istanbul University, Istanbul, Türkiye

The dual origin hypothesis (DOH) of the evolution of the cortex proposes the existence of two cortical sectors: dorsal and ventral, starting from the primitive three-layered allocortical structures and ending in the newest structures, the six-layered isocortex. The allocortex, is divided into archicortex and paleocortex. The archicortex is the hippocampal formation, and the paleocortex is the piriform cortex. So, by the names of their origins, the dorsal-archicortical division is hippocampocentric (HS), and the ventral-paleocortical division is olfactocentric (OS). The more primitive amygdala with its connectivity pattern, can be seen as the origin of the ventral sector. The HS sector is primarily related to those mental functions belonging to cognitive domains (i.e., episodic memory, etc.). These functions are also called "cold" functions in the popular language. The OS sector is related to functions gathered under the heading of social cognition. These functions are also called "hot" functions. The amygdala and hippocampus are anatomically interconnected core limbic structures; functionally, they subserve episodic memory. Common neurodegenerative diseases, such as Alzheimer's disease (AD) and Parkinson's disease (PD), predispose to these structures. According to neurofibrillary tangle (NFT) staging system, in stages I-II transentohorhinal (TEC) and entorhinal cortices (ECx) are involved. Clinically they are asymptomatic or subjective cognitive impairment stages. Paralimbic structures are involved in stages III-IV, corresponding to mild cognitive impairment (MCI). Stages V-VI is the involvement of association cortices corresponding to dementia. Braak's staging of caudo-rostral extension of Lewy bodies (LB) in PD, stages I-II correspond to pre-motor stages. In these stages, the olfactory bulb (OB) and the lower brain stem are involved. The amygdala and the TEC are involved in stages III and IV, respectively, corresponding to PH-MCI clinically. Although these two diseases neuropathologically destroy the HS and OS departments in parallel, clinical focus is on HS-dependent functions (memory and other "cold" cognitive areas), while OS-dependent functions (smell and "warm" social cognitive functions) are neglected. For the earliest diagnosis of these diseases, multimodal neuroimaging of networks originating from HS and OS and a neuropsychological evaluation that includes both cold and warm mental functions are required.

Keywords: Parkinson's disease, Alzheimer's disease, dual origin hypothesis

PN11-2

Detection of cognitive impairment in Parkinson's disease with multimodal MR imaging and machine learning

Esin Öztürk Işık

Boğaziçi University, İstanbul, Türkiye

Parkinson's disease (PD) is a neurodegenerative disorder that has affected more than 4 million people in the past 50 years. While Parkinson's disease is generally known for motor symptoms such as tremor, posture and gait disturbances, and muscle stiffness, cog-

nitive dysfunction has also been indicated at the early stages of the disease. Parkinson's disease dementia (PDD) affects daily life by disrupting memory, fluent speech, visuospatial and visual-perceptual functions. Parkinson's disease mild cognitive impairment (PD-MCI), on the other hand, is defined as a transitional stage between cognitively normal (PD-CN) and PDD. PD-MCI is seen in 27% of PD patients, and MCI is an important determinant for the development of dementia. In the past years, studies have been carried out to determine the diagnostic criteria of PD-MCI, which remain subjective due to the qualitative measurements. Magnetic resonance (MR) imaging has been commonly used in the diagnosis and follow-up of neurodegenerative diseases. Multimodality MR imaging provides chemical, functional and anatomical information of the underlying tissue of interest. MR spectroscopic imaging provides noninvasive information regarding the biochemistry of the tissue. Arterial spin labeling MR imaging is used to acquire cerebral blood flow and arterial blood volume maps without the need of using contrast agents. In this talk, several of our studies on the detection of PD-MCI and PDD with multimodal MR imaging methods and machine learning will be discussed.

Funding: The content of this speech was prepared with the support of TÜBİTAK grant number 115S219.

Keywords: MR spectroscopic imaging, arterial spin labelling MR imaging, Parkinson's disease, cognitive impairment

PN11-3

Neuroimaging findings in Parkinson's disease-associated cognitive impairment

Ulaş Ay

Neuroimaging Unit, Hulusi Behçet Life Sciences Research Laboratory, Istanbul University, Istanbul, Türkiye

Parkinson's disease (PD) is a neurodegenerative disease characterized by cardinal motor symptoms such as bradykinesia, rigidity, tremor and postural instability. Besides motor symptoms, some common non-motor symptoms, such as hyposmia and cognitive impairment, have also been associated with PD. This panel will discuss three studies carried out in Istanbul University Hulusi Behçet Life Sciences Research Laboratory on the PD-related cognitive impairment continuum. First, the findings of our study, which examined the anatomical and functional alterations in the PD-associated cognitive impairment continuum, will be presented. This study found no anatomical alterations between PD patients with mild cognitive impairment (PD-MCI) and cognitively normal PD (PD-CN), while decreased cortical thickness has been shown in PD patients with dementia compared with those without dementia in the somatomotor regions, temporoparietal junction, posterior midline structures, and frontal structures. When the functional connectivity changes of the regions with decreased cortical thickness were investigated, it was shown that functional connectivity in the PD-MCI group compared to the PD-CN group began to be considered in all intrinsic connectivity networks, primarily the visual network and frontoparietal network. We found that the functional connectivity of specific regions that will display critical cortical thinning in the dementia stage already began to decrease at the PD-MCI stage, although they did not show any significant anatomic difference between the PD-MCI and PD-CN groups. Then, findings related to posterior cortical atrophy, which may be a sign of cognitive impairment in PD, will be discussed in another study in which anatomical changes between PD-MCI and PD-CN groups were examined on a hypothesis-driven basis through visual scoring. Finally, the findings of another study, which supports that the cortico-amygdaloid transition area volume, which can be defined as the olfactory amygdala, can classify PD-MCI and PD-CN patients with high accuracy and may be a biomarker for PD-associated cognitive impairment, will be discussed.

Funding: Present work was supported by IU-BAP (Project Nr: 2019K12-149071).

Keywords: Parkinson's disease, Parkinson's disease with mild cognitive impairment, Parkinson's disease dementia, functional magnetic resonance imaging, morphometry

PN11-4

Neuroimaging findings along the Alzheimer's disease continuum

Emre Harı

Neuroimaging Unit, Hulusi Behçet Life Sciences Research Laboratory, Istanbul University, Istanbul, Türkiye

The main neuropathological changes in Alzheimer's disease (AD) are oligomerization of amyloid-beta peptide (Aβ) and hyperphosphorylated tau protein (pT). Aβ initially accumulates in neocortical areas, while pT accumulates in limbic areas. The accumulation of tau pathology mainly in the limbic areas, especially in the transentorhinal cortex and hippocampus, has made these regions interesting to investigate the early stages of the disease. In this context, both structural and functional connectivity and volumetric studies on Alzheimer's disease contiuum are carried out at Hulusi Behçet Life Sciences Research Laboratory (HUBAL) using magnetic resonance imaging (MRI). As a result of our study, in which we examined the structural connections of the Papez circuit in Alzheimer's disease, it was found that the fornix and ventral cingulum pathways were affected in the advanced stage of the disease. In addition, a high level of correlation was found between the microstructure of the ventral cingulum and memory performance in the early stages of the disease. As a result of the functional connectivity analysis, it was determined that the connectivity between the parahippocampal cortex and the retrosplenial cortex was affected in the early stage of the disease. In the volumetric analyzes of the medial temporal lobe structures, there was a significant loss of volume in the entorhinal cortex, amygdala, and especially the anterior amygdaloid area (AAA). In this context, it has been concluded that

studies evaluating AAA volume and sense of smell may play an important role in the early diagnosis of AD.

Funding: Present work was supported by IU-BAP (Project Nr: 2019K12-149071).

Keywords: Alzheimer's disease, magnetic resonance imaging, functional connectivity, neuroimaging

Panel 12
Obesity, chronobiology and circadian rhythm disorders: a multidisciplinary perspective

PN12-1
Obesity and circadian rhythm

Serpil Çeçen

Department of Physology, Hamidiye Medical Faculty, University of Health Sciences, Istanbul, Türkiye

Obesity is a chronic disease that seriously threatens human health and is characterized by an increase in adipose tissue. Obesity incidence is increasing in the world. Mortality and morbidity rates increase with the increase in obesity in both childhood and adults. Obesity is a complex multifactorial chronic disease caused by the interaction of genetic and environmental factors. It is thought to increase as a result of the interaction of social, behavioral, cultural, physiological, metabolic and genetic factors. However, the increasing prevalence of obesity both in the world and in our country suggests that the factors explaining obesity are not sufficient and that different factors may be the cause of obesity. Recent studies have shown that there may be a relationship between the sleep-wake cycle and obesity. Circadian rhythm is the most basic determinant of the sleep-wake cycle. This rhythm also regulates the activity of enzymes and hormones involved in metabolism. Circadian rhythm is defined as the repetition of the biochemical, physiological and behavioral rhythms on living things created by the rotation of the earth around its axis, which lasts for about 24 hours, but can vary between 20 and 28 hours. Human has a "diurnal" feature that exhibits the characteristic of living actively such as nutrition, exercise, work during the day, and rests at night. Today, the development of technology and shift working hours offered by modern life to people, night work system negatively affect the circadian rhythm, disrupt the energy balance and increase the risk of development of many metabolic diseases such as obesity, diabetes and heart diseases.

Keywords: Obesity, chronobiology, circadian rhythm

PN12-2
Obesity, chronobiology and circadian rhythm disorders: a multidisciplinary perspective

Belma Haliloğlu

Marmara University, Istanbul, Türkiye

Clock gene oscillations are necessary for many vital functions and also for the control of hormone secretion. All living organisms have feedback loops that produce oscillations. They are called circadian clocks and synchronized by external and internal factors. Dysregulation of these factors such as hormones (melatonin, leptin, ghrelin etc), the gut microbiome and energy metabolism can play a role in the risk of obesity. Especially, feeding time and dietary nutrients are the most important environmental factors that influencing mechanism in obesity development. Insufficient sleep time and distribution of day-night cycles leads not only to an increase of the total calorie intake but changes the meal with high carbohydrate content.

Keywords: Obesity, circadian rhythm, leptin, gherlin

PN12-3
Obesity, circadian rhythms, psychiatric disorders in childhood and adolescence

Aliye Tuğba Bahadır

Department of Child and Adolescent Psychiatry, School of Medicine, Marmara University, Istanbul, Türkiye

Obesity, the prevalence of which is increasing in children and adolescents, is an important public health problem that can be accompanied by many psychiatric disorders. Difficulties related to the regulation of sleep and circadian rhythms can be encountered in many psychiatric disorders such as attention deficit hyperactivity disorder (ADHD), depression, bipolar disorder, seasonal affective disorder, anxiety disorders, substance use disorders, psychotic disorders, autism. Obesity can accompany many of the mentioned psychiatric disorders. Research findings support that circadian rhythm disruption mediate the association between ADHD and obesity. Carpenter et al. (2021) proposed a new depression phenotype, which they defined as 'circadian depression': They stated that the main clinical features of circadian depression are, disruption of the 24-hour sleep-wake cycle, decreased motor activity, low energy and weight gain. Carpenter et al. (2021) suggested that there is more circadian disruption in bipolar disorder and atypical depression than in other depression subtypes. Increased sleep and appetite, and weight gain have been reported in the depressive phase of bipolar disorder and in atypical depression. Leptin dysregulation was detected in atypical depression. Evening chronotype was found to be associated with more depressive symptoms in normal weight and overweight adolescent girls. However, this association was found to be stronger in overweight girls. As the associations between circadian rhythm problems, obesity and psychiatric disorders are clarified; the importance of fixing circadian rhythm disruptions will increase and this will contribute positively to the course of both obesity and psychiatric disorders.

Keywords: Obesity, circadian rhythms, child and adolescent psychiatry

Panel 13
"White rabbit" and "Lucy in the sky": return of the psychedelic drugs

PN13-1
Psychedelics and their mechanisms of action

Ali Yağız Üresin
Istanbul Faculty of Medicine, Istanbul University, Istanbul, Türkiye

Psychedelics are defined as substances affecting thoughts, perception and mood without causing significant psychomotor stimulation or depression. Throughout history, societies have used naturally originated psychedelics such as psilosibin and meskalin in various rituals. LSD, which was found during drug research in the 1940s, mediated all these substances to be spoken at the scientific level. One of the most important reasons that make psychedelic substances an attractive option for scientists is that they are not addictive like other centrally acting drugs used in treatment and they make a significant difference in short-term use. Until the 1960s, psychedelics has been popular and has been the subject of many studies. However, it was then withdrawn from the market for reasons such as social abuse and its use was restricted. At that time, it was focused on the use of these substances in the treatment of some psychiatric patients, but these studies were influenced by the restriction decision of the states. With the changing and developing technology, some of the substances of psychedelics continue to be investigated in detail, but the researches concentrated on which pathways of these substances on the central nervous system were carried out on which pathways were carried out. This new results/data directed researchers to re-evaluate the usability of psychedelics in treatment. Recurrent and treatment-resistant depressive disorders, post-traumatic stress disorder, anxiety, OCD, addiction, life-threatening diseases, depression are discussed in cases where the existing central-effective drugs are insufficient or missing. Increased interest in the use of psychedelics has paved the way for clinical research on these substances. Recently, studies have been compared with drugs accepted by health authoritarians. When the results of this study were examined, the results were in favor of both parties. Different applications such as the microdose method and single-dose use also increase the interest in psychedelics. In addition to the developments in the field of medical use, it should not be forgotten that the disadvantages that can be caused by non-medical grounds within the framework of "recreation" and "esoteric" trend in popular culture should not be missed and the use of more comprehensive, evidence should be remembered when evaluating the use of treatment.

Keywords: Psychedelic, hallucinogens, psychiatric disorders

PN13-2
Natural psychedelics

Emine Akalın
Faculty of Pharmacy, Istanbul University, Istanbul, Türkiye

Natural psychedelics (plants, fungi, animals…) that have been used for thousands of years as healing or in religious rituals have always attracted attention. In recent years, the use of such products and the active substances obtained from them as therapeutics has become popular. In this, with developing technology, the increase in studies aimed at elucidating the effects and mechanisms of action of psychedelic substances has also been effective. Studies have shown that psychedelics used in the right environment, dose and indication, can be effective in many areas such as reducing anxiety, improving cognitive functions and memory, and combating alcohol and substance addiction. It is possible to classify psychedelic plants and fungi according to the active substance they contain such as 8-phenethylamines (peyote), teonanacatyls (magic mushrooms), B-carbolines (Peganum harmala, Banisteriopsis caapi), tropans (Datura species, Atropa species). American origin, peyote cactus (Lophophora williamsii), Banisteriopsis caapi and Psychotria viridis species containing psychedelic compounds such as N,N-dimethyltryptamine and harmine, are still used in religious ceremonies. Mexican origin Salvia divinorum which is used by chewing the leaves, and Tabernanthe iboga, which is recently researched in the treatment of opiate addiction, are among the prominent plants. In Türkiye and nearby geographies, Artemisia absinthium known as wormwood, and Peganum harmala, which is known as wild rue and is believed to ward off evil spirits by the public, is one of the plants used because of the harmaline and harmine alkaloids it contains. Plants of the Solanaceae family such as Datura stramonium, Atropa and Hyoscyamus, which are still used in some regions due to their tropane alkaloids, and Claviceps purpurea, containing ergot alkaloids, are natural sources with psychedelic effects, whose direct or semi-synthetic molecules are also used as drugs. Mad honey, which is made from the nectar of Rhododendron ponticum and Rhododendron luteum species with a high grayanotoxin content, is also known for its psychedelic effects. Treatment with psychedelic natural substances is based on a complex and multidimensional perspective. Numerous theoretical, methodological and ethical challenges complicate the integration of psychedelic therapy into psychiatric practice. Results-oriented research will also advance understanding of psychedelic substances, herbs, and related applications, while trying to establish an evidence base for treatment.

Keywords: Psychedelics, psychoactive treatment, natural psychedelics

PN13-3
Psychedelic psychotherapy

Mehmet Bilgin Saydam
Istanbul Faculty of Medicine, Istanbul University, Istanbul, Türkiye

Defining the 'psychedelic psychotherapy' as psychotherapy facilitated by psychoactive substances, we notice that the enthusiasm in this field in 1950's -but extinguished by exaggerated social-political reactions-, has been revived in recent years. In fact, it's

an ancient technique. In different cultures, shamans as the 'proto-psychotherapists', used psychoactive substances in healing practices. The shaman -as the 'proxy-of-the-patient'-, takes advantage of these substances to trigger his/her transition to altered states of consciousness for a metaphorical solution of problems in this 'other world'. There are also treatment methods in which the patient uses psychoactive substances under the supervision of the shaman: We can consider this approach as the prototype of modern psychedelic psychotherapies. Deepening in psychotherapeutical/psychoanaytical process leads to the manifestation of archaic contents and dynamics that have no possibility to be verbalized and recognized as subjective material: Too deep, that the subject leaves the area where 'man' feels him/herself at home. The archaic unconscious, which shapes the very origins of conscious life, but its wisdom cannot be grasped, emerges in all its violence, striking and driving man. To the extent that they cannot be understood, they appear a priori, so they cannot be linked and integrated in a meaningful narrative. Psychedelics such as LSD, mescaline cause unconscious psychic material to overwhelm and drag the users beyond conscious control. The perception-intensity increases, and the person's view of him/herself and the world changes positively or negatively in correlation with his/her experiences. This change ranges from enthusiasm/admiration to experiences of anxiety/dread, and is the explosive expression of personalistic and/or situational inner dynamics. The point to emphasize here is that psychedelics are unpredictable. Revealing unconscious material inevitably affects the user, alienates him/her from usual assumptions, and will probably have repercussions in later life. However, understanding what is what, what it corresponds to in past and present, and how this insight can be used requires mental work. Experiences without this working-through remain alien and incomprehensible. The accompaniment of a professional who assists in processing such valuable but also uncanny content can facilitate a powerful positive change while integrating the alien in the personality.

Keywords: Psyhedelics, psychotherapy, psychoanalysis

PN13-4

"The doors of perception" and entheogenic rituals: an anthropological critique

Ebrar Akıncı

Faculty of Letters, Istanbul University, Istanbul, Türkiye

In his classical work published in 1954, "The Doors of Perception," Aldous Huxley interpreted the effects of mescaline that he experienced under supervision, and he acknowledged the resemblance of these effects to a mystical experience. Based on his reflections under the influence of mescaline, Huxley also associated sensations such as geometrical forms, radiance, and colors with the transcendence of art, and he raised a question about the universal aspects of all these experiences. Huxley's analysis of the link between mystical experiences and cognitive processes evidently had a notable impact in his era. The interpretation promised an alternative "door" to mysticism seekers of the counterculture movement that was also interested in the wisdom teachings and meditation techniques of eastern religions as an alternative to the West. Accordingly, among the indigenous peoples of the Americas, the use of entheogens such as peyote came to be seen as the "original" or "genuine" form of mystical experience too. This romantic interest has also broadened popular culture's stereotypical representations of indigenous peoples. Certain indigenous communities use entheogens for therapeutic or ritual purposes because they are culturally confirmed and part of their worldview. Above all, the therapeutic use of the plants in question reveals an established and long-standing knowledge rooted in tradition transmitted through generations. However, the attitude of a Western individual who questions modernity and strives for a way out of the old theology, seeking to "expand perception" through collecting religious rituals of the natives as an "experience" and detaching them from their original context, could be interpreted as "consumption". Currently, entheogens of indigenous people are offered to "all humanity" by agents in a ritual setting. Besides, urban "entrepreneurs" who introduce particular symbols of indigenous customs into stereotypical patterns and claim themselves as gurus are promising treatments for health issues such as depression or addiction, serving "authentic" experiences disentangled from their original context.

Keywords: Aldous Huxley, entheogens, indigenous people, culture

PN13-5

Risks in psychedelics

Selçuk Şen

Istanbul Faculty of Medicine, Istanbul University, Istanbul, Türkiye

Psilocybin; lysergic acid diethylamide (LSD), a chemical found in many plants; N,N-dimethyltryptamine (DMT), found in some plants; 3,4-methylenedioxy-N-methylamphetamine (MDMA), which is recognized for its role in ecstasy (the abuse is also a current problem); and mescaline, which is found in some cactus species can be counted as psychedelic drugs. It is claimed that psychedelic therapy with various plants and compounds can be used in the treatment of mental health problems such as addiction, depression, and post-traumatic stress disorder. However, before evaluating the safety profiles and possible risks of psychedelic drugs, it should be kept in mind that psychedelic therapy is an experimental treatment method. Currently, no psychedelic drug has a proven indication for the treatment of the aforementioned diseases. Theoretically, psychedelic drugs can cause serious adverse effects due to their mechanism of action, especially through changes in consciousness. These adverse effects include psychosis and hallucinations that may cause fear, trauma, and flashbacks. On the other hand, psychedelic drugs can cause serious cardiovascular adverse effects through physiological changes such as vasospasm and an increase in blood pressure/heart rate. The possible beneficial

effects of short-term psychedelic use in the treatment of mental health problems are a current research topic. In addition to the effectiveness, the safety data of psychedelics should be evaluated in detail and compared with existing treatments in conducted and planned future studies. Currently, data from generally single-arm studies conducted on a small sample size in the literature are very limited for risk assessment. Misevaluations made without sufficient evidence and misuse/abuse of psychedelics by the community can cause serious health problems.

Keywords: Psychedelics, safety profile, risk factors

Panel 14
Molecular mechanisms of neurological disorders – Contemporary experimental approaches

PN14-1
Autoimmune mechanisms in epilepsy

Erdem Tüzün

Aziz Sancar Institute of Experimental Medicine, Istanbul University, Istanbul, Türkiye

Epilepsy is a neurological disorder afflicting several million individuals and bringing a serious social and economic burden to the society. Antigen-specific immune response findings that are particularly detected in focal epilepsy of unknown cause have brought forward the notion that autoimmune mechanisms may participate in some epilepsy types. It is important to enlighten autoimmune mechanisms that are putatively involved in pathogenesis of epilepsy since epilepsy patients with an autoimmune origin may respond to immunosuppressive medications rather than conventional antiepileptic drugs. Antibodies directed against neuronal membrane and intracellular antigens and detected in some patients with epileptic seizures constitute the basis of autoimmune epilepsy research. These antibodies are found not only in autoimmune encephalitis patients presenting with seizures but also chronic epilepsy cases and mostly interact with glutamate receptors, voltage gated potassium channel complex components and glycine receptor, all of which crucially involved in synapse functions. Several neuronal cell culture and animal model studies have shown that these antibodies may enhance neuronal excitability and thus lead to epileptic seizures. There is accumulating evidence showing that antibody negative epilepsy patients display increased effector T and B cell subtypes, increased activation of innate immunity and reduced functioning of regulatory T cells. Th-17 type helper T cell responses have been shown to increase in various chronic focal epilepsy types. These findings suggest that complex interactions between peripheral and central nervous system innate immunity cells and antigen-specific adaptive immunity cells may cause dysfunction in widespread neuronal networks and thus lead to chronic epileptic seizures.

Keywords: epilepsy, autoimmunity, autoimmune encephalitis, antibody, T cell.

PN14-2
Identification of the pathological mechanisms of Alzheimer's disease by functional genomics in zebrafish

Çağhan Kızıl

Irving Medical Center, Columbia University, New York, NY, USA

More than 70 genes were shown to be related to the pathological mechanisms of Alzheimer's disease in human, yet the molecular mechanisms of actions of most of these genes are unknown. To investigate those mechanisms, we generated an adult zebrafish model of amyloid toxicity by cerebroventricular injection of human amyloid-beta42 monomers into the cerebrospinal fluid of the adult zebrafish brain. Using histological analyses, imaging, transcriptomics and proteomics, we determined the similarities of zebrafish amyloid pathology to humans. Amyloid pathology in zebrafish brain is reminiscent of human brains. Zebrafish induce microglial response, synaptic degeneration, neuronal death, and impairment in cognitive abilities. We identified the molecular mechanisms that underlie the pathology-induced neuro-immune response and translated this finding to pre-clinical mammalian models. From a clinical functional genomics approach with a genome-wide association in AD patients, we identified that the gene FMNL2 links cerebrovascular disease and AD, by regulating the astroglial and blood vessel interactions and controlling the efficient clearance of toxic proteins from the brain. Finally, we performed a design-based novel hit compound identification by using zebrafish as a pre-clinical model for synaptic integrity. We conclude that zebrafish is a useful model for functional investigation of AD-related genes identified in clinical studies by providing in vivo biological knowledge on disease mechanisms, on which drug development strategies can be based.

Keywords: Zebrafish, Alzheimer's disease, functional genomics, drug development, pre-clinical animal model

PN14-3
Molecular mechanisms and their clinical translation in Parkinson's disease

George Tofaris

University of Oxford, Oxford, UK

Parkinson's disease is the second most common neurodegenerative disease currently without cure. Despite the disease complexity, a key pathogenic event is the aggregation of a small protein called alpha-synuclein into fibrillar assemblies. We have determined how alpha-synuclein is targeted for degradation by the ubiquitin system and used iPSC-derived dopaminergic neurons from patients with alpha-synuclein gene multiplications to model the pathological effects of its accumulation and aggregation. Our mechanistic insights provided a rationale for the development of novel biomarkers based on extracellular

vesicle isolation and alpha-synuclein measurements in the prodromal and clinical phase of Parkinson's disease.

Keywords: Alpha-synuclein, fibrils, extracellular vesicles

Panel 15
Neurobiology of language

PN15-1
A look into aphasia from the window of Turkish

Mustafa Seçkin

Departmant of Norology, School of Medicine, Acıbadem Mehmet Ali Aydınlar University, Istanbul, Türkiye

Aphasia is a cognitive disorder affecting one or more linguistic functions including speech production, comprehension, reading, writing, naming, grammar and, repetition caused by a damage to the left perisylvian language areas of the brain. Aphasia can be associated with cerebrovascular (stroke aphasia) or neurodegenerative (progressive aphasia) causes. The international classification guidelines of both stroke aphasia and progressive aphasia are based on data obtained from English-speaking aphasia patients, in other words these classification guidelines rely on studies focusing on Indo-European language family. Nevertheless, even in English-speaking aphasic individuals, "unclassified" cases that cannot be classified in any of the subtypes have been reported in up to 35-40% of all cases. Furthermore, as a language that belongs to the Ural-Altaic language family, Turkish has distinct syntactical, morphosyntactical and phonological characteristics. Therefore, it is even more difficult to place aphasia subtypes of Turkish-speaking patients in templates developed for English-speaking individuals. In this talk, we will discuss how the morphosyntactical characteristics associated with the agglutinative language structure and the flexibility of word-order in Turkish cause distinctive linguistic differences in aphasia assessment compared to the English-speaking individuals based on the systematic narrative analysis conducted at our laboratory. Additionally, we will focus on how the regular structure of the grapheme-to-morpheme conversion distinguishes Turkish from English language that contains substantial amount of irregular words and on how these characteristics help Turkish language become a natural laboratory for linguistic research. The outputs of our findings will help develop new classification criteria for aphasia subtypes in Turkish-speaking individuals.

Keywords: Aphasia, Turkish, classification

PN15-2
A new addition to the language network: the anterior temporal lobe

Robert S. Hurley

Cleveland State University, Cleveland, OH, USA

Wernicke proposed a theoretical area for language comprehension in the 1800s, and we have been searching for it ever since. Studies of primary progressive aphasia (PPA) now suggest that the left anterior temporal lobe fulfills much of the functionality originally ascribed to Wernicke's area. I will review several metrics we have established to assess word knowledge in PPA, including those derived from event-related potentials, eye movements, and magnetic resonance imaging. Results link word knowledge to the anterior temporal lobe rather than other putative areas for Wernicke's area such as the temporoparietal junction. Degradation of word knowledge in PPA takes on the form of "taxonomic blurring", where words from the same category such as "dog" and "cat" can no longer be differentiated. Hemispheric differences in anterior temporal functionality are also described, being more important for word knowledge in the left hemisphere and object knowledge in the right hemisphere.

Keywords: Language, anterior temporal lobe, primary progressive aphasia

PN15-3
Improvising brain, creative language

Koray Tarhan

Müjdat Gezen Art Center, Bakırköy, Istanbul, Türkiye

Steven Pinker draws attention to a necessity in his book where he asks the question of "How the mind works"; We need ideas that capture the ways a complex device can tune itself to unpredictable aspects of the world and take in the kinds of data it needs to function. What kind of opportunities would we face if we highlight "improvization" as an idea to meet that necessity? What happens to the brains of jazz musicians while they use improvization to connect to each other and to the sounds and create coherent musical outputs to construct a universal language "in the moment"? How is it possible to create a common language during improvized performances of the actors who construct their stories without relying on a written script? Our ability to improvize, that facilitates correct decision making during a crisis or helps bring the artistic fragments created without any preparatory work from unconscious to conscious right in front of the audience, may help understand how our brain works. What is the role of our bodies besides our brains in linguistic creativity? How do we experience the balance between the mind and body in improvization that proceeds based on action and reaction principle? How can our unconventional experiences and mistakes help us gain the flexibility that facilitates management of unpredictible circumstances? How can everyone learn altogether during a process where nonone knows nothing about? We will try to find the answers to these questions while "improvising" altogether.

Keywords: Improv, language, creativity

Oral Presentations

(O-01 — O-90)

O-01

The role of the oxidative stress metabolism in the central nervous system at the pre-symptomatic and symptomatic stages of the ALS disease

Duygu Aydemir, İbrahim Kulaç, Ayşe Nazlı Başak, Nuriye Nuray Ulusu

Koç University, Istanbul, Türkiye

Objective: ALS is the most common motor neuron disease. Despite incidence of the disease is increasing, there is no effective treatment against ALS and urgent therapeutic approaches are required for the treatment of people with ALS. Thus, we investigated oxidative stress metabolism and antioxidant capacity of the central nervous system at the pre-symptomatic and symptomatic stages of ALS.

Methods: SOD1G93A mutated albino male rats (n=90) were used for the experiments. Mitochondrial and cytosolic fractions of the brain and spinal cord were prepared and used for the experiments. H&E, OLIG2 and myelin staining were performed to evaluate histopathological experiments. Glucose-6 phosphate dehydrogenase (G6PD), 6-phosphoglucanate dehydrogenase (6-PGD), glutathione reductase (GR), glutathione-s transferase (GST), catalase (CAT), superoxide dismutase 1 (SOD1), isocitrate dehydrogenase 1,2,3 (IDH1,2,3) were evaluated in brain and spinal cord. Human mutant SOD1G93A protein aggregation was evaluated via western blot, where enzyme activity and ELISA was performed via spectrophotometer.

Results: Cytosolic and mitochondrial G6PD, 6-PGD, GR, GST, CAT, SOD1, IDH1, IDH2 and IDH3 enzyme activities were impaired in the SOD1G93A mutated rats compared to the wild type rats of each group in both spinal cord and brain. OLIG2 expression increased in the ALS rats, where histopathological alterations were observed in the SOD1G93A rats. Additionally, SOD1G93A protein aggregation were observed in the cytosol and mitochondria of both spinal cord and brain.

Conclusion: Oxidative stress metabolism and pentose phosphate pathway (PPP) have been impaired because of the accumulation of human mutant SOD1G93A protein accumulation. Impaired oxidative stress metabolism results in the histopathological changes in the spinal cord and brain tissues of ALS rats. Therefore, targeting oxidative stress metabolism and PPP can be a promising therapeutic target to cure people with ALS in the future.

Keywords: Oxidative stress, ALS, pentose phosphate pathway, pre-symptomatic, symptomatic

O-02

Investigation of mitochondrial dynamics during development in a valproic acid-induced autism model

Samed Özer, Efe Sarı, Metincan Erkaya, İlayda Darılmaz, Devrim Öz Arslan, Meltem Müftüoğlu, Güldal Süyen

Acıbadem Mehmet Ali Aydınlar University, Istanbul, Türkiye

Objective: The pathophysiology of autism, a neurodevelopmental disease whose prevalence has been increasing in recent years, has not been fully explained. Besides genetic factors, immune and mitochondrial disorders, inflammation, environmental toxins, some drugs used during pregnancy are thought to play a role in the pathogenesis of autism. Use of valproic acid (VPA), an antiepileptic drug, during pregnancy increases the incidence of autism. We aimed to examine cognitive/behavioral parameters and mitochondrial dynamics in cortical tissue and peripheral blood in VPA-induced autism model of rats.

Methods: On pregnancy day 12.5, pregnant Sprague-Dawley rats (n=10) were administered with a single dose of 600 mg/kg VPA dissolved in 1 mL/kg 0.9% NaCl (vehicle) intraperitoneally. Control group of rats were given vehicle. Animals (n=7) at postnatal day 21 (P21) were not differentiated according to sex, whereas both female and male (n=7/sex) animals were used in the P50 groups. Mitochondrial dynamics (mitochondrial mass, membrane potential, oxidative stress and mitochondrial genes) were determined by flow cytometry and real-time polymerase chain reaction in animals in the P21 and P50 groups, while a behavioral test battery was applied to the animals in the P50 group.

Results: An increase in anxiety, and locomotor activity, learning and memory, and social behavior detoriations were observed in female rats ($p<0.05$). VPA deregulated the genes associated with oxidative phosphorylation, mitophagy and mitochondrial fusion in the prefrontal cortex in both sexes, more pronouncedly in females ($p<0.05$). Mitochondrial mass, membrane potential and amount of reactive oxygen species were impaired in peripheral monocytes and lymphocytes in VPA group rats independent of sex ($p<0.05$).

Conclusion: While VPA exposure during pregnancy causes autism, the severity of autism and its effect on mitochondrial dynamics vary according to gender. The fact that no change was observed in mitochondrial dynamics on P21 but on P50 suggests that mitochondrial dynamics are impaired during the development of autism.

Keywords: Autism, valproic acid, mitochondrial dynamics, prefrontal cortex, rat

O-03

The effect of astrocyte-derived fatty acid-binding protein 7 on blood-brain barrier breakdown in LPS-induced sepsis in mice

Deniz Altunsu[1], Ecem Ayvaz[1], Arzu Temizyürek[2], Mehmet Kaya[3], Bülent Ahıshalı[4]

[1]Graduate School of Health Sciences, KUTTAM, Koç University, Istanbul, Türkiye; [2]Department of Physiology, School of Medicine, Altınbaş University, Istanbul, Türkiye; [3]Department of Physiology, School of Medicine, Koç University, Istanbul, Türkiye, [4]Department of Histology and Embryology, School of Medicine, Koç University, Istanbul, Türkiye

Objective: Sepsis is a life-threatening condition involving systemic abnormalities caused by exogenous factors including lipopolysaccharide (LPS) derived from pathogens and endogenous factors released by the host cells. Sepsis severely affects the function of various organs including brain in response to systemic inflammation. Barrier-type brain capillary endothelial cells play a vital role in maintaining neuronal homeostasis by regulating the trafficking of substances between blood circulation and brain parenchyma. Fatty acid-binding protein 7 (FABP7) involves in astrocytic differentiation and migration and supports vascular regeneration in the damaged brain. Moreover, it regulates the formation of caveolae, a specific lipid raft functioning in molecular transport across plasmalemma.

Methods: To investigate the effect of exogenous FABP7 administration on sepsis-induced BBB disruption, the control group was injected with % 0.9 saline (n=6) and the septic mice model was obtained by single dose LPS (n=6, 3 mg/kg). One hour later, these mice were treated with FABP7 at 40 or 80 µg/kg doses (n=6). As a BBB tracer, Alexa-fluor albumin 594 was injected at 23 h and allowed to circulate for one hour.

Results: LPS increased body temperature, whereas, in these animals, a high dose of FABP7 yielded a decrease from 41°C to 37 °C ($p<0.05$). LPS increased serum procalcitonin level which was decreased by 80 µg/kg FABP7 ($p<0.05$). Moreover, a significant increase in BBB permeability to the tracer was observed by LPS and 80 µg/kg FABP7 administration significantly reversed the BBB breakdown ($p<0.05$). In addition, LPS severely triggered anxiety-like behavior, which was significantly alleviated following 80 µg/kg FABP7 ($p<0.05$).

Conclusion: In conclusion, our data show that FABP7 administration may be used as a novel therapeutic approach in the treatment of sepsis-related BBB disruption.

Keywords: Blood Brain-Barrier, LPS, FABP7, inflammation

O-04

Reduced folate carrier 1 regulates blood-brain barrier integrity

Gökçe Gürler[1], Kadir Oğuzhan Soylu[1], Melike Sever-Bahçekapılı[1], Nevin Belder[2], Hülya Karataş-Kurşun[1], Radu Bolbos[3], Marlène Wiart[4], Fabien Chauveau[5], Müge Yemişci[1,6–8]

[1]Institute of Neurological Sciences and Psychiatry, Hacettepe University, Ankara, Türkiye; [2]Biotechnology Institute, Ankara Unversity, Ankara, Türkiye; [3]CERMEP-Imaging Platform, Groupement Hospitalier Est, Bron, France; [4]CarMeN Laboratory, INSERM, INRA, INSA Lyon, Univ. Lyon 1, Lyon, France; [5]Lyon Neuroscience Research Center, CNRS, INSERM, Univ. Lyon 1, Lyon, France; [6]Department of Neurology, Faculty of Medicine, Hacettepe University, Ankara, Türkiye; [7]Neuroscience and Neurotechnology Center of Excellence (NÖROM), Ankara, Türkiye; [8]Graduate School of Health Sciences, Hacettepe University, Ankara, Türkiye

Objective: Reduced Folate Carrier 1 (RFC1) protein is recently shown by our studies in cerebral endothelial cells and pericytes which constitute blood-brain barrier (BBB). Despite its potential role determined by a meta-analysis in silent brain infarctions, its role in the pathophysiology of ischemic stroke is overlooked. We aimed to explore whether RFC1 has other roles than transportation of folate in BBB in health and cerebral ischemia. Besides, by modifying RFC1 in vivo via a custom designed RFC1-Accell siRNA we aimed to evaluate BBB via magnetic resonance imaging (MRI).

Methods: We used adult Swiss albino mice, and microvessels were isolated from brain to immunohistochemically determine RFC1 protein and tight-junction protein occludin. Vessels were marked with Lectin. We administered RFC1-targeted-Accell-siRNA (50uM) intracortically (n=8). Intraluminal monofilament method was used to induce Middle Cerebral Artery occlusion (MCAo) for 90 minutes and recanalization for 1, 24 or 48-hours. We harvested brains for immunohistochemistry (n=3/time-point), Western blotting (n=3/time-point), microvessel isolation (n=3/time-point), and qRT-PCR (n=2). In vivo-MRI(Bruker Biospec 7T) was performed at the beginning (H0) and the end (H24) of the MCAo in groups receiving RFC1-siRNA or control-siRNA. Contrast agent Gadolinium was delivered via tail vein.

Results: RFC1 was determined to decrease via ischemia at the three time points by immunohistochemistry and Western Blottings ($p<0.05$). Additionally, isolated ischemic microvessels demonstrated dispersed RFC1 immunolabeling compared to controls. RFC1-targeted-siRNA decreased RFC1 mRNA to 30.4% after 48 hours (n=2, $p=0.021$), and diminished occludin immunolabeling in isolated cerebral microvessels. RFC1-siRNA treatment before ischemia enhanced BBB permeability in H24 ($p= 0.01$) evaluated by 7T-MRI.

Conclusion: Abundantly expressed in endothelial cells and pericytes, RFC1 protein has a role in cerebral ischemia/

recanalization. The increased BBB permeability during ischemic stroke with RFC1-siRNA, may refer that diminished levels of RFC1 may lead to hemorrhagic transformation of ischemic stroke or have a role in the pathophysiology of silent brain infarctions as it affects BBB.

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Keywords: RFC1, blood-brain barrier, ischemic stroke, middle cerebral artery occlusion

O-05

Bioactive drug delivery systems for neuroinflammation-related neural damage

Özgül Gök[1], Beyza Dönmüş[2], Ali Murad Özmen[3], İleyna Sevde Üvak[2], Elif Gülin Ertuğral Samgar[3]

[1]Department of Biomedical Engineering, Faculty of Engineering and Natural Sciences, Acıbadem Mehmet Ali Aydınlar University, Istanbul, Türkiye; [2]Biomedical Engineering Program, Graduate School of Natural and Applied Sciences, Acıbadem Mehmet Ali Aydınlar University, Istanbul, Türkiye; [3]Medical Engineering Program, Graduate School of Natural and Applied Sciences, Acıbadem Mehmet Ali Aydınlar University, Istanbul, Türkiye

Objective: In this study, polymeric hydrogels were prepared which contain peptides for reducing neuroinflammation and selectively triggering nerve cell adhesion. These peptides were immobilized to polymeric structures using different conjugation methods. Hydrogels are biocompatible and biodegradable polymeric scaffolds, and hydrogels containing bioactive molecules can also be used as effective and controlled drug release platforms by using properties such as adjustable physical strength, porosity, biodegradability and high water holding capacity.

Methods: General cell adhesion peptide RGD and the neuron-specific cell adhesion peptide IKVAV were conjugated to a hydrogel structure. Using thiol-in click chemistry, synthetic and hydrophilic PEG-based hydrogel structures reinforced with Poly (lactic acid) (PLA) (5–10–20% wt) and Hyaluronic acid (HA) (10–20–30% wt) polymers and its suitability for mechanical nerve cell attachment were evaluated. On the other hand, HA-MA with methacrylate functional groups was prepared at 3% w/v and gelled under UV (365 nm) with photoinitiator. The IKVAV peptide, with a methacrylic group via heterofunctional molecule, was also added.

Results: Hydrogels were chemically characterized by FT-IR Spectroscopy and mechanical properties using rheometer. SEM demonstrated that hydrogels have porous structure (30-40 µm). BCA assay and SEM-EDS detector were used for peptide quantitation and ~35% immobilization efficiency was calculated. Using LC-MS/MS, hydrogels were shown to release drug molecules encapsulated within a week slowly. in vitro studies demonstrated non-toxic behavior (>80% viability) of the hydrogels against mouse fibroblast cells. In addition, human brain cortical neuron cells were used on the surface of peptide and non-peptide hydrogels for ongoing cell adhesion studies.

Conclusion: Ibuprofen, for reducing neuroinflammation in nerve cell damage, was physically loaded with maximum loading efficiency of 90%, and shown to release in a controlled fashion for at least 1 week. These hydrogels were made selective to nerve cells by the addition of IKVAV.

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Keywords: Hydrogel, polymeric scaffold, drug release, peptide conjugation, nerve cell attachment

O-06

Dynamic changes of visual attention to food images in adolescents with anorexia nervosa: an eye-tracking study

Elif Akçay[1], Özgür Aydın[2], Özge Parlak Gözükara[1], Esra Çöp[3], Seda Beğli[1], Gülser Şenses Dinç[1], Demet Taş[4]

[1]Child and Adolescent Psychiatry, Ankara City Hospital, Ankara, Türkiye; [2]Department of Linguistics, Ankara University, Ankara, Türkiye; [3]Child and Adolescent Psychiatry, University of Health Sciences, Ankara, Türkiye; [4] Faculty of Medicine, Adolescent Medicine, Ankara Yıldırım Beyazıt University, Ankara, Türkiye

Objective: Anorexia nervosa (AN) is characterised by an intense fear of weight gain, restrictive eating, and self-starvation and is classified into restricting (R) and binge-eating/purging (BE/P) subtypes. Our study's primary aim was to determine the proportion of fixations to high-calorie food cues in adolescents with AN, both AN-R and AN-BE/P subtypes, and conduct a time-course analysis in the free exploration eye-tracking paradigm.

Methods: In total, 73 girls (11–17 years) were included in the study: 53 adolescents with AN (38 AN-R, 15 AN-BE/P), and 20 healthy adolescents. The adolescents viewed a series of high-calorie and low-calorie food and nonfood images. Each trial was presented for 8000 ms. Their eye movements were recorded using the SMI IViewX Hi-Speed eye-tracking system at a 500 Hz sampling rate. The eye-movement data preprocessing was done in R using the eyetrackingR package. The generalized additive mixed modelling (GAMM) was performed in R using the mgcv package for time-dependent analysis.

Results: Time-course GAMM analysis of the proportion of fixations on images of high-calorie foods determined that the attentional processing of the AN and control group (CG) differed (F=23.40, EDF=8.30, p<.001), especially in the early stages (0–2000 ms). Time-course analysis of the proportion of

fixations on high-calorie images showed that attentional processing of both AN-R (F= 66.07, EDF=8.80, p<.001) and AN-BE/P (F=26.08, EDF=8.39, p<.001) differed from the CG. The difference between the non-linear patterns of the AN-R and the AN- BE/P (F=66.41, EDF=8.80, p<.001) was more prominent at later attentional stages.

Conclusion: This study indicates that visual attention to high-calorie food cues in adolescents with AN, both restricting and binge-eating/purging subtypes varies over time. Moreover, our findings suggest that visual attention to high-calorie food cues was clearly different between the AN-R and the AN-BE/P.

Keywords: eye-tracking, visual attention, eating disorder, anorexia, adolescent

O-07

Stress and decision making under uncertainty: the role of higher cognitive processes, skin conductance response and personality traits

Selin Yılmaz[1], Hatice Kafadar[2]

[1]Adana Alparslan Türkeş Science and Technology University, Adana, Türkiye; [2]Bolu Abant İzzet Baysal University, Bolu, Türkiye

Objective: The main aim of this study was to probe mediating and moderating mechanisms identified in line with the predictions of Somatic Marker Hypothesis (SMH) and Dual Process Theory of the effect of acute stress on decision-making performance.

Methods: The sample group of the research comprised of 61 (31 female, 30 male) healthy university students aged between 18–23 ($\bar{x}$=21, SD=1.28). Data collection tools were Skin Conductance Response Measurement, Iowa Gambling Test, Wisconsin Card Sorting Test, Wechsler Memory Scale-III Spatial Span Subtest, Stroop Test TBAG Form, Wechsler Adult Intelligence- IV Matrix Reasoning Subtest, Stress Rating Scale, The State-Trait Anxiety Inventory, Big Five Personality Traits Scale, Ways of Coping Inventory, Beck Depression Inventory.

Results: With regard to mediator analysis results, the mediating effects of all variables, except inhibition were significant [χ^2 (45, n=61)=72.8, p>0.5; χ^2/df=1.21; RMSEA=0.06; CFI= 0.98]. As a result of the analysis, it was seen that especially the variables with the highest predictive power in the indirect effect of stress on decision making were set-shifting, analytical intelligence, working memory, and skin conductance response, respectively. In addition, moderated mediation analysis demonstrated that only neuroticism among the five different personality traits significantly predicted set-shifting (ß= 0.21, p≤.05). The interaction effect of stress and neuroticism significantly predicted set-shifting (β= -0.58, p<.001). [χ^2 (57, n=61) =78.72, p>0.5; χ^2/df=.996; RMSEA=0.000; CFI=1.00]. In other words, the protective effect of set-shifting skills on the effect of stress on decision making increases in the low neuroticism condition

Conclusion: The findings indicated that acute stress gives rise to decision making failures by supressing the SCR emphasized in SMH and higher cognitive processes defined in System 2. Furthermore, neuroticism had a moderating role in the relationship between stress and decision-making.

Keywords: somatic markers, system 2, set-shifting, analytical intelligence, neuroticism

O-08

A comparison of individuals whose capaticity of working memory is high and low from the perspective of WCST performance

Hatice Kafadar[1], Hasibe Arıcan Süren[1], Selin Yılmaz[2]

[1]Department of Experimental Psychology, Faculty of Arts and Sciences, Bolu Abant İzzet Baysal University, Bolu, Türkiye; [2]Department of Clinical Psychology, Faculty of Humanities and Social Sciences, Adana Alparslan Türkeş University, Adana, Türkiye

Objective: Working memory (WM) is considered a cognitive ability that encodes and processes information coming from the environment, enables the selection of appropriate behaviors, and also performs the storage of this information as long as necessary. This study aimed to compare individuals with low and high WC capacity from the perspective of WCST performance.

Methods: The participants consist of 157 people, including 89 women and 68 men. WM capacity was measured with the Wechsler Memory Scale-III Letter-Number Sequence Subtest. The participants were divided into two groups based on their results from this test: low and high working memory capacity. In addition, the Wisconsin Card Sorting Test (WCST) was administered to the participants.

Results: Independent groups t-test was applied to the data obtained from the participants. In addition, eta squared was calculated for bootstrap analysis and effect size. According to analysis there was a significant difference between high (mean: 13.38) and low (mean: 8.02) WM capacity individuals in Total Number of Responses (WCST 1) (t=3.48, p=.001, eta squared= .10), Total Number of Errors (WCST 2) (t=3.00, p=.003, eta squared=.08), Total Number of Correct (WCST 3) (t=2.71, p= .008, eta squared=.07), Total Number of Perseverative Responses (WCST 5) (t=3.12, p=.002, eta squared=.09), Total Number of Perseverative Errors (WCST 6) (t=3.15, p=.002, eta squared=.09), Total Number of Non-Perseverative Errors (WCST 7) (t=2.20, p=.03, eta squared=.04), Percentage of Perseverative Errors (WCST 8) (t=2.79, p=.006, eta squared= .07), Conceptual Level Responses (WCST 10) (t=2.25, p=.027,

eta squared=.05), Percent Conceptual Level Response (WCST 11) (t=-2.00, p=.048, eta squared=.04) scores.

Conclusion: The differentiation of the WCST scores of the participants according to the WC capacity revealed that the WM did not only process and store the information coming from the environment. This study reveals that especially individuals with high WM capacity perform better in high-level cognitive processes such as reasoning, problem solving, abstract thinking, set-shifting, and creating concepts.

Keywords: Working memory, problem solving, executive functions, abstract thinking, set-shifting

O-09

The effect of emotional auditory stimuli on visual memory and decision-making processes

Suat Merve Mavral[1], Simge Şişman Bal[2]

[1]Department of Psychology, Istanbul Kültür University, Istanbul, Türkiye; [2]Department of Psychology, Istanbul University, Istanbul, Türkiye

Objective: This study aims to investigate the effects of affective auditory stimuli (negative, positive, and neutral) on visual memory and decision-making processes.

Methods: Neutral human faces and emotional sounds were presented simultaneously to 65 university students (53 female, 12 male) aged between 18–27. Participants first rated the emotional valence of stimuli and then answered the decision-making questions under different instruction conditions. In the visual recognition memory task, participants reported 'Old-New' judgments for neutral face stimuli, participants also reported how confident they were in their answers. The study conducted 2 (instruction type: directive instruction, not-directive instruction) × 3 (emotional valence of auditory stimulus: positive, negative, neutral) factorial design. The instruction type variable was created as the between-group design and the emotional valence of auditory stimulus variable was created as the within-group design. The directive instructions were balanced and presented to participants who received the directive instruction as auditory-oriented and visual-oriented instructions. The emotion evaluation score and answers to the decision-making questions, the visual recognition memory task and confidence assessment scores, and the reaction times of all tasks were analyzed with 2×3 mixed-design ANOVA.

Results: The main effect of the emotional valence of the auditory stimulus was significant (p<.05) while the main effect of the instruction type was not significant (p>.05). There were also significant interaction effects on the emotion evaluation and decision-making performances and reaction time of the emotion evaluation performance (p<.05).

Conclusion: The findings showed that the emotion evaluation and decision-making scores were affected by the emotional valence of the auditory stimulus. The neutral face stimuli presented with the negative auditory stimuli can have a disruptive effect on visual recognition memory performance. The results indicated that when the information from one modality is unclear, emotional information from another modality can create a context effect and change perception and attention processes towards stimuli.

Keywords: Emotional auditory stimuli, neutral faces, visual memory, decision-making

O-10

Investigation of decision making strategy in obsessive-compulsive disorder patients using fNIRS

Adnan Kuşman[1], Aykut Eken[2], Bora Baskak[3]

[1]Department of Psychiatry, Bulanık State Hospital, Mus, Türkiye; [2]Department of Biomedical Engineering, TOBB University of Economics and Technology, Ankara, Türkiye; [3]Department of Psychiatry, Faculty of Medicine, Ankara University, Ankara, Türkiye

Objective: Obsessive compulsive disorder (OCD) is a heterogeneous disorder characterized by obsessions and compulsions and stated that caused by inability to control executive functions. In cognitive approach, obsession is characterized as cognitive deficits such as need for cognitive closure and reduction in cognitive flexibility. On the other hand, it has been suggested that this disability originates from the disorder in decision-making (DM) processes and these disorders may be an endophenotype. In this study, OCD patients were compared with healthy controls in terms of DM strategy and relationship between cortical activity pattern, cognitive functions and severity of obsessions were investigated.

Methods: Fifty subjects participated (25 OCD,25 HC). Demographic and clinical data were obtained by SDD form, Need for Cognitive Closure Scale(NCCS), Beck Anxiety Inventory(BAI), YBOCS, Stroop Test, and jumping-to-conclusion task (JTC task usual/ambiguous condition). During the JTC task reprised via computer, fronto-temporal cortical activity were measured via 52-channel fNIRS device.

Results: In OCDG, JTC task (normal, ambiguous) (p=0.04, p=0.001), NCC (p<0.001) and BAI (p<0.001) scores were higher. In fNIRS measurements, left-IFG activity was higher in OCDG (p=0.017). Right-MTG (p=0.03), right-PO (p=0.003), right-IFG (p=0.001) and left-IFG (p=0.05) activities increased in ambiguous condition. Only, group-condition interaction on left-IFG was significant (p=0.05). This significance was due to high activity in OCDG during the usual condition (p=0.018). Task duration differed significantly depending on group effect (p=0.001), condition effect (p<0.001) and group-condition interaction (p=0.015).This difference was due to length of DM time of OCDG (p=0.001). OCDG took longer time to make

decisions in ambiguous conditions (p=0.001). Hemodynamic, clinical, and demographic data relationships were examined in correlation analysis. Significant correlations were found between left-IFG and YBOCS in usual condition (r=0.5, p=0.006), right-MTG and BTI in usual condition (r=0.5, p=0.003), right-IFG and decision-making time in ambiguous condition (r=0.4, p=0.03).

Conclusion: The view that DM differ from everyday thoughts independently from the content is supported. The cortical activity pattern is consistent with this view. In addition, clinical and imaging data were found to be related to the severity of obsessions, but this relationship could not be demonstrated by demographic data.

Keywords: Obsession, jumping to conclusion bias, need for cognitive closure, fNIRS

O-11

Cognitive fatigue during paced auditory serial addition test: a preliminary FNIRS study

Fulya Tuzcu[1], Çağdaş Güdücü[2], Emre Eskicioğlu[2], Cem Şeref Bediz[3], Ersin Oğuz Koylu[1]

[1]Department of Physiology, Faculty of Medicine, Ege University, Izmir, Türkiye; [2]Department of Biophysics, Faculty of Medicine, Dokuz Eylül University, Izmir, Türkiye; [3]Kyrenia University Cyprus, Kyrenia, TRNC

Objective: Cognitive fatigue (CF) is defined as decreased performance at sustained attention task and used as a follow-up test for some of the neurological diseases. On the other hand, the assessment of CF mostly relies on self-reports, and it is a limitation to measure CF objectively. Functional Near Infrared Spectroscopy (fNIRS) shows prefrontal oxyhemoglobin levels altering by function. Paced Auditory Serial Addition Test (PASAT) is a commonly used cognitive test, known to cause cognitive fatigue. Our aim was to establish an objective CF measurement with fNIRS during PASAT.

Methods: In our study, seven (7) male volunteers between the ages of 16–22 performed the PASAT test between 09:00 and 12:00 in the presence of an observer. Prefrontal oxyhemoglobin levels were recorded by fNIRS during whole PASAT performance. In the first and last 30 seconds of the PASAT performance, oxyhemoglobin levels were analyzed with the matched T test, the change in correct response was analyzed with the nonparametric Wilcoxon Test, and the relationship between the two parameters was analyzed with the Spearman correlation test.

Results: Prefrontal cortex oxyhemoglobin levels of the last part of PASAT were found significantly higher than the first part (p<0.01). The correct answers at the last part of the PASAT were lower than the first part (p=0.05). Negative correlation was observed in the correlation analyzes of these two parameters, but it was not found to be statistically significant (r=-0.5, p>0.05).

Conclusion: In this preliminary study, high oxyhemoglobin levels by fNIRS measurement appear to be associated with an increase in false answers during PASAT. In future studies, the measurement of cognitive fatigue via fNIRS could be an objective method to evaluate or follow-up the cases with different cognitive levels.

Keywords: Cognitive fatigue, PASAT, fNIRS

O-12

The roles of the brain's intrinsic connectivity networks in the working memory process

Elif Kurt[1], Ali Bayram[1], Tamer Demiralp[2]

[1]Department of Neuroscience, Aziz Sancar Institute of Experimental Medicine, Istanbul University, Istanbul, Türkiye; [2]Neuroimaging Unit, Hulusi Behçet Life Sciences Research Laboratory, Istanbul University, Istanbul, Türkiye

Objective: In resting-state fMRI studies, spontaneous activity fluctuations in different brain parts were defined as "intrinsic connectivity networks" (ICNs). However, elucidating the roles of these networks during cognitive tasks requires extensive research. In this study, changes of ICNs during working memory (WM) performance were examined.

Methods: 28 healthy volunteers participated in the study. fMRI data were recorded during simple reaction time task (SRTT) and N-back task using 3T MRI scanner. While participants responded to all letters by pressing the button during SRTT, in 1-back, 2-back, and 3-back conditions of the N-back task, they pressed only when the letters were the same as one, two, and three previous ones. ICNs were obtained by independent component analysis. The regression of the ICN time-series with the experimental conditions was evaluated with general linear model, and differences of the obtained t-values between experimental conditions were compared using repeated-measures ANOVA in SPSS.

Results: Twelve ICNs showed significant differences between task conditions (p<0.003). The ventral attention network (VAN) showed significant difference between SRTT and 1-back; frontoparietal (FPN), lateral visual (VN), and lateral somatomotor (SMN) networks showed significant difference between 1-back and 2-back, and default-mode (DMN), limbic (LN), dorsal attention (DAN), and basal ganglia (BG) networks showed significant difference between both SRTT and 1-back, and 1-back and 2-back conditions (p<0.003).

Conclusion: The correlation pattern of WM with major ICNs has been revealed. The maximum variation of the VAN's intrinsic connectivity in the simple WM task reveals its

unavoidable importance in this cognitive function. The fact that DMN, LN, DAN and BG show an increasing variation in the presence of a simple WM task, but also with increasing task difficulty, points to the central role of these networks in WM. On the other hand, FPN, lateral VN and SMN changed their intrinsic connectivities in relation to cognitive load, independent of the cognitive domain's content.

Keywords: Functional magnetic resonance imaging, Intrinsic connectivity networks, Independent component analysis, Working memory, N-back task

O-13

The effect of ibuprofen treatment on TGF-ß1 in the formation of acute hypoxic ventilatory response

Hasan Salkın

Department of Medical Services and Techniques, Pathology Laboratory Techniques Program, Vocational School, Beykent University, Istanbul, Türkiye

Objective: Acute hypoxic ventilatory response (aHVR) is a rapid increase in ventilation (V) to the hypoxic stimulus. Nucleus tractus solitarius (NTS), one of the neural network regions that control breathing during short-term sustained hypoxia, end region of carotid sinus nerve synapses. Neuron activation in this area elicits aHVR. Besides neuron activation, pro-inflammatory factors also contribute to the formation of aHVR. TGF-β1 is a cytokine with anti-inflammatory properties. In this study, we hypothesized that neuron activation and TGF-1 expression in NTS play a role strong aHVR.

Methods: In this study, 3 months old 12 male Sprague Dawley rats were used. aHVR (10% O_2) was measured by whole body plethysmography (WBP) in the control (CON, n=6) and Ibuprofen (IBU, n=6) groups. After WBP measurement rats were perfused. Tissues were harvested from the medulla cross-section between the calamus scriptorius and the cervical spinal cord C1 segment. cFOS, for neuron activation, and TGF-β1, for inflammation relationship, primary antibodies were used on transverse sections of 20µ thickness by immunofluorescence staining. After imaging the NTS region with a confocal microscope, density analyzes were performed for each primary antibody. For comparisons between groups, 2-way ANOVA tests were used. $p<0.05$ was determined as statistical significance level.

Results: V was significantly increased in aHVR in the CON group compared to baseline ventilation before (p=0.0133) and after (p=0.0408) hypoxia. In the IBU group,V increased significantly in aHVR compared to baseline ventilation only after hypoxia (p=0.0398). Expression of cFOS in NTS was significantly decreased in the IBU group compared to the CON group (p=0.004). TGF-β1 expression was also significantly decreased in the IBU group compared to the CON group (p=0.003).

Conclusion: aHVR is a mechanism that requires both neuron activation and glial cell activation. Our findings suggest that pro-inflammatory factors may have an important role in addition to neuron activation required for increased ventilation in aHVR. The use of non-steroidal anti-inflammatory drugs such as ibuprofen for a potent ventilation response to acute hypoxia may have adverse effects in acute hypoxia-dependent clinical scenarios.

Keywords: Acute hypoxic ventilatory response, NTS, cFOS, TGF-β1, ibuprofen

O-14

Effect of COX-2 inhibition on long-term facilitation in rats exposed to acute intermittent hypoxia

Bengisu Arslantaş[1], Güzide Şatır Başaran[2]

[1]*Genome and Stem Cell Research Center, Erciyes University, Kayseri Türkiye;* [2]*Department of Biochemistry, Faculty of Pharmacy, Erciyes University, Kayseri ,Türkiye*

Objective: Acute intermittent hypoxia (AIH) causes long-term facilitation (LTF), known as a persistent increase in the amplitude of the ventilatory motor output response. LTF, requires motor neuron activation. furthermore, pro-inflammatory signal-induced glial cell activation has a role in LTF. In this study, it was hypothesized that COX-2 inhibition plays a role in ventilatory plasticity.

Methods: In our study, divided into 2 groups as control (CON) and ibuprofen (IBU), 6 adult male, 3-month-old Spraque Dawley rats were used in each group were exposed to AIH. During the protocol, subjects were exposed to AIH and ventilation(V) measured. After that, tissue perfusion was performed and 20µ thick transverse medulla oblongata sections were taken. cFOS was used to show neuron activation, and GFAP, Iba-1/CD11b primary antibodies were used to show glial cell activation by immunofluorescence staining. The nucleus tractus solitarius (NTS) region on the medulla oblongata was visualized with a confocal microscope and density analyzes were performed. 2-way ANOVA tests were used for group comparison. $p<0.05$ was determined as a statistical significance level.

Results: Baseline ventilation at 60th (666±35, p=0.0150) and 90th (658±35, p=0.0217) minutes after intermittent hypoxia increased significantly in CON group compared to baseline ventilation (549±16). There was no significant increase in IBU group. Expression of cFOS in NTS was significantly decreased in IBU group compared to CON group ($p<0.05$). There was no significant difference in expression of GFAP/Iba-1 and GFAP/CD11b in IBU group compared to CON group.

Conclusion: Although LTF requires neuron activation, pro-inflammatory signaling pathway-dependent glial cell activation

may also be required. Our data showed that ventilation was increased due to increased neuron activation in NTS. In addition, the absence of a significant increase in glial cell activation, but COX-2 inhibition causing depression in ventilation may result from this depression without and/or the initiation of glial cell activation. In conclusion, we think that COX-2 inhibition may block the LTF mechanism without glial cell activation after short-term intermittent hypoxia.

Keywords: Acute intermittent hypoxia, ventilatory long-term facilitation, NSAID, COX-2

O-15

Intracerebroventricular LGI1 antibody administration increase seizure severity and impair memory in rats

Şura Akat Pişkin[1], Hande Yüceer[2], Canan Ulusoy[2], Selen Soylu[2], Zerrin Karaaslan[2], Ece Erdağ Turgeon[2], Nihan Çarçak Yılmaz[1], Cem İsmail Küçükali[2], Filiz Onat[3], Erdem Tüzün[2]

[1]Department of Pharmacology, Faculty of Pharmacy, Istanbul University, Istanbul, Türkiye; [2]Department of Neuroscience, Aziz Sancar Institute of Experimental Medicine, Istanbul University, Istanbul, Türkiye; [3]Department of Medical Pharmacology, Faculty of Medicine, Marmara University, Istanbul, Türkiye

Objective: Anti-LGI1 encephalitis is a neuroimmunological syndrome associated with memory impairment and frequent seizures. In this study, it was aimed to clarify the role of LGI antibodies on epileptogenesis and cognitive performance in the passive transfer rat model.

Methods: IgG purified from the peripheral blood of anti-LGI encephalitis patients (n=10) and healthy controls (HC) (n=9), and serum physiologic (SF) (n=7) were intracerebroventricularly injected into non-epileptic Wistar rats on consecutive days. Behavioral assessments and EEG recordings were performed before and after IgG administration. A convulsive dose (45 mg/kg) of pentylenetetrazol (PTZ) was then intraperitoneally administered. Acutely induced epileptic discharges and seizure stages were evaluated and compared between groups.

Results: Motor seizure latency, first motor seizure duration, and latency for myoclonus were increased in LGI1 group. In addition, LGI1 antibody-given rats had significantly higher stage of seizures compared to HC and SF groups ($p<0.05$). Also, vertical activity in open field maze, spontaneous alternation in Y-maze, and discrimination index in novel object recognition test were significantly different in LGI1 group ($p<0.05$).

Conclusion: LGI1 antibodies appear to increase the susceptibility of seizures as well as disrupt memory functions. Here developed LGI1 antibody-mediated passive transfer autoimmune encephalitis rat model can be considered as a potential in-vivo model for anti-LGI1 encephalitis. Further work will elucidate the complex role of LGI1 antibodies in seizures and cognitive deficits observed in anti-LGI1 encephalitis.

Keywords: Autoimmune encephalitis, LGI1, autoantibodies, seizure, memory

O-16

Silencing [KCNS3] and [FCRLB] genes in the murine model of MuSK myasthenia gravis

Gizem Koral, Canan Aysel Ulusoy, Selen Soylu, Elif Şanlı, Erdem Tüzün, Vuslat Yılmaz

Department of Neuroscience, Aziz Sancar Institute of Experimental Medicine, Istanbul University, Istanbul, Türkiye

Objective: Myasthenia gravis (MG) is a prototypic-autoimmune-neuromuscular disease. Muscle-specific-kinase antibodies (MuSK-Abs) in MG reduce neuromuscular transmission by inhibiting MuSK phosphorylation and acetylcholine receptor (AChR) clustering. Our project aimed to determine the effect of silencing FCRLB (Fc Receptor-Like B) and KCNS3 (Potassium Voltage-Gated-Channel-Modifier Subfamily-S Member-3) genes using shRNA on the experimental autoimmune MuSK MG.

Methods: Mice were immunized with 45 µg/ml Ecto-MuSK (6–8 week old, female, 22 Balb/c) in Complete Freund's Adjuvant (CFA). For clinical progression, weight measurement, grip strength test, and clinical scoring were followed. After the second immunization, FCRLB-shRNA, KCNS3-shRNA, Scrambled-shRNA, or saline (as control) were injected intraperitoneally. At the end of the experiment serum, skeletal muscle, lymph nodes, and spleen were collected and stored under appropriate conditions. The total amount of anti-MuSK antibody in serum was measured by ELISA. RNA was isolated from splenocytes and expression of FCRLB and KCNS3 genes was validated by RT-qPCR. The muscle samples were labeled with immunofluorescent C3, IgG, and α-bungarotoxin. Immunophenotyping was performed by flow cytometry in the cells from lymph nodes.

Results: Disease severity was significantly higher in KCNS3-gene-silenced mice, compared to the MuSK-MG mice (saline-treated). In the FCRLB-shRNA group, significant amelioration was observed in mice. The amount of MuSK-IgG found in the serum was significantly less in the FCRLB-group ($p<0.0001$). C3 and IgG deposition at the neuromuscular junction were significantly lower in the FCRLB gene silenced group ($p<0.0001$). CD19+CD5+B1a cells were markedly lower in the FCRLB-group.

Conclusion: Silencing FCRLB (associated with autoantibody production) causes amelioration in the EAMG model, while the KCNS3 gene silencing worsens the disease. KCNS3, specifically expressed in muscle, may have functions related to muscle strength and the immune system. Silencing of the

FCRLB gene were lead to amelioration of the disease suggesting that it may be a novel treatment target.

Keywords: Myasthenia gravis, shRNA, FCRLB, KCNS3, autoimmune

O-17

Investigation of activation of the HSF1 (heat shock factor 1) complex in a kainic acid-induced cellular excitotoxicity model

Ayşenur Akkulak, Emre Yeşilören, Abdullah Yalçın, Gizem Dönmez Yalçın

Aydın Adnan Menderes University, Aydın, Türkiye

Objective: Excitotoxicity is the accumulation of excess glutamate in the synaptic space observed in neurodegenerative diseases. The heat shock pathway is activated in stressful situations. HSF1 is the main regulator of the heat shock pathway. Activation of the HSF1 complex occurs through the interaction of HSF1 and eEF1a proteins with HSR1 non-coding RNA. The three factors come together to form an RNA-protein complex. Our aim is to investigate whether the heat shock pathway, which is activated in all other stress situations, is activated in glia and neuronal cells in the case of kainic acid (KA)-induced excitotoxicity and its mechanism.

Methods: In IHA and SHSY-5Y cells, excitotoxicity was established with KA and measured by MTT and glutamate assay. HSF1 complex trimerization in these cells was observed by western blot technique. Protein levels of HSF1 and eEF1a constituting the HSF1 complex were determined by western blot and gene expression of HSR1 non-coding RNA by qPCR.

Results: As a result of MTT assay, cell death increased when KA was given to cells (p=0.028 for IHA, p=0.0016 for SHSY-5Y). In the CA group, on the other hand, glutamate secretion decreased, in accordance with MTT, due to cell death (p: 0.0169 (12 hours for IHA), p=0.035 (24 hours), p=0.0025 (48 hours); for SHSY-5Y= p=0.0425 (12 hours), p=0.0078 (24 hours), p=0.0038 (48 hours) Results are statistically significant according to T-test In SHSY-5Y cells, HSF1 monomer and oligomers are more expressed as a result of KA treatment. This is due to the increase in HSF1 protein expression rather than the difference in trimerization capacity.No change in HSF1 expression or trimerization was observed in IHA cells as a result of KA treatment.EEF1a protein (p=0.7316) and HSR1 non-coding RNA, which forms the HSF1 complex, were not observed in both cell lines. There was no statistically significant difference in the levels of KA treatment before and after CA treatment (p=0.139 for IHA, p=0.752 for SHSY-5Y).

Conclusion: Activation of the heat shock pathway and HSF1 also occurs during excitotoxicity, but only in neuronal cells. The elucidation of this mechanism will be very important in the development of drugs and treatments against neurodegenerative diseases.

Keywords: Excitotoxicity, glutamate, heat shock, kainic acid, neurodegeneration

O-18

Therapeutic efficacy of low-intensity pulsed ultrasound and withaferin A on diabetic neuropathy

Özlem Bozkurt Girit[1], Hatice Fulya Yılmaz[2], Gizem Dönmez Yalçın[3], Mehmet Dinçer Bilgin[1]

[1]Department of Biophysics, Faculty of Medicine, Aydın Adnan Menderes University, Aydın, Türkiye; [2]Department of Biophysics, Institute of Health Sciences, Aydın Adnan Menderes University, Aydın, Türkiye; [3]Department of Medical Biology, Faculty of Medicine, Aydın Adnan Menderes University, Aydın, Türkiye

Objective: Diabetic neuropathy (DN), a chronic complication of diabetes, leads to the progressive injury of neurons by axonal degeneration, generally in the lower extremities. This study was conducted to assess the therapeutic efficiencies of low-intensity low-frequency pulsed ultrasound and withaferin A (WA, a leptin sensitizer) on diabetic neuropathy.

Methods: 50 adult male Wistar rats were randomly divided into five groups as control, diabetic, WA (1.25 mg/kg) treated diabetic, and 1 MHz, 0.5 W/cm^2 and 1.5 W/cm^2 pulsed ultrasound treated diabetic groups. After the induction of diabetes by streptozotocin injection (50 mg/kg), the rats were maintained untreated for 4 weeks for the formation of DN. Then, treatments of low-intensity low-frequency pulsed ultrasound and WA were applied daily for 14 consecutive days. Alterations in nociceptive pain perception, nerve conduction and histopathology of sciatic nerves were assessed.

Results: Diabetes resulted in an increase in nociceptive latencies ($p<0.001$), compound muscle action potential durations and a decrease in sciatic nerve conduction velocities ($p<0.001$); which were restored upon treatments, especially in WA and 1.5 W/cm^2 ultrasound treated groups. Moreover, diabetes led to a decrease in microvessel lumen area and an increase in arteriolar wall thickness ($p<0.001$) together with a significant decrease ($p<0.001$) in the myelin thickness, axon and myelinated nerve fiber diameters; which were improved upon treatments, more prominently in 1.5 W/cm^2 ultrasound treated group ($p<0.001$). In addition, higher immunoreactivity of glial fibrillary acidic protein (GFAP), Iba-1 and S100β were observed in diabetic sciatic nerve sections, which were reduced upon treatments, especially in the 1.5 W/cm^2 ultrasound treated group ($p<0.001$).

Conclusion: The findings revealed that WA and 1 MHz 1.5 W/cm² pulsed ultrasound treatments exhibit a therapeutic potential in restoring diabetes-induced alterations and warrants further investigations.

Funding: This study was supported by the Scientific and Technological Research Council of Türkiye (TÜBİTAK) through a grant number 219S443.

Keywords: Diabetic peripheral neuropathy, ultrasound, withaferin A, myelination, nerve conduction

O-19

Effect of degeneration of nigro-striatal pathway on calretinin immunoreactivity in genetic absence epilepsy and non-epileptic rats

Özlem Kirazlı[1], Yekta Çulpan[2], Zehra Nur Turgan Aşık[2], Medine Gülçebi İdrizoğlu[2], Ümit Şehirli[1], Rezzan Gülhan[2], Filiz Onat[3]

[1]Department of Anatomy, School of Medicine, Marmara University, Istanbul, Türkiye; [2]Department of Pharmacology, School of Medicine, Marmara University, Istanbul, Türkiye; [3]Department of Pharmacology, School of Medicine,Acıbadem Mehmet Ali Aydınlar University, Istanbul, Türkiye

Objective: Calcium binding proteins have essential roles on neurogenesis and neuronal functions. One of the calcium binding proteins, calretinin (CR), is expressed in aspiny and GABAergic interneurons and forms synaptic connections between dopaminergic and glutamatergic cortico-striatal inputs. The number of striatal CR positive neurons has been shown to change following the degeneration of neurons in nigro-striatal dopaminergic pathway. Moreover there are clinical and experimental results showing the sensitivity of CR expressing interneurons to epilepsy. This study focused on the effect of nigrostriatal dopaminergic neuronal loss on calretinin positive neurons during the epileptogenesis in genetic rat model of absence epilepsy.

Methods: Stereotaxic surgery was used for injection of 6-hydroxydopamine (6-OHDA, 4mg/µl) to the medial forebrain bundle (AP=-1.4, ML=1.6, V=7.1) of 30-day old Wistar (n=5) or genetic absence epilepsy rats from Strasbourg (GAERS) (n=5) in order to degenerate nigrostriatal dopaminergic pathway whereas naive rats were used as control groups. The rat brain sections (40 µm) were immunohistochemically stained for CR. The number of the CR positive neurons in the striatum and substantia nigra (SN) were counted on the fluorescence staining sections. GraphPad Prism V6 was used for the analysis of the results.

Results: There was no difference in the number of calretinin positive neurons in striatum between 6-OHDA injected groups and their control groups. The number of calretinin positive neurons significantly decreased in SN pars compacta ($p<0.05$) and SN pars reticulata ($p<0.05$) in 6-OHDA injected Wistar rats and GAERS compared to their control groups.

Conclusion: Our results show that CR may have a protective role for the dopaminergic neurons against to degeneration of nigro-striatal pathway.

Keywords: GAERS, calretinin, nigrostriatal pathway

O-20

The effects of liraglutide on NLRP3 ınflammasome activation and cognitive-behavioral changes in the lithium-pilocarpine-induced temporal lobe epilepsy model in rats

Fatma Merve Antmen[1], Zeynep Fedaioğlu[2], Dilan Acar[1], Sevcan Demircan[3], Lala Rzyave[3], Farah Kardouh[3], Bengisu Karaköse[3], Ece Ada[3], İlayda Esma Yavuz[3], Ahmet Kerem Sayar[3], Simge Senay[4], Güldal Suyen[5], Devrim Öz Arslan[6]

[1]Department of Physiology, Institute of Health Sciences, Acıbadem Mehmet Ali Aydınlar University, Istanbul, Türkiye; [2]Department of Molecular Biology and Genetics, Faculty of Arts and Sciences, Acıbadem Mehmet Ali Aydınlar University, Istanbul, Türkiye; [3]School of Medicine, Acıbadem Mehmet Ali Aydınlar University, Istanbul, Türkiye; [4]Department of Medical Biotechnology, Institute of Health Sciences, Acıbadem Mehmet Ali Aydınlar University, Istanbul, Türkiye; [5]Department of Physiology, School of Medicine, Acıbadem Mehmet Ali Aydınlar University, Istanbul, Türkiye; [6]Department of Biophysics, School of Medicine, Acıbadem Mehmet Ali Aydınlar University, Istanbul, Türkiye

Objective: Glucagon-like peptide-1 receptor agonists (GLP-1RAs) have neuroprotective effects in several neurodegenerative diseases, however; their effects on epilepsy remain obscure. Our aim is to examine the effects of liraglutide (a GLP-1RA) on mitochondrial dynamics, inflammation, antioxidant pathways and cognitive-behavioral changes of epileptic animals.

Methods: Status epilepticus (SE) was induced by low-dose-repetitive-lithium chloride–pilocarpine hydrocholoride intraperitoneal injections. Epileptic and healthy control rats were treated with 0.9% saline (1 mg/kg/day) or liraglutide (300 g/kg/day) by intraperitoneal injections for three days. Seven rats of each group were sacrificed to examine alterations on mitochondrial dynamics, inflammation and antioxidant capacity following the three-days-treatment. Seven rats were subjected to cognitive-behavioral tests (open field, elevated plus maze, Morris water maze tests) three weeks after SE. Mitochondrial membrane potential and SOX levels were investigated in peripheral blood mononuclear cells by flow cytometry. Mitochondrial dynamics (Pink1, Mfn2), inflammation (NRLP3, Caspase-1) and antioxidant pathways related proteins (Nrf-2, phospho-Nrf-2) were examined on hippocampal tissues using western blot analysis. Malondialdehyde and glutathione levels were analyzed on hippocampal and whole brain tissues using spectrophotometric analysis. Anova and post-hoc analysis was used for normally distributed, Kruskal-

Wallis test and post-hoc analysis were done for non-parametric data.

Results: Pink1, Mfn2 and phopsho-Nrf2 levels increased (p=0.05, p=0.01, p=0.01), while NLRP3 and Caspase-1 levels decreased (p=0.01, p=0.01) in liraglutide-treated-epileptic rats. MitoSOX levels of monocyte population reduced (p=0.036), malondialdehyde decreased (p=0.03) and glutathione increased (p=0.0086) upon liraglutide treatment on hippocampus. Healthy-liraglutide-treated controls' locomotor activity and anxiety were increased (p=0.01, p=0.02). In epileptic rats liraglutide reduced (p=0.01) the movement-enhancing effect of epilepsy whereas it did not ameliorate anxiety. Epileptic rats or healthy controls' learning and memory capacity were not affected by liraglutide. This work is supported by Acıbadem University Scientific Research Projects Commission (Grant number: 2021/02/09).

Conclusion: Our study provides the first evidence that liraglutide treatment changed mitochondrial dynamics, antioxidant capacity of epileptic rats and had an impact on both healthy and epileptic rats' behavioral functions.

Keywords: Epilepsy, liraglutide, behavior, inflammation, mitochondrial dynamics

O-21

Effect of orexin-2 receptor agonist on spike-and-wave discharges of absence epilepsy rats

Aylin Toplu[1], Nursima Mutlu[2], Elif Tuğçe Erdeve[3], Özge Sarıyıldız[1], Nihan Çarçak[4], Zoltán Molnár[5], Filiz Onat[6]

[1]Department of Neuroscience, Health Sciences Institute, Acıbadem Mehmet Ali Aydınlar University, Istanbul, Türkiye; [2]Department of Molecular Biyotechnology and Genetic, Health Sciences Institute, Istanbul University, Istanbul, Türkiye; [3]Department of Pharmacology, Health Sciences Institute, Istanbul University, Istanbul, Türkiye; [4]Department of Pharmacology, School of Pharmacology, Istanbul University, Istanbul, Türkiye; [5]Department of Physiology, Anatomy and Genetics, University of Oxford, Oxford, UK; [6]Department of Medical Pharmacology, School of Medicine, Acıbadem Mehmet Ali Aydınlar University, Istanbul, Türkiye

Objective: Orexin, which is primarily made by neurons in the lateral hypothalamus, controls sleep and wake rhythms by binding to orexin-1 and orexin-2 receptors (1, 2). In layer-6b-cortical neurons of the rodent brain, orexin receptors are expressed, and some of these neurons have extensive intracortical and thalamic projections. YNT-185 as a non-peptide orexin type-2 receptor agonist, has been studied in a number of sleep-related research as a non-peptide orexin type-2 receptor agonist. In this study, we assessed the effect of bilateral injection to the ventro-basal nucleus of the thalamus (VB) of YNT-185 on spike-and-wave discharges (SWDs) of Genetic Absence Epilepsy Rats from Strasbourg (GAERS).

Methods: We stereotaxically inserted bilateral VB guide cannula (AP=-3.2, ML=4.8, DV=5.5 mm) and bilateral electroencephalography (EEG) recording electrodes on skull of male 200–350 g GAERS (n=11) under isoflurane anesthesia. After a one-week-recovery-period, 3-hour basal-EEG-recordings were obtain from animals. The following day, the doses of YNT-185 were given: 30 nmol/500nL (n=3), 40 nmol/500nL (n=5) or 60 nmol/500 nL (n=3). Before and after the injection, EEG signals were recorded with Powerlab-8S-EEG-recording-system and analyzed with LabChart-8.0 Windows program. One-way-Anova-test was used for statistical analysis ($p<0.05$ was considered significant).

Results: No significant effect found by the injection of different YNT-185 doses into the VB on the cumulative duration of SWDs when compared to baseline recordings of GAERS ($p< 0.05$).

Conclusions: Although the findings show that there is no significant effect by the VB injection of YNT-185 doses on the cumulative duration of SWDs compared to the baseline EEG recording in GAERS, our study aims to continue the study in the future by increasing the number due to the limited number of groups.

Keywords: Orexin, absence epilepsy, YNT-185, GAERS, EEG, thalamus

O-22

Interaction of tranexamic acid with gaba receptors in an experimental model of epilepsy

Ferda Serdoğan[1], Kemal Tolga Saraçoğlu[1], Uğur Aykın[2], Metehan Akça[3], Cumaali Demirtaş[2], Ayten Saraçoğlu[4], Tamer Kuzucuoğlu[1], Mehmet Yıldırım[2]

[1]Department of Anesthesiology and Intensive Care, University of Health Sciences, Kartal Dr. Lütfi Kırdar City Hospital, Istanbul, Türkiye; [2]Department of Physiology, University of Health Sciences, Hamidiye Medical School, Istanbul, Türkiye; [3]Department of Physiology, Medical School, Tokat Gaziosmanpaşa University, Tokat, Türkiye; [4]Department of Anesthesiology and Intensive Care, Medical School, Marmara University, Istanbul, Türkiye

Objective: Tranexamic acid (TXA) is an antifibrinolytic agent used to reduce blood loss. An increase in neuronal excitability and stimulating effects on seizure development have been reported after TXA use in clinical and experimental studies. Mechanisms by which TXA may lead to increase in neuronal excitability have not yet been fully elucidated. In the present study, it was aimed to investigate effect of TXA on neuronal excitability electrophysiologically using experimental epilepsy model. Firstly, dose-dependent effect of TXA and then its interaction with GABAA and GABAB receptor agonists and antagonists were investigated.

Methods: A total of 62 male Sprague-Dawley rats were used in the study, divided into 9 groups (SBU-HADYEK-2020-03/03). Animals anesthetized with urethane (1.25 g/kg) were placed in

stereotaxic apparatus and bone tissue on left cerebral cortex was removed by craniotomy. In order to initiate interictal-epileptiform activity, 500 IU penicillin was administered intracortically to 8 experimental groups, except for TXA injected only group. After initiation of interictal-epileptiform activity, physiological saline (control group), 50 µg TXA, 100 µg TXA, 200 µg TXA, 10 µg mucimol+200 µg TXA, 10 µg bicuculline+200 µg TXA, 10µg baclofen+200 µg TXA or 10 µg paclofen+200 µg TXA was administered intracerebroventricularly (i.c.v.). Only TXA group was injected with 200 µg TXA via i.c.v. Electrocorticogram recordings were taken from all animals for 120 min. Latency, spike frequency and amplitude data related to interictal-epileptiform activity were analyzed using Mann-Whitney-U test after Kruskal-Wallis.

Results: While initial latency of interictal-epileptiform activity was 167±32 sec in penicillin injected control group, it was detected that interictal-epileptiform activity started in 60±28 sec when 200 µg TXA was administered alone ($p<0.05$). It was established that spike frequency decreased significantly ($p<0.05$) when GABAB receptor agonist baclofen was administered before TXA, and increased when GABAB receptor antagonist paclofen was administered ($p<0.05$).

Conclusion: It was concluded that TXA causes interictal-epileptiform activity by increasing neuronal excitability with GABAA receptor blockade.

Funding: This study was supported by SBU-BAP (Project no: 2020/116).

Keywords: Tranexamic acid, experimental epilepsy, neuronal excitability, GABA

O-23

Interaction of clonazepam with second-line antiepileptic drugs in experimental status epilepticus

Cumaali Demirtaş[1], Metehan Akça[2], Uğur Aykın[1], Yunus Emre Sürmeneli[1], Hava Yıldırım[3], Mehmet Yıldırım[1]

[1]Department of Physiology, Hamidiye Medical School, University of Health Sciences, Istanbul, Türkiye; [2]Department of Physiology, Medical School, Tokat Gaziosmanpaşa University, Tokat, Türkiye; [3]Department of Medical Biology, Hamidiye Medical School, University of Health Sciences, Istanbul, Türkiye

Objective: Status epilepticus is a medical emergency that is characterized by recurrent seizures and can lead to mortality. In this study, it was aimed to investigate interactions of clonazepam (CLZ), one of most commonly used benzodiazepines in first-line treatment of status epilepticus, with levetiracetam (LEV), lacosamide (LCM), valproic acid (VPA) and fosphenytoin (fPHT), which are antiepileptic drugs used in second-line therapy. In this way, it is aimed to examine potential of combined use of antiepileptic drugs, which are recommended sequentially and gradually in status epilepticus treatment guidelines, as a polytherapy option.

Methods: Forty eight male Sprague-Dawley rats were divided into 6 groups (SBU-HADYEK 2020-03/15). Status epilepticus model was performed by injection of lithium CI (5 mEq/kg, s.c.) and pilocarpine HCl (320 mg/kg, i.p.) one week after EEG electrode (MS333/2A) was placed. CLZ (1 mg/kg) alone or in dual combinations with LEV (200 mg/kg), LCM (50 mg/kg), VPA (300 mg/kg) and fPHT (100 mg/kg) was applied intraperitoneally. Spike frequencies and amplitudes of status epilepticus were determined from video-EEG recordings obtained. Data were analyzed using Mann-Whitney U test after Kruskal Wallis analysis of variance.

Results: Mortality rate was found to be significantly lower in CLZ+LCM and CLZ+fPHT groups compared to status epilepticus group ($p<0.01$). It was appointed that decrease in mortality rate of CLZ+LCM and CLZ+fPHT groups was also significant compared to CLZ monotherapy ($p<0.05$). Spike frequency of epileptiform activity was found to be significantly decreased in all four combination groups ($p<0.01$). Spike amplitude was found to decrease only in combinations of CLZ+LCM and CLZ+VPA ($p<0.01$).

Conclusion: In the experimental status epilepticus, it was observed that CLZ applied alone could not provide enough seizure control. However, it was concluded that CLZ+LCM and CLZ+fPHT combinations are effective polytherapy options in preventing seizures and mortality related to status epilepticus.

Funding: This study was supported by SBU-BAP.Project no:2020/092.

Keywords: Status epilepticus, lithium-pilocarpine, clonazepam, antiepileptic drug

O-24

Irisin reduces oxidative brain damage and improves memory in acute epileptic seizure

Zarife Nigar Özdemir Kumral[1], Tuğçe Akgün[1], Ceren Haşim[2], Ezgi Ulusoy[2], Mehmet Kaan Kalpakçıoğlu[2], Muhammet Ferzan Yüksel[2], Tunahan Okumuş[2], Dilek Akakın[3], Meral Yüksel[4], Zeynep Us[5], Zafer Gören[5], Alper Yıldırım[1], Berrak Ç. Yeğen[1]

[1]Department of Physiology, Faculty of Medicine, Marmara University, Istanbul, Türkiye; [2]School of Medicine, Marmara University, Istanbul, Türkiye; [3]Department of Histology and Embriology, Faculty of Medicine, Marmara University, Istanbul, Türkiye; [4]Department of Medical Laboratory, Vocational School of Health-Related Professions, Marmara University, Istanbul, Türkiye; [5]Department of Pharmacology, Faculty of Medicine, Marmara University, Istanbul, Türkiye

Objective: Irisin, a myokine/adipokine found in cerebrospinal fluid and hypothalamus, is elevated following epileptic seizures in serum and brain, and exerts anti-inflammatory effects in neurodegenerative processes. We aimed to elucidate effects of exogenous application of irisin and acute exhausting exercise, which causes excessive muscle contraction similar to epileptic seizures associated with high levels of irisin release, on seizure-related oxidative brain damage.

Methods: Intracerebroventricular (icv) cannula was inserted under anesthesia to female Sprague Dawley rats (n=48). Following recovery, epilepsy was induced by intraperitoneal injection of pentylenetetrazole (PTZ, 45 mg/kg) after passive avoidance test (PAT), while saline was injected in control rats. Seizures were videotaped and assessed by Racine scoring. Before PTZ/saline injection, exercise groups completed a 10-min swimming session carrying a weight (8–10% of body weight); while other groups received icv (2 µl) injection of saline or irisin (7.5 µg) before PTZ/saline injection. At 24th hour of PTZ/saline injection, PAT was repeated, and rats were decapitated. Histopathological examination was performed in brain samples, and levels of glutamate and GABA, lipid peroxidation, antioxidant glutathione and catalase, and generation of luminol- or lucigenin-enhanced chemiluminescence were measured. Data were analyzed by one-way ANOVA.

Results: Irisin reduced average seizure score, and occurrence and duration of generalized tonic-clonic seizures ($p<0.05$). PTZ-induced memory dysfunction was improved by irisin treatment. Increased levels of lipid peroxidation, luminol, lucigenin, nitric oxide and decreased antioxidant glutathione and catalase levels ($p<0.05–0.01$) in brains of epileptic seizure-induced rats were reversed in exercised or irisin-treated groups ($p<0.05–0.01$). Decreased GABA levels following seizure were reversed by irisin ($p<0.01$), and elevated glutamate levels were depressed by exercise or irisin ($p<0.05–0.001$). On histological evaluation, neuronal degeneration due to PTZ was reduced in irisin-treated group.

Conclusion: Our results suggest that irisin reduces seizure severity by modulating neurotransmitter levels, and improves memory dysfunction by limiting oxidative damage and neuronal damage.

Keywords: Irisin, epilepsy, exhausting exercise

O-25

Relationship between distribution of peripheral blood cells and response to treatment in West syndrome

Selen Soylu[1], Minara Cherkezzade[2], Ece Akbayır[1], Hande Yüceer[1], Gizem Koral[1], Elif Şanlı[1], Pınar Topaloğlu[2], Vuslat Yılmaz[1], Erdem Tüzün[1], Cem İsmail Küçükali[1]

[1]Department of Neuroscience, Aziz Sancar Research Institute of Experimental Medicine, Istanbul University, Istanbul, Türkiye; [2]Department of Child Neurology, Istanbul Faculty of Medicine, Istanbul University, Istanbul, Türkiye

Objective: West Syndrome (WS) is an epileptic encephalopathy that typically occurs in infants and is characterized by hypsarrhythmia, infantile spasms, and neurodevelopmental impairment. Demonstration of autoantibodies and cytokines in some WS patients and favorable response to immunotherapy have implicated inflammation as a putative trigger of epileptiform activity in WS. Our aim was to provide additional support for altered inflammatory responses in WS through peripheral blood immunophenotype analysis.

Methods: Eight WS cases treated with synacthen and 11 age- and sex-matched healthy volunteers were included. Peripheral blood mononuclear cells (PBMC) were isolated and immunophenotyping was performed in pre-treatment baseline (8 patients) and 3 months post-treatment (6 patients) samples. The analysis included PBMC expressing NFκB transcription and NLRP3 inflammasome factors.

Results: In pre-treatment baseline samples, switched memory B cells (CD19+IgD-CD27+) were significantly reduced, whereas plasma cells (CD19+CD38+CD138+), plasmablasts (CD19+CD38+CD138-) and cytotoxic T cells (CD3+CD8+) were increased. WS patients also showed trends towards displaying higher frequencies of NFkB/NLRP3 expressing NKT cells. Regulatory T and B cells were not significantly altered. Synacthen treatment reduced helper and cytotoxic T cell subsets and increased memory B cell and monocyte subsets.

Conclusion: Our findings lend further support for the involvement of inflammation-related mechanisms in WS. New-onset WS patients are inclined to display increased effector B and T cell subsets in the peripheral blood. Synacthen treatment appears to dampen effector T cell subsets without showing a positive effect on B cell and innate immunity subsets.

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Keywords: West syndrome, epileptic encephalopathy, infantile spasm, immunophenotyping, synacthen

O-26

Evaluation of epileptogenic and behavioral features in a rat model of anti-NMDA receptor encephalitis

Şura Akat Pişkin[1], Hande Yüceer[2], Canan Aysel Ulusoy[2], Cem İsmail Küçükali[2], Filiz Onat[3], Erdem Tüzün[2], Nihan Çarçak Yılmaz[1]

[1]Department of Pharmacology, Faculty of Pharmacy, Istanbul University, Istanbul, Türkiye; [2]Deparment of Neuroscience, Istanbul University Aziz Sancar Institute of Experimental Medicine, Istanbul, Türkiye; [3]Department of Medical Pharmacology, Faculty of Medicine, Acıbadem Mehmet Ali Aydınlar University, Istanbul, Türkiye

Objective: Anti-N-methyl-D-aspartate receptor (NMDAR) encephalitis manifests with cognitive decline, abnormal motor movements, and seizures that can be resistant to anti-seizure medications. The pathophysiological mechanisms responsible for

the development of these findings have not been established. Here, we aimed to evaluate epileptogenesis and behavioral disorders in in-vivo model based on intacerebroventricular transfer of patient-derived NMDAR-positive immunoglobulins (IgGs) collected from the blood serum to non-epileptic Wistar rats.

Methods: Total IgG (2 mg/ml) from NMDAR-antibody positive patients and control serum obtained from healthy subjects were administered into the lateral ventricle of adult rats in a volume of 5 µl for 11 days. Animals were examined for spontaneous epileptic seizure development by continuous electroencephalography recordings. Besides, Y-Maze, Open-field and Rota-Rod behavioral tests were applied before and after antibody administration. At the end of the behavioral tests, pentylenetetrazole (PTZ) was administered at a convulsive dose (45 mg/kg) in order to detect changes in seizure threshold and seizures were staged with the Racine scale. At the end changes in NMDAR expression in the hippocampus were evaluated immunohistochemically.

Results: No spontaneous seizure was observed in animals during NMDAR-antibody infusions. However, PTZ-induced acute seizure stage, motor seizure latency, motor seizure duration and myoclonus latency were higher in the NMDAR-antibody group compared to the control ($p<0.05$). The horizontal and vertical activity in the open field test, as well as the percentage of spontaneous alternation and the total number of entries in the Y-maze were significantly reduced by NMDAR-antibody application ($p<0.05$). Human IgG staining pattern was detected in the hippocampal sections obtained from the NMDAR-antibody group, and decreased NMDAR expression is noteworthy.

Conclusion: Our findings indicates patient-derived autoantibodies transferred to experimental animals may lower seizure threshold as well as impair motor performance and memory functions in anti-NMDAR encephalitis and offer potential in-vivo model for testing novel therapies for refractory autoimmune seizures.

Keywords: Autoimmune encephalitis, NMDAR antibody, autoimmune epileptic seizure, PTZ, animal model

O-27

The role of ontogeny on the structure of the somatosensory map in the brain

Evrim Gülbetekin[1], Hilmi Uysal[2], Hatice Gül[3], Ayhan Şavklıyıldız[4]

[1]Department of Psychology, Faculty of Letters, Akdeniz University, Antalya, Türkiye; [2]Department of Neurology, Faculty of Medicine, Akdeniz University, Antalya, Türkiye; [3]Department of Therapy and Rehabilitation, Vocational School of Health Services, Akdeniz University, Antalya, Türkiye; [4]Department of Electrical and Electronics Engineering, Faculty of Engineering, Akdeniz University, Antalya, Türkiye

Objective: To examine the role of ontogeny in the representation of the body in the somatosensory cortex.

Methods: Participants consisted of 18 healthy undergraduate students and two phocomelia swimmers who were born without arms. We expected that stimulation of face and shoulder would lead to similar responses while stimulation of face and foot would lead to different responses in the controls. However, the organization of somatosensory homunculus would be different in phocomelia. Tactile stimulation was applied to face, shoulder, and foot. Electrophysiological responses were recorded with 32 channel EEG system. Delta and sub-delta values were analyzed.

Results: The power values (PV) in the electrodes C4, CZ, FC1 which correspond to somatosensory areas were analyzed. Left stimulation values were included. The values between different regions were compared with paired t-tests. The values in CZ were significantly different during the lip and foot stimulation $t(17)=-2.103$, $p=.05$ while the difference between shoulder and lip and shoulder and foot stimulation was not significant $p>.05$.In C4, the power during lip stimulation was different than that of foot $t(17)=-2.11$, $p=.05$ and shoulder $t(17)=2.24$, $p=.039$. In FC1, the power for lip and foot stimulation was significantly different $t(17)=2.78$, $p=.01$, while lip and shoulder stimulation was marginally different $t(17)=1.98$, $p=.06$. The rank of mean PV in controls was consistent with the homunculus: face (CZ=.19; C4=.14; FC1=.14), shoulder (CZ=.27; C4=.25; FC1=.27), foot(CZ=.32; C4=.22; FC1=.30).The values of swimmer1: face (CZ=.51; C4=.02; FC1=.06), shoulder (CZ=1.03; C4=.39; FC1=.62) and foot (CZ=.27; C4=.52; FC1=1.05).The values of swimmer2: face (CZ=.51; C4=.41; FC1=.06), shoulder (CZ=.49; C4=.32; FC1=.27) and foot (CZ=1.03; C4=.92; FC1=1.26).The rank of power values of swimmer1 was foot, face and shoulder respectively for CZ while it was face, shoulder, foot for C4 and FC1. The rank of PV of swimmer2 was shoulder, face and foot respectively in CZ and C4. However, it was face, shoulder and foot for FC1.

Conclusion: The results indicated that somatosensory organization was different in phocomelia.

Keywords: Somatosensory cortex, homunculus, phocomelia, tactile stimulation, EEG

O-28

Relationship of APOE polymorphism with cognitive impairment pattern and cortical atrophy in Alzheimer's disease

Hansa Şentürk[1], Miray Budak[2,3], Farzin Hajebrahimi[2,4], Zubeyir Bayraktaroğlu[2,5], Lütfü Hanoğlu[2,6]

[1]Department of Neuroscience, Institute of Health Sciences, Master Program, Istanbul Medipol University, Istanbul, Türkiye; [2]Health Sciences and Technologies Research Institute (SABITA), Regenerative and Restorative Medicine Research Center (REMER), Functional Imaging and Cognitive Affective Neuroscience Laboratory (fINCAN), Istanbul Medipol University, Istanbul, Türkiye; [3]Department of Ergotherapy, School of Health Sciences, Istanbul Medipol University, Istanbul, Türkiye; [4]Department of Physiotherapy and Rehabilitation, School of Health Sciences, Istanbul Medipol University, Istanbul, Türkiye; [5]Department of Physiology, School of Medicine, Istanbul Medipol University, Istanbul, Türkiye; [6]Department of Neurology, School of Medicine, Istanbul Medipol University, Istanbul, Türkiye

Objective: The APOE 4 allele has an importance in the pathogenesis of Alzheimer's Disease (AD), and it is known that those carrying this allele have an increased risk of developing the disease. However, it is known that those who do not carry the APOE 4 allele also get the disease. The purpose of this study was to investigate the effect of the presence of the APOE 4 allele on cognitive functions and cortical atrophy in AD.

Methods: Thirty-four patients who got clinical AD diagnosis according to the National Institute of Neurological and Communicative Diseases and Stroke/Alzheimer's Disease and Related Disorders Association (NINCDS-ADRDA) criteria and The Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-V), were 50 years and older, using Acetylcholinesterase Inhibitors and Memantine, had the APOE gene test, blood biochemistry values, and structural magnetic resonance imaging (MRI) images were included in the study. According to the presence of APOE ε4, individuals were divided into two groups, APOE ε4 (+) Group (n=17) and APOE ε4 (-) Group (n=17). Demographic data, blood biochemistry values, neuropsychological profiles and cranial brain images of individuals were collected and analyzed retrospectively. Volumetric analysis (cortical volume and thickness) was estimated using the openware, Freesurfer (http://surfer.nmr.mgh.harvard.edu/). The general linear model (GLM) was used to compare the differences in gray matter volume by voxel between groups. IBM SPSS (Statistical Package for Social Science) 25.0 for Windows was used for statistical analysis. The nominal data of the independent variables were analyzed with the chi-square test, and the numerical data of the independent variables were analyzed with the Independent Sample t-test. The significance value for all analysis was accepted as $p<0.05$.

Results: The groups were homogeneous in terms of age, education level, gender and blood biochemistry values ($p>0.05$). When neuropsychometry profiles were compared, Mini Mental State Examination [$t(32)=-2.37$, $p=0.024$], Verbal Memory Processes Test spontaneous retrieval [$t(34)=-2.29$, $p=0.028$], and Boston Naming Test [$t(31)=-2.20$, $p=0.035$] were found to be significantly worse in the APOE (+) Group ($p<0.05$). In the volumetric analysis, the right hemisphere cortical volume [$t(22)=-2.19$, $p=0.039$] of the APOE (-) Group was found to be significantly larger than the APOE (+) Group ($p<0.05$).

Conclusion: Presence of APOE ε4 allele in AD may be associated with worse performance in episodic memory, naming and general cognitive pattern, and more pronounced cortical atrophy in the right hemisphere.

Keywords: Alzheimer's disease, APOE ε4 polymorphism, neuropsychological profile, cortical atrophy

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The relationship of resting-state functional connectivity associated with prospective memory to CSF amyloid levels in the pre-dementia Alzheimer's disease continuum

Gülcan Öztürk[1], Emre Harı[1], Ali Bayram[1], Tamer Demiralp[2], İbrahim Hakan Gürvit[3]

[1]Department of Neuroscience, Istanbul University Aziz Sancar Institute of Experimental Medicine, Istanbul, Türkiye; [2]Neuroscience Unit, Istanbul University Hulusi Behçet Life Sciences Research Laboratory, Istanbul, Türkiye; [3]Department of Neurology, Behavioral Neurology and Movement Disorders Unit, Faculty of Medicine, Istanbul University, Istanbul, Türkiye

Objective: It was aimed to examine the relationship between resting state functional connectivity (rsFC) and CSF amyloid-beta42 ($A\beta_{42}$) levels related to prospective memory skills in people with pre-dementia Alzheimer's disease continuum. Low CSF $A\beta_{42}$ level is associated with amyloid deposition in the brain and is suggested as an early biomarker of Alzheimer's disease.

Methods: Sixty subjects with pre-dementia Alzheimer's disease continuum participated in the study. The Memory for Intentions Screening Test (MIST, Raskin 2009) was used to assess prospective memory. fMRI was used to obtain connectivity data. Using the participants' MIST total prospective memory scores as a regressor, rsFC was analyzed with Network Based Statistics (NBS). After the analysis, clustering was carried out with K-Means technique for 60 participants by using the inter-seed connectivity which was found to be significant. The resulting groups were compared in terms of connectivity values, prospective memory and other neuropsychological evaluation scores, CSF $A\beta_{42}$ levels. The relationship between connectivity values and CSF $A\beta_{42}$ levels was examined by correlation analysis. Data from a total of 22 participants were used in the analysis of CSF data.

Results: In the between group comparison, the high connectivity group performed better on prospective memory and some neuropsychological measures. Besides, the high connectivity group had a higher education level ($t=2.177$, $p=0.03$) and a lower mean $A\beta_{42}$ value ($t=-2.864$, $p=0.01$), that is, this group had more amyloid accumulation in the brain. A negative correlation was observed between $A\beta_{42}$ levels and connectivity values ($r=-0.541$, $p=0.009$), that is, connectivity increases as amyloid accumulation increases.

Conclusion: The fact that amyloid deposition was higher in the high connectivity group and cognitive performance and education level of this group were higher suggest a compensatory mechanism against the deteriorating effect of amyloid deposition. Another explanation is that amyloid deposition may occur as a result of high neural activity or connectivity. In both cases, reporting of subjective cognitive decline reveals a hidden

risk of progression to dementia, although higher connectivity and accompanying better cognition are demonstrated cross-sectionally.

Keywords: Alzheimer's disease, prospective memory, resting state functional connectivity, CSF amyloid

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Comparison of Alzheimer's dementia and healthy classification algorithms based on MRI data

Mesut Canlı[1], Onurhan Karatay[1], Ali Bayram[2], Tamer Demiralp[1]

[1]Department of Physiology, Istanbul Faculty of Medicine, Istanbul University, Istanbul, Türkiye; [2]Department of Neuroscience, Aziz Sancar Institute of Experimental Medicine, Istanbul University, Istanbul, Türkiye

Objective: Dementia is a neurological condition including cognitive impairment, psychiatric and behavioral symptoms. Alzheimer's disease (AD) is the most common cause of dementia. Current diagnosis of the disease bases on neuropsychological test (NPT) scores and detailed history taken from the patient and his relatives. However, an approach solely based on empirically specified cut-off points for NPT scores is not sufficiently objective. For this reason, more objective diagnostic methods with help of computer-aided diagnosis systems are being studied. We examined the performance of different machine classification methods on T1-weighted structural magnetic resonance imaging (MRI) data of demented AD patients (ADD) and healthy individuals.

Methods: MRI and clinical data were taken from the OASIS-2 (https://www.oasis-brains.org) database. T1 images of 30 ADD patients and 34 healthy control subjects aged between 60–96 were included in the analysis. Total gray matter, white matter, cerebrospinal fluid (CSF) and intracranial volumes of individuals were computed by using CAT 12 (Computational Anatomy Toolbox, https://neuro-jena.github.io/cat/) software. These data and the gender, age, total years of education and mini-mental state examination (MMSE) scores of the individuals were supplied to the classification algorithms as feature set. Naive Bayes, support vector machine and multilayer perceptron classifiers included in WEKA (https://www.cs.waikato.ac.nz/~ml/weka/) software package were tested. Total data set is divided into 70% training and 30% test subsets.

Results: The success rates of the algorithms in the test data sets were found to be 94.73% for Naive Bayes, 84.21% for the support vector machine and 84.21% for the multilayer perceptron, respectively.

Conclusion: Although acceptable success was achieved with all 3 machine learning methods applied on the data set including the total gray and white matter, CSF and intracranial volumes, the highest success rate was achieved with Naive Bayes Classifier.

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Keywords: Dementia, machine learning, classification, MRI

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Seed-based functional connectivity alterations in Parkinson's disease

Ani Kıçik[1], Ali Bayram[2], Emel Erdoğdu[3], Elif Kurt[2], Esin Öztürk Işık[4], Hakan Gürvit[5], Tamer Demiralp[6]

[1]Department of Physiology, Faculty of Medicine, Demiroğlu Bilim University, Istanbul, Türkiye; [2]Department of Neuroscience, Aziz Sancar Institute of Experimental Medicine, Istanbul University, Istanbul, Türkiye; [3]Department of Psychology, Faculty of Arts and Sciences, Işık University, Istanbul, Türkiye; [4]Institute of Biomedical Engineering, Boğaziçi University, Istanbul, Türkiye; [5]Department of Neurology, Istanbul Faculty of Medicine, Behavioral Neurology and Movement Disorders Unit, Istanbul University, Istanbul, Türkiye; [6]Department of Physiology, Istanbul Faculty of Medicine, Istanbul University, Istanbul, Türkiye

Objective: Parkinson's disease (PD) is a neurodegenerative disease characterized by clinical motor symptoms. In addition to motor symptoms, cognitive impairment is one of the most common non-motor symptom observed in PD. In this study, functional connectivity (FC) changes in PD were investigated by performing a seed-based analysis using resting-state functional magnetic resonance imaging (rs-fMRI) data to identify neuroimaging patterns related to motor and cognitive impairment in PD.

Methods: 55 PD patients diagnosed with PD according to the UK Brain Bank Diagnostic Criteria and 24 healthy controls (HC) matched for age, education, and gender were included in the study. Resting-state fMRI was acquired on a 3T MR (Phillips, Achieva, The Netherlands) at Istanbul Medical Faculty. To evaluate motor and executive, visuospatial cognitive functions of PD patients, UPDRS-III, Stroop, and Benton Judgment of Line Orientation tests were used, respectively. Seed-based FB analysis was performed using the CONN toolbox. Network-Based Statistics (NBS) method was carried out using the AAL3 atlas including 112 seeds to compare HC with the PH and with the PH sub-groups classified in terms of motor and cognitive performances.

Results: Compared to the HC, the PD group showed decreased FC in the 78 connections and 21 cortical regions including mostly the sensorimotor and visual areas ($p<0.05$, FWE-corrected). Compared to the HC, the PD sub-group with low motor performance showed decreased FC in the 22 connections ($p<0.05$, FWE-corrected); the PD sub-group with low visuospatial performance showed decreased FC in the 38 connections ($p<0.05$, FWE-corrected).

Conclusion: In our study, a significant decrease in FC was detected between the sensorimotor and the visual network,

indicating impaired visual-motor integration in PD. Furthermore, our results showed that FC alterations between the sensorimotor and visual regions increase associated with visuospatial cognitive impairment in PD.

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Keywords: Parkinson's disease, functional connectivity, seed-based analysis, cognitive impairment

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Evaluation of cognitive impairment in the Parkinson's disease with fALFF in resting state fMRI

Onurhan Karatay[1], Mesut Canlı[1], Ani Kıçik[2], Emel Erdoğdu[3], Ali Bayram[4], Esin Öztürk Işık[5], İbrahim Hakan Gürvit[6], Tamer Demiralp[1]

[1]Department of Physiology, Istanbul Faculty of Medicine, Istanbul University, Istanbul, Türkiye; [2]Department of Physiology, Faculty of Medicine, Demiroğlu Bilim University, Istanbul, Türkiye; [3]Department of Psychology, Faculty of Arts and Sciences, Işık University, Istanbul, Türkiye; [4]Department of Neuroscience, Aziz Sancar Institute of Experimental Medicine, Istanbul University, Istanbul, Türkiye; [5]Institute of Biomedical Engineering, Boğaziçi University, Istanbul, Türkiye; [6]Department of Neurology, Istanbul Faculty of Medicine,Behavioral Neurology and Movement Disorders Unit, Istanbul University, Istanbul, Türkiye

Objective: Parkinson's disease (PD) is a progressive neurodegenerative disease, which is characterized by severe motor symptoms such as bradykinesia, tremor, and rigidity. Degeneration is characterized by progressive loss of dopaminergic neurons in the substantia nigra. Mild Cognitive Impairment (PD-MCI), emerges as one of the major risk factors for PD Dementia (PDD). Revealing the markers associated with cognitive impairment with neuroimaging may play a critical role in the early diagnosis of the disease and early treatment.

Methods: 28 PD Patients with Mild Cognitive Impairment (PD-MCI) and 27 cognitively normal PD patients (PD-CN) who were statistically similar in terms of mean education years, age, and gender were included. Functional magnetic resonance imaging (fMRI) data were collected with a 3T MRI (Phillips, Achieva, The Netherlands). Fractional amplitudes of low-frequency fluctuations (fALFF) of resting-state blood-oxygen-level-dependent (BOLD) signal were calculated at the voxel level. after preprocessing steps with CONN (https://web.conn-toolbox.org/) software. Clusters with significant differences in fALFF values between the groups were calculated using the general linear model with a statistical threshold of puncorr<0.001 at the voxel level and pFDR <0.05 corrected at the cluster level. Clusters with 100 or more voxels were evaluated.

Results: In the PD-MCI group, fALFF values were found to be significantly lower in the temporal pole and insular cortex in the left hemisphere and in the insular cortex in the right hemisphere, when compared to the PD-CN group.

Conclusion: In the PD-MCI group, compared to the PD-CN group, reduction of the D2 receptor availability in the bilateral insula was previously demonstrated by Positron Emission Tomography (PET). This finding in PET, which requires the use of radioactive agents, has not yet been demonstrated in fMRI. In this study, fALFF decreases, observed in bilateral insula, highlight the importance of insular circuits in cognitive impairment in PD, and also sheds light on the neurochemical mechanisms of BOLD signal.

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Keywords: Parkinson's disease, mild cognitive impairment, fALFF, functional MRI

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Effects of transcranial direct current stimulation on resting state connectivity in mesial temporal lobe epilepsy

Zeynep Küçük[1], Kardelen Eryürek[2], Ali Bayram[2], Görkem Şirin[3], Betül Baykan[3], Sacit Karamürsel[4], Tamer Demiralp[5]

[1]Department of Psychology, Faculty of Science and Literature, Haliç University, Istanbul, Türkiye; [2]Department of Neuroscience, Aziz Sancar Institue of Experimental Medicine, Istanbul University, Istanbul, Türkiye; [3]Department of Neurology, Istanbul Faculty of Medicine, Istanbul University, Istanbul, Türkiye; [4]Koç University, School of Medicine, Department of Physiology, Istanbul, Türkiye; [5]Department of Physiology, Istanbul Faculty of Medicine, Istanbul University, Istanbul, Türkiye

Objective: Transcranial direct current stimulation (tDCS) is a non-invasive neuromodulation technique that has been used to control seizures in focal epilepsy, but its neural mechanism is unknown. Mesial Temporal Lobe Epilepsy (MTLE) characterized with seizures stemming from the temporal lobes is also associated with hippocampal sclerosis. Resting state network (RSN) studies based on functional magnetic resonance imaging (fMRI) data showed that the functional connectivity (FC) affected in MTLE is not limited to the seizure focus zone. The aim of this study is to explore the effect of tDCS on resting state networks (RSN) in patients diagnosed as left MTLE.

Methods: 17 drug resistant unoperated patients with left MTLE and 16 healthy controls were included in this study. Reting-state fMRI recordings were performed before and after cathodal (c)tDCS session. Seed-to-voxel functional connectivity (FC) analyses were performed using 49 seeds. Bonferroni correction for number of seeds was applied on FWE corrected p-value, pFWE <0.001 (0.05/49). 20-min ctDCS targeting the left temporal region (T3) was applied to participants.

Results: Increased FC following of ctDCS was observed between the SN anterior cingulate and left temporal lobe, and between the left putamen and left opercular cortex, left Heschl's gyrus, whereas ctDCS decreased the interhemispheric coherence of resting fMRI signal between left orbitofrontal

cortex and right lateral occipital cortex in left MTLE compared with healthy controls (pFWE <0.001). Main effect of ctDCS was increased FC between DMN and regions including SN, while FC was decreased within DMN in both MTLE patients and healthy controls (pFWE <0.001).

Conclusion: Results show that ctDCS affect RSN's in both hemisphere in a diffuse manner. However, the comparison of the ctDCS effects between left MTLE patients and healthy controls suggests that seizure control effect of the ctDCS reported in the literature may depend on its enhancing effect on the FC in the hemisphere ipsilateral to the seizure focus.

Funding: This study is supported by Istanbul University - Research Projects Unit, project nr. 2019K12-149071.

Keywords: Mesial temporal lobe epilepsy, transcranial direct current stimulation, functional connectivity, resting state networks

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Neural correlates of approach-avoidance behavior in healthy subjects: effects of low frequency repetitive transcranial magnetic stimulation (rTMS) over the right dorsolateral prefrontal cortex

Bernis Sütçübaşı[1], Ali Bayram[2], Barış Metin[3], Tamer Demiralp[4]

[1]Department of Psychology, Faculty of Humanities and Social Sciences, Acıbadem Mehmet Ali Aydınlar University, University, Istanbul, Türkiye; [2]Department of Neuroscience, Aziz Sancar Institute of Experimental Medicine, Istanbul University, Istanbul, Türkiye; [3]Department of Neurology, Faculty of Medicine, Üsküdar University, Istanbul, Türkiye; [4]Department of Physiology, Istanbul Faculty of Medicine, Istanbul University, Istanbul, Türkiye

Objective: The aim is to investigate the activation and connectivity changes in the brain related to emotion regulation by inhibiting right dorsolateral prefrontal cortex (dlPFC) by means of repetitive transcranial magnetic stimulation (rTMS). For this, the behavioral responses, neural activation, and connectivity variations to emotional stimuli after TMS were investigated with functional magnetic resonance imaging (fMRI).

Methods: In a placebo-controlled within subject design, 1 Hz active, thought to be inhibitory, and sham TMS was applied to the right dlPFC of 19 healthy volunteers in two sessions. After both sessions, fMRI data were recorded in trials where participants were required to show approach and avoidance responses to images with positive and negative emotional content, as well as in resting-state. Brain images were recorded with 1.5 Tesla Philips Achieva MR device at NPIstanbul Hospital. Activation analysis and general psychophysiological interaction (gPPI) analysis were performed on task-based fMRI, and seed-based functional connectivity analysis was applied on resting-state fMRI data.

Results: In task-based fMRI, the activation was higher and lateralized to the right hemisphere during presentation of negative images in general (p-FWE<0.001). After application of active TMS to the right dlPFC, increased activation was observed in the left medial prefrontal cortex (p-FWE<0.005). TMS shortened response times (p<0.01) and decreased error rates (p<0.05) in approach behavior, which was more prominent in positive images. Significant connectivity changes were observed in brain intrinsic connectivity networks (ICN) due to TMS, predominantly frontoparietal network (FPN) (pFWE-BC=0.00017) and visual network (VN) (medial component: pFWE-BC=0,0005; lateral component: pFWE-BC=0,00046) during the task, and default mode network (DMN) (pFWE-BC=0.0008) and VN (pFWE-BC=0.0005) at rest.

Conclusion: It has been shown that TMS applied to the right dlPFC affects large-scale neural networks and modulates emotion regulation. These findings from healthy individuals reveal that TMS may be used in the treatment of mood disorders such as bipolar or anxiety disorders.

Keywords: Emotion regulation, transcranial magnetic stimulation, functional connectivity, resting state networks, functional magnetic resonance imaging

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The Turkish version of the brief form of the affective neuroscience (BANPS) and its associations with five factor model of personality

Nehir Uçar, Soncu Büyükişcan

Yeditepe University, Istanbul, Türkiye

Objective: Affective Neuroscience Personality Scales (ANPS), developed by Davis and colleagues (2003), is the first and only scale that aims to measure personality traits based on the activity of six affective systems in the brain. However, the overly long scales and psychometric problems of the scale prevent its widespread use. The 33-item Brief Form of the ANPS (BANPS) was developed by Barrett and colleagues (2013) to solve these issues. and to measure personality through six affective systems in the brain (Seeking, Play, Care, Fear, Anger, Sadness). This study's purposes were to translate the BANPS into Turkish and determine the scale's reliability and validity by following the methodology in the original article of BANPS.

Methods: Translation-back translation method was used. The sample had 873 participants whose ages ranged between 18 and 65. Participants were asked to fill out BANPS, ANPS and Big Five Inventory (BFI) scales. All data were collected online.

Results: Internal consistencies calculated both for the whole scale (Cronbach α=.79), and individual scales (Cronbach α=586 to.825), revealed that the scale's internal consistency is good. The construct validity evaluated by calculating correlations between subscales and factor analyses was very close to the

original BANPS. Criterion validity was investigated by calculating the scale's correlations with BFI and ANPS. Findings revealed strong correlations between the BANPS and ANPS scales (r was between .55 and .80). The highest correlations between BANPS and BFI were Seeking and Openness to Experience (r =.49), Care and Agreeableness (r =.41), Play and Extraversion (r =.48) and Fear/Anger/Sadness and Neuroticism (r ranges from .53 to .55) (p<.001).

Conclusion: The findings showed the Turkish BANPS is a reliable and valid scale. The correlations between BANPS and BFI scales supported the hypothesis (Davis et al., 2003) that the big five factors of personality might be built on the six neurobiological emotional systems.

Keywords: Affective neuroscience, personality, scale adaptation, Brief Form of ANPS, ANPS

O-37

Examination of predictive powers of age, gender, language and cognitive functions in perception of emotional prosody

Cansu Yıldırım, Seren Düzenli Öztürk

Department of Speech and Language Therapy Faculty of Health Sciences, University of Bakırçay, Izmir, Türkiye

Objective: Perception of emotional prosody is an inseparable part of successful communication. The aim of this study is to examine the predictive effects of variables such as age, gender, language, and neurocognitive capacity to perceive emotional prosody.

Methods: The sample of the study consists of 69 healthy participants (33 males, 36 females) between the ages of 18–75. Perceptual Emotional Prosody Test (PEPT) and neuropsychological test batteries were administered to the participants. In PEPT, lexical sentence structures free from lexico-semantic clues were used as stimuli. In regression analysis, composite neuropsychological test scores were computed for attention (Digit Forward, Trail Making Test A-form), executive functions (Stroop Test, Trail Making Test B-form, Digit Backward) and language functions (Semantic and Phenomic Verbal Fluency, Mini-Mental State Examination language subtest).

Results: In the multiple linear regression analysis age, gender, language, executive functions and attention variables showed a significant relationship together (R=.772, R2=.565, F (5.63) =18.646, p<0.001). In order of importance, age (β=-.461), attention (β=.341), gender (β=-.288), language (β=.262), executive functions (β=-.157) variables, together explains 57% of the change in PEPT. It was determined that the age was the most important predictor variable and recognition of emotional prosody decreased with increasing age. It was determined that the increase in attention and language skills, increases recognition of emotional prosody. Male gender decreases recognition of emotional prosody.

Conclusion: Age-related decline in emotion recognition ability draws attention to the influence on the pragmatic component of language and successful communication. Minimal changes, which are considered to be within the normal range depending on age in the attention skill, which serves as a framework for cognitive functions, were reflected in the model. These findings suggest the effects of age, attention, and language skills should be considered in the evaluation of emotional prosody perception.

Keywords: Perception of emotional prosody, age, gender, language, neurocognitive capacity

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The effect of adenosine A2A receptors on anxiety-like behavior in cannabis addiction

Burçin Ün[1], Kübra Akıllıoğlu[2], Zeki Akarsakarya[3], Özlem Yorulmaz Özü[3], Fatma Peyman Ertuğ[3], Eda Karabal Kumcu[3], Mehmet Ata Seçilmiş[3]

[1]Department of Addiction, Çukurova University, Adana, Türkiye; [2]Department of Physiology, Division of Neurophysiology, Çukurova University, Adana, Türkiye; [3]Department of Medical Pharmacology, Çukurova University, Adana, Türkiye

Objective: Cannabis is the most commonly used recreational drug all over the world. Tetrahydrocannabinol (THC) in cannabis is known to induce anxiety-like behaviors, affect cognitive functions and cause addiction. In recent years, it has been reported that the adenosinergic system has an important role in the development of addiction to various stimulating substances. In our study, the possible role of the adenosinergic system on emotional behaviours in cannabis addiction was investigated.

Methods: In our study, THC (10 mg/kg intraperitoneally, i.p), Adenosine A2A receptor agonist CGS (3 mg/kg subcutaneously, s.c) and Adenosine A2A receptor antagonist Istradefyline (3mg/kg s.c), THC+Istradefyline, THC+CGS were administered once a day for 5 days to male Swiss albino mice. Sham groups were treated with solvents of drugs using same administration methods. The open field (OF) test and the elevated plus maze (EPM) test were applied to investigate anxiety-like behaviour and locomotor activity in mice. The distance covered in OF, the frequency of the center and the time spent in the center were evaluated. The time spent in the open arms and the frequency of head-dipping in the open arm were evaluated in EPM. Behaviours of mice was recorded for 5 minutes.

Results: In the OF test; THC, Istradefylline, or THC+Istradefylline increased the distance traveled, the frequency of entry to the center, and the time spent in the center,

while CGS or THC+CGS decreased when compared to those of Sham ($p<0.05$). In the EPM test; Istradefylline, but not THC, increased the time spent on the open field and reduced CGS- and THC+CGS- treated groups ($p<0.05$). Combination of THC and Istradefylline, augmented the effect of THC alone. While CGS and THC+CGS reduced the frequency of head-dipping in the open arm test, THC+Istradefylline increased the respons ($p<0.05$).

Conclusion: CGS decreased locomotor activity and increased anxiety-like behaviours while Istradefylline increased locomotor activity and decreased anxiety-like behaviours relative to THC. These findings suggest that the adenosine A2A receptor agonist CGS may have a modulatory role on the effect of THC.

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Keywords: Tetrahydrocannabinol (THC), adenosine A2A receptor, open field test, elevated plus maze test, anxiety

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The effects of pioglitazone on cognitive and anxiety-like behaviors in rat model of social isolation stress

Gülşen Çelebi, Semil Selcen Göçmez, Tijen Utkan

Department of Medical Pharmacology, Faculty of Medicine, Kocaeli University, Kocaeli, Türkiye

Objective: Social isolation since the early-life, one of the major sources of chronic stress, has been shown to adversely affect the brain development and adult behaviors. Previous studies have shown that learning-memory impairments and increased anxiety-like behaviors have been found in socially isolated rats. Pioglitazone, which is an antidiabetic drug, has also neuroprotective effect as well as anti-inflammatory, antioxidant and antidepressant effects. In this study, we investigated the effects of pioglitazone on cognitive functions and anxiety-like behaviors in the rat model of social isolation stress.

Methods: Male Wistar rats were divided into 4 groups (n=12/each group): control, control+pioglitazone, social isolation (SI), SI+pioglitazone. Rats exposed to social isolation were housed individually starting the age of 21 days during the 8-week isolation protocol. Pioglitazone (30mg/kg, p.o.) was administered to rats in control+pioglitazone and SI+pioglitazone for last 16 days of isolation protocol. After isolation period, rats were subjected to Morris water maze (MWM) test and passive avoidance (PA) test to assess the cognitive functions. Elevated plus maze (EPM) test was performed to explore the anxiety-like behaviors. In order to determine significant differences, one way ANOVA followed by Tukey posthoc test was used. $p<0.05$ was considered statistically significant.

Results: There were no significant differences between control and control+pioglitazone groups in behavioral tests ($p>0.05$). The retention latencies in PA test, the time spent in the escape-platform quadrant in MWM test and the time spent in open arms in EPM test were significantly decreased in SI group compared to controls ($p<0.05$), however pioglitazone treatment significantly increased these values compared to SI group and reversed to the controls ($p>0.05$).

Conclusion: Pioglitazone reversed the anxiety-like behavior and emotional and spatial memory dysfunctions developed in socially isolated rats. These data suggest that pioglitazone may have the potential to improve cognitive functions and have anxiolytic effects during SI stress.

Keywords: Social isolation, pioglitazone, anxiety, cognitive function, stress

O-40

Psychosocial stress increases interval timing performance

Güvem Gümüş-Akay, Gözde Vatansever, Ayşe Gökçe Erman, Can Kaan Karahan, Metehan Çiçek

Department of Physiology, School of Medicine, Ankara University Ankara, Türkiye

Objective: Interval timing is affected by changes in emotion-induced psychophysiological responses. It can be predicted that stressful experiences that produce psychophysiological responses may affect interval timing. Our aim was to evaluate the effect of psychophysiological response differences triggered by social stress on interval timing.

Methods: Forty-four healthy young adult volunteers (23F, 21E) were experimentally exposed to social stress using Trier Social Stress Test (TSST). Cortisol responses to social stress were analyzed by ELISA method from the saliva samples collected at 6 different time points (t-30, t0, t15, t30, t45 and t60). Participants were given time reproduction task before and after the TSST, and spatial reproduction task was used as a control. Deviation coefficietns from the target were calculated to compare participant's responses of the time perception and space perception task. Participants were divided into two groups by dividing from the median cortisol increase rates during t0–t30 time interval: low cortisol response(LCR, n=22) and high cortisol response (HCR, n=22). Mixed model repeated measure ANOVA was conducted with 2 (task: TR and SR) χ^2 (group: LCR and HCR) χ^2 (stress: TSSTpre and TSSTpost) design.

Results: Main effect of task was significant [$F(1.42)= 47{,}20$, $p<0{,}001$, $\eta^2_p= 0.53$], meaning that participants performed better in space task compared to time task. Social stress showed a significant main effect [$F(1.42)=13.72$, $p<0.001$, $\eta^2_p= 0.25$],

indicating that participants' pre- and post-TSST time and space task performances were significantly different. Significant stress-task interaction [F (1.42)=13.82, p<0.001, η^2_p=0.25] showed that while stress improved time perception performance, it had no effect on the space perception performance. However, the main effect of cortisol response (LCR and HCR) was not significant [F (1.42)= 0.58, p=0.45, η^2_p=0.01]).

Conclusion: Our findings indicate that social stress causes to decrease in the error that exists in the form of underestimation especially in time perception. In other words, stress leads to more accurate time estimation. Our results also support that not individual differences such as cortisol response, but instantaneous events such as social stress affect interval timing.

Funding: This work is supported by TUBITAK(219K089).

Keywords: Psychosocial stress, cortisol, interval timing, time perception

O-41

Investigation of behavioral changes due to neurofeedback application in children with attention deficit hyperactivity disorder by using Wechsler intelligence scale for children-revised: a randomized single-blind preliminary study

Rukiye Ölçüoğlu[1], İlknur Kozanoğlu[1], Eylem Gül[2]

[1]Department of Physiology, Faculty of Medicine, Başkent University, Ankara, Türkiye; [2]Department of Biostatistics, Faculty of Medicine, Başkent University, Ankara, Türkiye

Objective: The aim of this study is examining the effects of neurofeedback system in terms of Wechsler intelligence scale for children aged 8–12 with attention deficit.

Methods: For this purpose, the experimental group (n=20) and sham group (n=20) were formed with random sampling from participants who applied to the special education center between May-December 2021. In the first phase of the study, Wechsler intelligence scale for children was applied as a pre-test to determine the mental performance of participants in both study groups. Then, the infra low frequency protocol was applied to the experimental group for 5 months, every other day for half an hour, totally 60 sessions. Infralow frequency training was performed by studying the frequency range below 0.1 Hz. After 6 months, Wechsler intelligence scale for children was applied again as a post-test and data were statistically analyzed with Independent Two Samples t-test (Student's t-test) and Paired t-test.

Results: In the comparison, no difference was found (p>0.05) between the pre-test and post-test scores of the experimental and control groups. Examining the differences within-group, verbal IQ scores did not differ in the experimental group (p=0.121), while the scores in the control group increased statistically (p=0.011). Performance IQ scores increased in both the experimental group (p=0.011) and the control group (p=0.003). In terms of total IQ score, pre-test and post-test scores showed a statistically significant increase in both the experimental group (p<0.001) and the control group (p=0.007).

Conclusion: In terms of Wechsler intelligence scale for children, it was determined that the mental performance of neurofeedback group increased in terms of performance IQ and total IQ. However, this finding could not be statistically confirmed in the sham-group. Future studies should use large samples, including control groups, to demonstrate the clinical significance of the results and should also evaluate symptomatology in long-term follow-ups.

Keywords: Attention deficit hyperactivity disorder, neurofeedback, Wechsler intelligence scale for children.

O-42

How to define qualia neuroscientifically

Gürkan Sinan Yaşar[1], Tolga Esat Özkurt[2]

[1]Department of Cognitive Sciences, Middle East Technical University, Ankara, Türkiye; [2]Department of Health Informatics, Middle East Technical University, Ankara, Türkiye

Objective: Qualia, phenomenal properties of consciousness, seem to strongly correlate with functional properties of consciousness. While having a subjective experience requires being conscious, consciousness cannot be considered without subjectivity, as being conscious in itself is a subjective experience. However, there is an apparent ontological difference between qualia and the functional properties of consciousness. This distinction is often referred to as the explanatory gap. Besides, functional and phenomenal features of consciousness are also epistemologically separate. While the difference between being conscious and unconscious is functionally distinguishable via brain patterns, qualia are not observable in the brain data. Accordingly, although one needs to be conscious for having a subjective experience, subjectivity is not identical to being conscious.

Methods: Qualia are to be furtherly described in relation to neuroscience for neural mechanisms related to necessary and sufficient elements forming qualia may theoretically be established for neuroimaging experiments can be adequately designed to capture how an experience acquires subjective content from the neural aspect.

Results: Theories of consciousness integrated with neuroscience, such as Higher-Order Theories, Global Workspace Theories, and Integrated Information Theory (Though IIT claims a phenomenological account of consciousness, it does not differentiate consciousness from subjectivity, and it only refers to "global states" of consciousness rather than "local states" which are qualia), seem to concentrate on the structure

or likely place of consciousness rather than having a descriptive theory of the subjective content of conscious experience. However, as the above reasoning suggests, consciousness is necessary but not sufficient for having a subjective experience. Therefore, it is imperative to distinguish between being conscious and having a subjective experience philosophically and neuroscientifically. Moreover, qualia need to be furtherly characterized for an encompassing description suitable for scientific consideration.

Conclusion: We propose a more comprehensive explanatory scheme of qualia and theoretically point out the requirement of revealing neural mechanisms related to necessary and sufficient elements for an experience to obtain subjective characteristics.

Keywords: Qualia, neurophilosophy, functionalism, subjective experience, theories of consciousness

O-43

Investigation of interaction of amyloid beta peptide with mitochondrial RNAs

Zuhal Yurttaş, Tugay Çamoğlu, Erdinç Dursun, Duygu Gezen Ak

Department of Neuroscience, Institute of Neurological Sciences, Istanbul University-Cerrahpaşa, Istanbul, Türkiye

Objective: Despite the polycistronic origin of mitochondrial RNA (mt-RNA), investigations have shown that a variety of post-transcriptional processes can control transcription. Prion and asyn, which are amyloidogenic proteins, have RNA binding capacity. Except for simulation research with a few computer prediction programs, there is no knowledge regarding the RNA interaction of amyloid beta1–42 (Aβ1–42), the main peptide of the pathogenesis of Alzheimer's disease (AD). In monomer form, Aβ1–42 is in the α-helix conformation, however by binding zinc, Aβ1–42 accomplishes β-sheet folding. This new conformation of Aβ is similar to zinc finger transcription factors. Morover, by using synthetic, randomly generated DNA and RNA molecules, it has been shown that the region where the Aβ peptide interacts with metals can interact with RNA. Thus, Aβ peptide can interact with mtRNAs, and this interaction may be connected to mitochondrial abnormalities in AD.

Methods: The LRP130 protein, which is involved in the post-transcriptional processes of mtRNAs, may be impacted by Aβ1–42, on the other hand. Our goal in this work is to determine whether Aβ1–42-mtRNA may interact with one another and whether Aβ1–42 application affects LRP130's ability to bind to mtRNA.

Results: Aβ RNA-IP showed that in untreated cells, binding signals were captured for some specific mtRNAs, although not very high. With Aβ administration, the binding signals of Aβ obtained in the endogenous group disappeared. As a result of Aβ1–42 application, the affinity of LRP130 to mtRNAs decreased significantly compared to the untreated cells.

Conclusion: Aβ1–42 administration may have the capacity to affect mitochondrial expression at the post-transcriptional stage. When we look at the importance of RNA-protein interactions in neurodegeneration processes, we evaluate that our study can provide an up-to-date approach to biomarker research for AD and the development of RNA aptamers, which are therapeutic tools.

Funding: This study was supported by TUBITAK (Project No: 219Z179).

Keywords: Amyloid beta 1–42, mitochondria, mitochondrial RNA, Alzheimer's disease

O-44

The roles of heat shock proteins on intracellular transport and extracellular release of amyloid-fibrillar alpha-synuclein

Tugay Çamoğlu, Erdinç Dursun, Duygu Gezen Ak

Department of Neurocience, Institute of Neurological Sciences, Brain and Neurodegenerative Disorders Research Laboratory, İstanbul University-Cerrahpaşa, Istanbul, Türkiye

Objective: Fibrillar alpha-synuclein (F-aSyn) can be transported along the cellular extensions and released from the cell. Actors which are involved in the transport and release of F-aSyn have not been completely identified. In this study, we have investigated whether HSPs and kinesin-1 accompany F-aSyn in its transport and release.

Methods: Studies were performed with SH-SY5Y cells with 3 replicates. To determine whether HSPs bind to F-aSyn in the transport, immunoprecipitation experiments were performed by targeting alpha-synuclein after 12 h F-aSyn administration to the cells (n=7). The samples were analysed by Western blot and dot blot. Additionally, Hsc70, Hsp70 an Hsp90 were labelled by immunofluorescence on fluorescently labelled F-aSyn (F-aSyn-488) treated cells. Motor proteins transporting F-aSyn were examined by targeting kinesin-1 by immunofluorescence on the cells cultured on coverslips or microfluidic chips. Finally, Hsp70 inhibitor was applied to the cell after 24 h F-aSyn-488 treatment, and extracellular F-aSyn was measured to find out whether HSPs involved in the release of F-aSyn (n=7). Statistical significance was analysed with Graphpad 3.6 (Dunn's multiple comparisons test).

Results: Immunoprecipitation and immunofluorescence findings indicate that Hsp70 and Hsp90 colocalized with both F-aSyn and kinesin-1. Moreover, immunofluorescence labelings on microfluidic chips showed that F-aSyn colocalized with

kinesin-1. Also, we have found that inhibition of Hsp70s increased the releasing of F-aSyn($p<0,05$).

Conclusion: Our findings have shown that Hsp40, Hsp70 and Hsp90 may mediates the transport of F-aSyn or only stay bound, and kinesin-1 can be the motor protein transporting F-aSyn. These findings suggest that other HSPs may also be involved in these processes. Additionally, increased release of F-aSyn after Hsp70 inhibition may stem from the dysfunctions in cellular defense mechanisms against the aggregates. In conclusion, our findings indicates that HSPs can be therapeutic targets or biomarkers for synucleinopathies.

Funding: This study was supported by Istanbul University-Cerrahpaşa BAP. Project ID: 33479.

Keywords: Synucleopathy, alpha-synuclein, heat shock proteins, transport

O-45

The dose dependent effects of linalool on the cerebellar morphology of diabetic rats

Merve Nur Ermez[1], Özgür Devrim Can[2], Emel Ulupınar[3]

[1]Department of Anatomy, Faculty of Medicine, Eskişehir Osmangazi University, Eskişehir, Türkiye; [2]Department of Pharmacology, Faculty of Pharmacy, Anadolu University, Eskişehir, Türkiye; [3]Department of Health Science Institute, Interdisciplinary Neuroscience Eskişehir Osmangazi University, Eskişehir, Türkiye.

Objective: We aimed to examine dose-dependent effects of monoterpene Linalool on cerebellum of diabetic rats, which is common in aromatic plants and has antinociceptive, neuroprotective, anti-inflammatory and antioxidant properties. Histomorphological alterations in different subregions of cerebellum were compared by considering their connections, functions, and possible relationships with peripheral neuropathy (PN). Oxidative stress in the pathogenesis of diabetes (DM), detrimental effects of PN/diabetes on CNS, but the scarcity of studies focusing on cerebellum, and the aforementioned properties of linalool led to the planning of this study.

Methods: Adult male Sprague-Dawley rats (n=24) were divided into control, diabetes (Streptozocin, 50 mg/kg, IV) and treatment (75 mg/kg, 150 mg/kg, IP, 14 days) groups. Diabetes was confirmed by blood glucose measurement, and 4 weeks for the development of neuropathic pain. PN has confirmed with dynamic-plantar and Randall-Selitto tests. After intracardiac perfusion, serial sections of 80µm thickness were taken from vermis, paravermis and hemispheres of cerebella and stained with toluidine blue. The volume proportions (Vv) of molecular and granular layers were estimated by point-counting method and number of Purkinje cells per unit length were compared with statistical methods. All procedures were approved by Institutional Animal Usage Committee of ESOGU (Protocol number: 883/2022).

Results: According to one-way ANOVA test results, the mean Vv ratio in vermis was significantly higher in diabetic and high-dose linalool treatment groups than that of control, respectively (1.59±0.18, 1.52±0.13>1.27±0.04). No significant difference was observed in terms of Purkinje cell densities in subregions.

Conclusion: Functional connectivity and heterogeneity vary among different cerebellar subregions. We found that vermis is more susceptible to changes than paravermis and hemisphere, following the induction of hyperglycemia and PN in animals. Similar morphological parameters between low-dosage linalool treatment and control groups imply that Linalool may be helpful in preventing neuronal damage in diabetic animals. In conclusion, this study suggests that Linalool has dose and region-dependent properties and dose-dependent effects (low-dose) on cerebellum may be due to antinociception and the latter due to vermis's spinal connections.

Keywords: Cerebellum, diabetes, linalool, rat, peripheral neuropathy

O-46

A high-fat dietary regimen, as well as the interaction with various drug treatments, affect the brain in an age-dependent manner: evidence from the zebrafish (Danio rerio) model organism

Narin Ilgım Ardıç-Avcı[1], Serena Sevdiye Aktürk[1], Beyza Özen[1], Ergül Dilan Çelebi-Birand[2], Michelle M. Adams[3]

[1]Interdisciplinary Program in Neuroscience, Aysel Sabuncu Brain Research Center, İhsan Doğramacı Bilkent University, Ankara, Türkiye; National Nanotechnology Research Center (UNAM), İhsan Doğramacı Bilkent University, Ankara, Türkiye; [2]Biftek Inc., Ankara Türkiye; Interdisciplinary Program in Neuroscience, Aysel Sabuncu Brain Research Center, İhsan Doğramacı Bilkent University, Ankara, Türkiye; National Nanotechnology Research Center (UNAM), İhsan Doğramacı Bilkent University, Ankara, Türkiye; [3]Interdisciplinary Program in Neuroscience, Aysel Sabuncu Brain Research Center, İhsan Doğramacı Bilkent University, Ankara, Türkiye; UNAM, İhsan Doğramacı Bilkent University, Ankara, Türkiye; Department of Psychology, İhsan Doğramacı Bilkent University, Ankara, Türkiye

Objective: Aging causes chronic, low-grade inflammation in a manner similar to a high-fat diet (HFD). Understanding how inflammation due to diet and drug treatments contributes to the neuronal changes in the aging brain and determining whether drugs can reverse the adverse effects are the main aims of this study. This study will provide evidence as to how the aged versus young brain responds to neuroinflammation as well as possible therapeutic targets.

Methods: Three different 6-weeks HFD feeding regimens, intermittent fasting (IF), ad libitum (AL), and overfeeding (OF), as well as 1-hour copper sulfate (proinflammatory drug) and 3-hour rapamycin (anti-inflammatory drug) treatments were applied to wild-type zebrafish. Fifty-seven young (9 months) and sixty old (24–27 months) fish were maintained in standard conditions for all treatments. Body weight and length

were measured, and the comparison was performed with one-way between-subject ANOVA. Brain protein levels of markers of mammalian-target-of-rapamycin (mTOR), phosphorylated-mTOR (p-mTOR), Tumor-Necrosis-Factor-α (TNF-a), proliferating-cell-nuclear-antigen (PCNA), doublecortin-like-kinase-1 (DCAMKL1) and glial-fibrillary-acidic-protein (GFAP) were measured using Western-Blot analysis. Data were analyzed with two-way ANOVA followed by post hoc analysis using a Bonferroni Correction.

Results: Our results demonstrated significant increases in the body mass index (BMI) between young animals fed with OF and IF (p=<.01), as well as OF and AL (p=<.001). However, in the old group, the significant differences were between OF and IF (p =<.01), as well as AL and IF (p=<.001) fish. Protein levels of p-mTOR indicated a significant increase in old-OF compared to young-OF (p=.04). TNF-a levels showed a main effect of aging (p=.002), especially in non-treated OF groups (p=.04) and AL groups (p=.007), as well as the copper sulfate-treated IF groups (p=.04). Analysis of protein levels of relevant markers indicates statistically significant differences in response to diet and drug treatment in and between both age groups.

Conclusion: HFD feeding with various regimens caused significant BMI changes in both young and old zebrafish; preliminary data suggest that both dietary and drug treatments affect the expression levels of proteins of interest in an expected manner. Taken together, these results indicate that diets and drug treatments modulate inflammation.

Funding: This research is supported by TUBITAK-1001-grant: 119S660.

Keywords: Aging, high-fat-diet, ıntermittent-fasting, zebrafish

O-47

Investigation of the effects of calorie restriction on the chronic unpredictable mild stress model in rats

Esra Fidan Karamaden[1], Güler Buğdaycı[2], Özgür Mehmet Yis[3], Aslıhan Şaylan[4], Murat Alışık[3]

[1]Department of Interdisciplinary Neuroscience, Institute of Graduate Education, Bolu Abant İzzet Baysal University, Bolu, Türkiye; [2]Department of Medical Biochemistry, Faculty of Medicine, Haliç University, Istanbul, Türkiye; [3]Department of Medical Biochemistry, Faculty of Medicine, Bolu Abant İzzet Baysal University, Bolu, Türkiye; [4]Department of Histology and Embryology, Faculty of Medicine, Bolu Abant İzzet Baysal University, Bolu, Türkiye

Objective: The effect of calorie restriction on chronic stress, an important problem of our age, is being investigated. For this purpose, in our study, we aimed to investigate the histopathologically tissue morphology of chronic stress in the hippocampus and BDNF protein expression immunohistochemically, as well as the effect of calorie restriction on behavioral changes in the chronic unpredictable mild-severe stress (CUMS) model.

Methods: In the study, 48 male rats of 7–9 weeks of age, 8 in each group, were used. In order to create the chronic stress process, the CUMS model was applied. Afterthat, calorie restriction was applied. Open field test and elevated plus maze test were performed to examine behavioral changes. Morphometric measurement and immunohistochemical BDNF expression in dentate gyrus (DG), cornu ammonis 1 (CA1) and cornu ammonis 3 (CA3) regions were evaluated histopathologically in hippocampus tissues.

Results: Based on behavioral findings, the 50% and 25% calorie restriction groups were found to be anxiolytic in the CUMS model, excluding the 25% chronic calorie restriction applied after stress (p=0.001, p≤0.05). All findings on the DG region in the same groups were similar to each other (p≤0.05). Except for 25% chronic calorie restriction applied after stress, 50% acute calorie restriction and 25% chronic calorie restriction; There was an increase in BDNF protein expression in the DG and CA1 (p=0.043, p=0.032, p≤0.05).

Conclusion: As a valuable result of the study; The fact that the DG region is the most effective region on the stress model of calorie restriction. Except for 25% chronic calorie restriction applied after stress, 50% acute calorie restriction and 25% chronic calorie restriction; Another valuable finding is the increase in BDNF protein expression in the DG and CA1 regions. Our project numbered 2021.08.04.1489 was supported by the BAIBU BAP unit.

Keywords: Brain-derived neurotrophic factor, calorie restriction, hippocampus, rat, stress, psychological

O-48

Differentiated proteome pattern of genetic absence epilepsy rats treated with ketogenic diet

Aslıhan Günel[1], Nazlı Başak Açıkgöz[1], Aylin Toplu[1], Ülkü Güler[2], Bekir Salih[2], Dilşad Türkdoğan[3], Filiz Onat[1]

[1]Department of Neuroscience, Institute of Health Sciences, Acıbadem Mehmet Ali Aydınlar University, Istanbul, Türkiye; [2]Department of Chemistry, Faculty of Medicine, Hacettepe University, Ankara, Türkiye; [3]Department of Paediatrics, Division of Child Neurology, Marmara University, Istanbul, Türkiye

Objective: The effect of ketogenic diet (KD) on genetic generalized epilepsy has not been specifically reported. Absence epilepsy is a common form of childhood genetic generalized epilepsy. This study aimed to understand the anti-absence effect of the KD on the absence epilepsy in genetic absence epilepsy rats from Strasbourg (GAERS).

Methods: 3 Naive GAERS with normal diet and 4 GAERS with KD for 30 days were used in this study. Rats on normal and KD were decapitated, and then frontal cortex and hippocampus were dissected immediately after the brain was removed. The brains were washed in cold 1×PBS containing

protease and phosphatase inhibitors to remove blood and other tissue debris. Brain compartments were pulverized in liquid N2 and homogenized in 50 mM Tris.HCl pH 7.5 buffer including 150 mM NaCl, 1%NP40, 0.2% TritonX100, protease and phosphatase inhibitor cocktails. The homogenate was centrifuged at 16000xg for 15 min at cold, the supernatant was collected and digested as below. Protein from each sample obtained from both tissues was reduced with dithiothreitol (DTT) and alkylated with iodoacetamide (IAA). Proteins were precipitated using methanol/chloroform precipitation protocol. The protein was digested with trypsin (1:100 (w/w, trypsin-LysC/protein). Peptides were run on an EASY-Spray column connected to an Ultimate 3000 RSL nano system (Dionex, Thermo Scientific) in a Q Exactive Plus MS in the data-dependent mode. The MS/MS data were processed using Mascot search engine against the Rat_Protemoe database (29,947 sequences). Localization of identified proteins is predicted with EnrichR tool.

Results: As a result, 5 proteins are down-regulated and 6 are up-regulated in the KD-treated GAERS cortex compared to the cortex of GAERS-normal diet. No differentiated protein was detected in the hippocampus of the animals.

Conclusion: The differentiated proteins are primarily found in the ketone body metabolism, glycogen metabolism, and trafficking of myristoylated proteins to the cilium.

Keywords: Absence epilepsy, ketogenic diet, proteome

O-49

Investigation of flotillin and NfL levels in MS, NMOSD and PTS patients with previous EBV infection

Bihter Gökçe Bozat[1], Şule Aydın Türkoğlu[2], Şeyda Karabörk[3], Firdevs Uluç[1], Serpil Yıldız[2]

[1]Department of Interdisciplinary Neuroscience, Institute of Graduate Studies, Bolu Abant İzzet Baysal University, Bolu, Türkiye; [2]Department of Neurology, Faculty of Medicine, Bolu Abant İzzet Baysal University, Bolu, Türkiye; [3]Department of Medical Microbiology, Faculty of Medicine, Bolu Abant İzzet Baysal University, Bolu, Türkiye

Objective: Little is known about the possible mechanism by which demyelination can occur by stimulating the triggering of the autoimmune response and its relationship to viruses. In this study, it is aimed to determine the comparison of anti-flotillin, neurofilament light chain (NfL) levels in newly diagnosed cases of multiple sclerosis (MS), neuromyelitis optica spectrum disorder (NMOSD) and pseudotumor cerebri (PTS) according to their anti-EBV IgG autoantibody positivity/negative status.

Methods: Ethics Committee approval was obtained with the decision numbered 04.02.2020/74. Biomarkers in CSF samples taken for diagnostic purposes of MS (n=19), NMOSD (n=8) and PTS (n=15) cases aged 19–55 years who applied to our clinic were studied with ELISA and IFA methods. Independent Sample T/Mann Whitney-U, Crosstabs-Fisher's exact and Pearson/Spearman correlation analysis tests were used for group comparisons. A p-value of <0.05 was considered statistically significant.

Results: Anti-EBV (p=0.405), Anti-flotillin (p=0.242) IgG positivity was highest in the MS group and no significant difference was found between the groups. Anti-AQP4 positivity percentage was highest in PTS group, p=0.055. NfL levels were observed less in anti-Flotillin positive MS cases, p=0.051. A positive correlation was found between the age of onset of the disease and NfL levels (p=0.027) in NMOSD cases.

Conclusion: It is thought that the high anti-EBV positivity in three cases groups may be a parameter to be used in treatment strategies rather than differential diagnosis. According to the results obtained, it is recommended to evaluate anti-AQP4 positivity in PTS cases at the diagnosis stage. There is a need for new multicenter studies with larger number of cases related to anti-flotillin in the differential diagnosis.

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Keywords: Demyelinating diseases, pseudotumor cerebri, epstein barr virus, flotillin, neurofilament light chain

O-50

Early spontaneous movements in term infants born to mothers with gestational diabetes

Bilge Nur Yardımcı Lokmanoğlu, Yusuf Topal, Doğan Porsnok, Akmer Mutlu

Faculty of Physical Therapy and Rehabilitation, Developmental and Early Physiotherapy Unit, Hacettepe University, Ankara, Türkiye

Objective: Various studies showed that gestational diabetes (GDM) might cause changes in the infants' brains. The study aimed to examine early spontaneous movements in term infants born to mothers with GDM and to compare results with the infants in the control group in which both the infant and mother had no risk factors.

Methods: A total of 60 infants, 30 of whom were term born to mothers with GDM and 30 in the control group, were included in the study. The early spontaneous movements of the infants were assessed using General Movements Assessment (GMA) which functionally assesses the integrity of developing nervous system between 9-and 20-post-term weeks. In addition to fidgety movements, movement and postural patterns were analyzed with detailed analysis, and the Motor Optimality Scores (MOS) were determined. Differences between the groups were compared using Pearson chi-squared, Fisher's exact, and Mann-Whitney U tests.

Results: The median (min-max) values of gestational age and birth weight of infants born to mothers with GDM and infants

in the control group were 38 weeks (min-max=37–41 weeks); 38 weeks (min-max=37–40 weeks), and 3260 grams (min-max=2020–4560); 3425 grams (min-max=2620–4000 grams), respectively, and there was no significant difference between the groups (p>0.05). The assessment ages of infants were 14 weeks (min-max=11–19 weeks) and 13 weeks (min-max=11–17 weeks), respectively, and there was no difference between the groups (p=0.151). When GMA results were examined, there was a difference between the groups in MOS (p<0.001), age-adequate movement repertoire (p<0.001), and observed postural patterns (p=0.002), while no significant difference was found in fidgety movements (p=0.237), observed movement patterns (p=0.206), and movement character (p=0.301).

Conclusion: Our study has shown that infants born to mothers with GDM might have a higher risk of developmental problems than infants without risk factors. It is recommended that infants who do not have fidgety movements or have low MOS results should be followed-up and referred to early-intervention according to their needs.

Keywords: Early spontaneous movement, fidgety movements, general movements, gestational diabetes

O-51

Evaluation of auditory temporal discrimination tresholds in migraine patients

Ozan Gökdoğan[1], Çağıl Gökdoğan[1], Fulya Yalçınkaya[2], Bülent Cengiz[3], Hayrünnisa Bolay[3]

[1]Department of Otorhinolaryngology, Faculty of Medicine, Muğla Sıtkı Koçman University, Muğla, Türkiye; [2]Department of Speech Language Therapy, Faculty of Health Sciences, Atlas University, Istanbul, Türkiye; [3]Department of Neurology, Faculty of Medicine, Gazi University, Ankara, Türkiye

Objective: Changes in sensorial processing are observed in migraine patients. Although vestibular migraine is included in the diagnosis and treatment guidelines of migraine-related diseases, the effects of migraine on the cochlear system have not been clearly identified yet.The aim of this study is to determine whether the temporal auditory discrimination, which is one of the auditory processing methods of the auditory pathway, is affected in migraine patients with normal hearing.

Methods: Because migraine is more common in women, only right-handed female patients were included in the study. Group 1 consisted of 18 patients evaluated within 3 days before or after migraine pain, group 2 consisted of 26 patients diagnosed with migraine in the interictal period, and group 3 consisted of 25 healthy volunteers with similar demographic characteristics to groups 1 and 2. Random gap detection test (RGDT), discrimination in noisy environment test, and dichotic listening test (word and sentence) were applied to all 3 groups. Additionally, group 2 and group 3 patients were evaluated with the auditory cortical potentials and the mismatch negativity (MMN) test.

Results: There was a statistically significant difference between the 3 groups in the RGDT examination. There was no statistically significant difference in terms of dichotic tests and word discrimination tests in noisy environment between the groups. There was no statistically significant difference in auditory cortical potentials between group 2 and group 3, however, a statistically significant difference was found between the groups in terms of MMN latency.

Conclusion: The auditory pathway may be affected in migraine patients although hearing tests are normal. This interaction continues in the period between attacks, being more evident during the pain period. Therefore disorders of hearing or speech perception in migraine patients should be evaluated by further audiological tests.

Keywords: Migraine, auditory perception, auditory perception disorder, auditory processing

O-52

Evaluation of interoceptive accuracy in individuals with episodic migraine and healthy volunteers

Serkan Aksu[1], Buse Rahime Hasırcıoğlu-Bayır[2]

[1]Department of Physiology, Faculty of Medicine, Muğla Sıtkı Koçman University, Muğla, Türkiye; [2]Department of Neurology, Health Sciences University, Haydarpaşa Training and Research Hospital, Istanbul, Türkiye

Objective: Episodic migraine is a common primary headache syndrome and its pathophysiology has not been fully elucidated. Interoception is the process of the perception and the evaluation of the signals from the inner body that has been considered to have a key role in the emergence and the chronification of pain. It has been mainly maintained by the insula, which is a multimodal integration area between the prefrontal cortex and the descending pain pathways. Interoceptive accuracy has been depicted to decrease in chronic pain syndromes like fibromyalgia, musculoskeletal pain, and neuropathic disorders. Dysfunctions in descending pain pathways and insula have also been observed in episodic migraine and insula response to interoceptive awareness has been associated with migraine attack frequency in a recent study though interoceptive accuracy has not been evaluated. The present study aimed to evaluate interoceptive accuracy in individuals with episodic migraine and healthy individuals.

Methods: After obtaining approval from the Haydarpaşa Numune Research and Training Hospital Ethical Committee, 24 individuals with episodic migraine and 24 healthy adult volunteers were recruited. Heartbeat Counting Task was administered to all individuals. Two group means were compared using the Independent Samples t-test. Correlations were performed using Pearson tests.

Results: The mean age of the sample was 24.18. The interoceptive accuracy index was lower (p=0.002) in individuals with episodic migraine (0.572) than in healthy volunteers (0.756). Relationships between interoceptive accuracy index and age (p=0.045) as well as body mass index (p=0.016) were found.

Conclusion: Similar to other chronic pain syndromes, a lower interoceptive accuracy index was found in individuals with migraine than in healthy volunteers. Electrophysiology and neuroimaging studies were warranted to delineate the mechanisms underlying the observed effect. The present results were contemplated to contribute to the development of interoception-oriented therapies like yoga and interoceptive training in individuals with episodic migraine.

Keywords: Episodic migraine, interoception, neurophysiology, pain

O-53

Effects and mechanisms of cholinergic modulation in a rat model of nitroglycerin-induced migraine

Erkan Kılınç[1], İbrahim Ethem Torun[1], Yasemin Baranoğlu Kılınç[2]

[1]Department of Physiology, Faculty of Medicine, Bolu Abant İzzet Baysal University, Bolu, Türkiye; [2]Department of Pediatrics, Bolu İzzet Baysal State Hospital, Bolu, Türkiye

Objective: Clinical studies suggest an association between parasympathetic activation and migraine-headache, but the underlying mechanisms are not yet known. We investigated effects and mechanisms of cholinergic modulation on mechanical hyperalgesia, c-Fos expression, calcitonin gene-related peptide (CGRP) release and meningeal mast cells, which are associated with migraine pathophysiology, in a rat model of nitroglycerin-induced migraine.

Methods: Male Wistar-rats were randomly divided into 7 groups (n=6, totally 42) and migraine model was established by intraperitoneal injection of 10 mg/kg nitroglycerin (NTG). Control group received NTG solvent intraperitoneally, and the other groups received saline, saline, acetylcholinesterase inhibitor neostigmine (10 µg/kg), muscarinic receptor antagonist atropine (100 µg/kg), mast cell stabilizer cromolyn (10 mg/kg), atropine+neostigmine, cromolyn+neostigmine, respectively, 105 minutes after NTG injection. Mechanical hyperalgesia was measured by von-Frey. Trigeminal ganglion CGRP levels and brainstem CGRP and c-Fos levels were determined by ELISA. Count and degranulation of mast cells were determined by toluidine-blue staining. Data were analyzed by one-way ANOVA.

Results: In model group, NTG increased mechanical hyperalgesia, trigeminal ganglion CGRP levels, brainstem CGRP and c-Fos levels, and the count and degranulation of mast cells compared to control (p<0.001). Neostigmine significantly further increased these parameters, except for mast cell count, induced by NTG (p<0.05). Atropine inhibited neostigmine-induced additional increases in CGRP levels in trigeminal ganglion and brainstem (p<0.05), while it did not change mechanical hyperalgesia, c-Fos levels and mast cell degranulation. Cromolyn significantly reduced the neostigmine-induced effects in all parameters (p<0.05).

Conclusion: Our findings provide for the first-time direct evidence that endogenous acetylcholine participates in migraine pathophysiology particularly through activation of meningeal mast cells. It also revealed that muscarinic receptors mediate the release of CGRP from the trigeminal ganglion and brainstem, without excluding the possible role of nicotinic receptors in the cholinergic effects in migraine. Thus, favorable muscarinic antagonists with mast cell stabilizing properties may be promising strategies in migraine treatment.

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Keywords: migraine, cholinergic system, neurogenic inflammation, mast cells, CGRP

O-54

The role of cholinergic receptors in the analgesic effect of uridine

Sevda Şehzade, Ayşen Çakır, Nevzat Kahveci

Department of Physiology, Faculty of Medicine, Bursa Uludağ University, Bursa, Türkiye

Objective: Pain is a messenger system that alerts the body to a problem and a health issue that adversely affects life. Due to factors including individual variability in pain threshold, various pain etiologies, and side effects of analgesics, a standard treatment could not be implemented. The cholinergic system is known to play a role in analgesia. In this study, the potential analgesic effects of uridine on acute thermal and mechanical nociception and the contribution of the cholinergic system to these effects were investigated.

Methods: Our study was conducted in two stages: dose and experimental study, using 10–12-week-old Sprague Dawley male rats (n=98). In the dose study; following the intraperitoneally (i.p.) injection of saline or 0.5, 1 and 2 mmol/kg doses of uridine, the thermal pain threshold was assessed with Tail Flick and Plantar tests and the mechanical threshold with the von Frey Test at 1st, 2nd and 3rd hours. After determining the effective dose and time; in the experimental phase, atropine (5 mg/kg; i.p.) or mecamylamine (1 mg/kg; i.p.) was injected 2h later following saline or uridine administration, and thermal and mechanical tests were performed 30min after the injections. The results were presented as percentage of maximum potential effect (%MPE).

Results: It was found that rats administered 1 mmol/kg dose of uridine had the highest %MPE values, especially at the 2nd hour, it showed a significant antinociceptive effect in all tests ($p<0.001$). It was determined that inhibition of both nicotinic and muscarinic acetylcholine receptors significantly decreased %MPE values ($p<0.001$).

Conclusion: Intraperitoneally uridine administration has demonstrated a dose-dependent analgesic effect in acute pain. Furthermore, it has been determined that cholinergic receptors play a role in the analgesic effect of uridine. In conclusion, uridine is thought to be an alternative agent in the treatment of acute pain.

Funding: This study was supported by Bursa Uludağ University Scientific Research Projects Unit (Project No: TYL-2021-326-BAP).

Keywords: Acute pain, uridine, analgesia, cholinergic receptors

O-55

Is it possible to reduce the dose of carbamazepine by verapamil combination in trigeminal neuralgia pain treatments?

Havva Demir[1], Cihan Süleyman Erdoğan[2], Engin Sümer[1], Bayram Yılmaz[2], Turgay Çelik[3]

[1]Department of Neuroscience, Yeditepe University, Istanbul, Türkiye; [2]Department of Physiology, Yeditepe University, Istanbul, Türkiye; [3]Department of Pharmacology, Yeditepe University, Istanbul, Türkiye

Objective: Neuropathic pain syndrome Trigeminal neuralgia(TN) symptoms are treated pharmacologically with Carbamazepine. However, Carbamazepine cannot be tolerated long-term because of side effects. Due to successful Verapamil and Carbamazepine combination treatments, this study aimed to investigate the impact of Verapamil and/or Verapamil combination on TN neuropathic pain with inflammatory markers in rats.

Methods: The experiment began after randomly dividing the rats into five groups (n=25); Sham, Control, Carbamazepine, Verapamil, and Carbamazepine-Verapamil combination. First, all animals underwent chronic constriction injury of the infraorbital nerve (CCI-IoN) to constitute the animal model of trigeminal neuralgia. The following week, the mechanical stimulation test (MST) is carried out with von Frey filaments (vFF 0.02 g/0.16 g/0.4 g/1 g/2 g) as a neuropathic pain behavioral assay. On the 28th day, the animals were sacrificed; degenerative trigeminal nerve, trigeminal ganglion, and serum samples were taken from some animals (n=10). Interleukin-6, interleukin-1β and TNF-α levels were tested by ELISA.

Results: When the responses of the Carbamazepine, Verapamil, or control groups to vFF 0,16g and 0,40g filaments were compared statistically, MST scores of Verapamil (1 mg) and Carbamazepine (30 mg) were found to be significantly different from the control group ($F=6.763$, $p<0.011$; $F=7.860$, $p<0.023$). There was no significant difference between Carbamazepine or Verapamil and sham groups. However, the mean MST scores (1.8) of CBZ 15mg plus Verapamil 1mg were decreased significantly than the MST scores (2.6 and 2.8) of Verapamil and CBZ by two-way repeated ANOVA (vFF 0.16 g, $F=6.615$, $p<0.048$). No significant results were obtained from ELISA tests in the tissues. However, when IL-6 concentration was evaluated in serum samples with one-way ANOVA; it was found that the control group concentration (11.9 pg/ml) showed a significant difference from both the sham group concentration (4.2 pg/ml) and the Carbamazepine group concentration (5.2 pg/ml) ($F=4.760$, $p<0.1$). No significant difference was found between the other groups.

Conclusion: Results suggest Verapamil and Carbamazepine combination may be a novel treatment approach to treat neuropathic pain in TN disease. However, ELISA results indicate that the inflammatory process is not measurable. Results should be supported with further studies.

Keywords: Trigeminal neuralgia, pain, verapamil, carbamazepine, mechanical stimulation test

O-56

Agmatine ameliorates the nerve damage in methotrexate-induced peripheral neuropathy

Hatice Fulya Yılmaz, Özlem Bozkurt Girit

Department of Biophysics, Aydın Adnan Menderes University, Aydın, Türkiye

Objective: Chemotherapeutic agents, such as methotrexate (MTX), can damage peripheral nerves leading to chemotherapy-induced peripheral neuropathy. This study aims to investigate the therapeutic efficacy of agmatine (AgM), an endogenous neuromodulator, on MTX-induced peripheral neuropathy in the sciatic nerve.

Methods: 40 Wistar albino male rats were randomly divided into four experimental groups as control, MTX, AgM and MTX-AgM. MTX was administered at a weekly dose of 37.5 mg/kg/week (intraperitoneal) for 3 weeks. Then, AgM was injected at a 40 mg/kg dose (intraperitoneal) twice a day for 7 days. Nociceptive pain perception and behavioral alterations were determined via hot plate, tail-flick, water maze, rotarod and open field tests. Assessment of the sciatic nerve conduction, sciatic function index and histopathological evaluations were performed.

Results: MTX administration resulted in the increase in escape latency ($p<0.05$) and decrease in the time spent in the quadrant ($p<0.01$) in the water maze test and led to the decrease in nociceptive pain perception ($p<0.001$) and the decrease in the line crossing frequency ($p<0.001$) in the open field test in comparison to the control. Nerve conduction velocity was also reduced

in MTX group compared to that of control (p<0.001). In addition, MTX injection led to a decrease in the axon diameter (p<0.001), myelin thickness (p<0.001) and resulted in a higher glial fibrillary acidic protein (GFAP) immunoreactivity in sciatic nerves in comparison to those of control group. AgM administration improved the MTX-induced alterations in behavioral performance, nociceptive pain perception (p<0.05), nerve conduction, GFAP immunoreactivity and sciatic nerve histology in comparison to the MTX group.

Conclusion: The results revealed the therapeutic efficacy of AgM in restoring the alterations produced by MTX-induced peripheral neuropathy. However, dose regulation and/or combined treatment may increase the effectiveness of the treatment.

Funding: This study was supported by ADU-BAP through the grant number TPF-21004.

Keywords: Methotrexate, agmatine, sciatic nerve, peripheral neuropathy, glial fibrillary acidic protein

O-57

Effects of methylglyoxal on the pathogenesis of Parkinson's disease induced by rotenone in rat

Yekta Çulpan[1], Lara Özden[2], Yakup Gözderesi[2], Beril Koçak[2], Zeynep Hazal Baltacı[2], Ayberk Denizli[2], Betül Karademir Yılmaz[3], Rezzan Gülhan[1]

[1]Department of Medical Pharmacology, Faculty of Medicine, Marmara University, Istanbul, Türkiye; [2]Faculty of Medicine, Marmara University, Istanbul, Türkiye; [3]Department of Medical Biochemistry, Faculty of Medicine, Marmara University, Istanbul, Türkiye

Objective: Type-2 diabetes is a risk factor for Parkinson's disease, and methylglyoxal which is involved in the formation of advanced glycation end-products related to hyperglycemia, may have a role in the pathology of Parkinson's disease. The aim of our study is to investigate the effects of methylglyoxal on the pathology of Parkinson's disease.

Methods: Wistar rats (~2–3 months) were divided into Control (Water+Dimethylsulfoxide (DMSO), n=10), Methylglyoxal (MGO+DMSO, n=10), Rotenone (Water+ Rotenone, n=11) and MGO+Rotenone (n=11) groups. Methylglyoxal/water were administered orally for 55 days, Rotenone/DMSO were administered subcutaneously for 40 days. Locomotor activity, rearing, and rotarod tests were used to evaluate motor functions. Tyrosine hydroxylase immunoreactivity in striatum and substantia nigra was evaluated. GraphPad Prism v8 was used in data analysis.

Results: A significant increase was observed in the weight of the control group (p<0.001), while a statistically insignificant decrease was observed in the other groups. In locomotor activity test, the distance traveled, and the number of vertical movements decreased in MGO+Rotenone group compared to the control's (p=0.035, p=0.017, respectively). Rearing behavior was reduced in the Rotenone and MGO+Rotenone groups compared to control's (p=0.030, p=0.007, respectively). In Rotarod test, the longest time MGO+Rotenone group stayed on the platform was shorter than the control's (p=0.008). While the percentage of immunoreactivity positivity in striatum region before the anterior commissure in MGO+Rotenone group was lower than the control and MGO groups (p=0.027, p=0.047, respectively), there was no significant difference at the level of and after the anterior commissure (p>0.05). There was no difference among groups in the number of tyrosine hydroxylase positive cells in substantia nigra pars compacta (p>0.05).

Conclusion: Methylglyoxal was found to exacerbate motor dysfunction and increase the damage in dopaminergic neurons when nigrostriatal degeneration was triggered.

Funding: Our study (TTU-2022-10441) was supported by the Marmara University Scientific Research Projects.

Keywords: Parkinson's disease, type-2 diabetes, methylglyoxal, rotenone, tyrosine hydroxylase

O-58

Metaproteogenomic analysis of saliva from Parkinson's disease patients with cognitive impairment

Muzaffer Arıkan, Zeynep Yıldız, Tuğçe Kahraman Demir, Nesrin H. Yılmaz, Aysu Şen, Lütfü Hanoğlu, Süleyman Yıldırım

Istanbul Medipol University, Istanbul, Türkiye

Objective: One of the most common non-motor symptoms of PD is cognitive impairment (CI) that progressively develops on a spectrum from mild cognitive impairment (PD-MCI) to full-scale dementia (PDD). A better understanding of the mechanisms and links underlying CI progression may lead to new prognostic tools that can help track of CI thus decreasing its burden to patients and their families. Changes in saliva secretion and composition have already been investigated extensively in PD for exploration of potential biomarkers. However, the number of studies focusing on the potential relationship between saliva composition and CI in PD is very limited. In this study, we applied a metaproteogenomics approach by combining 16S rRNA gene amplicon sequencing and metaproteomics to identify candidate signature taxa and proteins in saliva composition that can differentiate CI stages in PD patients.

Methods: We recruited a prospective cohort of PD-MCI (43), PDD (45), and healthy controls (HC, 27) groups in a multicenter study. We investigated the microbial composition of saliva by sequencing V3-V4 region of 16S rRNA gene and performed metaproteomics analysis on the saliva samples.

Results: Salivary microbiome and proteome profiles differentiated HC, PD-MCI and PDD groups successfully. In addition, we detected decrease in the relative abundance of Neisseriaceae with the progression of cognitive impairment. A machine learn-

ing model based on integrated microbiome and metaproteome data accurately classified study groups and revealed important taxa and protieins potentiall differentiating cognitive impairment stages in PD. The findings of this study show that salivary microbiome and metaproteome profiles are associated with the progression of cognitive impairment in PD. The results point to the potential of signatures in the salivary microbiome and proteome for tracking cognitive impairment stages in PD.

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Keywords: Parkinson, microbiome, saliva, metaprtoeomics, machine learning

O-59

A Wilson–Cowan model describing the time–frequency character of local field potentials in Parkinson's disease

Rahmi Elibol, Tolga Esat Özkurt

Department of Health Informatics, Graduate School of Informatics, METU, Ankara, Turkiye

Objective: In this study, we aim to integrate the data obtained in a clinical neuroscience setting with the models in the field of computational neuroscience. Experimentally obtained data can be attempted to be explained using models representing neural structures and networks. In this direction, a computational model of beta band activity, which is considered an important biomarker of Parkinson's disease, was proposed. The characteristics of the measurement data were evaluated comparatively in order to describe the brain mechanisms of the disease.

Methods: The model of neural structures was realized with mass models. An important advantage of the mass model equations is that it has a relatively low computational load and hence small number of parameters. Thus, the effects of the parameters on the dynamic variables of interest in the model can be revealed via bifurcation diagrams.

Results: With the underlying model, the neural activities of basal ganglia were shown to match with those given by the literature, when dopamine level varies. The functioning of the direct and indirect pathways in the basal ganglia circuits was demonstrated. The peaks and troughs were investigated by computing the relative maxima and minima between the zero-crossings of the beta activity obtained from the computational model. In addition, features such as rise-decay symmetry and peak-trough symmetry were extracted and compared.

Conclusion: Basal ganglia recordings obtained by neurosurgery and experimental methods reveal increased power within the beta band. There are limitations to the sole use of frequency information. Hence, one should consider not only the spectral power in the beta frequency band, but also the waveform, phase and amplitude of the beta activity and the relationship between these last two. Some nonlinear measures proposed in the literature such as beta activity change in time domain, peak-trough points and sharpness asymmetries were also examined.

Keywords: Parkinson's disease, computational model, beta activity, time–frequency analysis

O-60

Multi-scale computational model for cortical electrical stimulation

Mahmut Emin Çelik

Gazi University, Ankara, Türkiye

Objective: Recent technological advancements in neuroscience have expedited the development and use of implantable neural interfaces as an innovative tool for diagnosis and treatment of some neurological disorders. The implantable neural interfaces include electrodes of various sizes, designs and densities for recording or stimulation. Stimulation of targeted neural structures using micro-electrodes enables an effective therapy like deep brain stimulation for the treatment of Parkinson's disease or epilepsy. Moreover, as a neuroprosthetic device, it improves the quality of life by modulating neuron activity with high resolution in cellular level. This work presents multi-scale computational model to explore neural responses of a neocortical pyramidal neuron in sensory cortex to electrical stimulation via a disc electrode.

Methods: Multi-scale computational model combines volume conductor head model and multi-compartmental neuron model. Biophysical properties of neocortical pyramidal neurons in Mainen's paper were used. Multi-compartmental neuron model includes soma, axon and dendrite compartments with realistic three-dimensional morphology and biophysical properties. Neuron model is developed in NEURON simulation environment. Electrical stimulation is applied via a planar disc electrode with various size, between 50 µm and 200 µm in a volume conductor head model. The disc electrode is placed distinct positions around neuron that have different distances to the nearest neural compartment, between 50 µm and 500 µm. Current threshold is calculated for each case.

Results: It is seen that distance between electrode and neural compartment plays a key role in the value of stimulation threshold. The distance and threshold are directly proportional. Moreover, as the electrode size decreases, the current threshold also decreases gradually.

Conclusion: This work shows that computational modeling with realistic neuron and electrode models can help to plan experimental work in terms of electrode type, shape and size, resulting more accurate and reliable findings.

Keywords: Multi-scale modeling, electrical, stimulation, neuron, model, threshold, current, electrode, volume conductor.

O-61

An fNIRS-based BCI system for identification of neuropsychiatric disorders

Gülnaz Yükselen, Sinem Burcu Erdoğan

Acıbadem Mehmet Ali Aydınlar University, Istanbul, Türkiye

Objective: The majority of neuropsychiatric disorders are diagnosed using subjective measures (i.e., structured interviews, self-reports, and questionnaires), which calls into question the validity of final clinical decisions. The ultimate aim of this study was to propose a machine learning-based classification approach for objective identification of three disorders of neuropsychiatric or neurological origin by using functional near-infrared spectroscopy (fNIRS) derived objective biomarkers.

Methods: 13 healthy control subjects and 67 patients who were clinically diagnosed with migraine without aura (n=20), schizophrenia (n=21), and obsessive-compulsive disorder (n=26) performed a Stroop task, while prefrontal cortex hemodynamics were monitored with fNIRS. Global Efficiency (GE) metrics were computed from the hemodynamic signals and a Cognitive Quotient (CQ) was computed from the behavioral data. Three commonly used and computationally efficient machine learning algorithms, namely linear discriminant analysis (LDA), naïve Bayes (NB), and support vector machines (SVM), were trained with these biomarkers and the efficacy of each algorithm in correctly classifying each subject across the four classes was tested with 10 runs of 10-fold cross-validation.

Results: All algorithms achieved four-class classification performances with accuracies and F1-scores above 83%. SVM had the highest performance in terms of accuracy (85.1±1.77%), sensitivity (84±1.7%), specificity (95±0.5%), precision (86±1.6%), and F1-score (85±1.7%).

Conclusion: The results show the feasibility of integrating neurally induced fNIRS-derived biomarkers with machine learning algorithms for accurate classification and objective identification of psychiatric disorders. Unlike conventionally used subjective measures, fNIRS-derived hemodynamic features have no subjective report bias when serving as diagnostic markers. The proposed automated classification approach has the significant potential for assisting in the objective diagnosis of neuropsychiatric disorders associated with frontal lobe dysfunction.

Keywords: Brain-computer interface, classification, functional near-infrared spectroscopy, stroop test

O-62

Improving deep learning performance of brain computer interface with spatio-spectral decomposition

Zafer İşcan

Department of Electrical and Electronics Engineering, Bahçeşehir University, Istanbul, Türkiye

Objective: Steady state visual evoked potential (SSVEP) based brain computer interfaces (BCI) are popular due to their high classification performance. Recently, deep learning based methods generated higher accuracy values compared to traditional machine learning methods. Spatio-spectral decomposition (SSD) is a method to maximize the power in the frequency of interest while minimizing it at neighboring frequencies. In the study, the goal is increasing the deep learning performance using SSD as the preprocessing method.

Methods: Electroencephalogram (EEG) were recorded from seven healthy subjects between 17 and 24 years old. Visual stimuli (circles) were presented on the monitor in four frequencies (5.45 Hz, 8.57 Hz, 12 Hz, 15 Hz). Subject focused on each circle (stimulus frequency) during three seconds. EEG were recorded from a 60-channel system. For each stimulus frequency, 30 responses were recorded. A convolutional neural network (CNN) based deep learning model was used to classify these responses. Classification performances were compared with and without SSD based preprocessing for different number of channels (24, 59) and stimuli length (0.25 s – 3 s).

Results: For different number of channels and stimuli length, accuracy values with preprocessing based on SSD were higher than the values without preprocessing. For the highest accuracy case with 24 channels and 3 s stimuli length, accuracies were 91.07% and 82.14% with and without preprocessing, respectively. Besides, accuracies obtained for selected 24 channels were higher than the ones for the 59 channels. Even for a stimuli duration of 250 ms, 59.14% accuracy was reached.

Conclusion: SSD based preprocessing increases the deep learning performance significantly. SSD was used for the first time as a preprocessing method in a CNN based classification. Similar approach can be used in other fields where there are expected oscillations in the recorded signal.

Funding: The study was partly funded by the Russian Academic Excellence Project '5-100'.

Keywords: Brain computer interface, classification, convolutional neural network, deep learning, spatio-spectral decomposition, steady state visual evoked potential.

O-63

Multimodal evaluation of motor learning and mental workload during laparoscopic surgery training

Kübranur Kara Baştürk, Hasan Onur Keleş

Department of Biomedical Engineering, Ankara University, Ankara, Türkiye

Objective: Laparoscopic surgery is complex and imposes additional demands on surgeons' perceptual and cognitive abilities. There is a need of objective methods for surgical skills and performance assessment. Numerous studies show that functional neuroimaging can accurately measure mental status descrip-

tors. We propose to determine the neuroimaging correlates of human performance and expertise in surgery training using multimodal approach.

Methods: Data from 12 surgeons (41±13) with varying levels of laparoscopy experience and 22 students (23±4 / with no laparoscopy experience) were in this study. Participants performed standard tasks including peg transfer and string pass in cooperating pairs. EEG+ECG were recorded as in standard psychology experiments. In addition, collected data included time to completion, error rate, and Nasa-TLX for subjective mental workload. We also introduced a secondary task in order to monitor the subjects' reaction times (RT) during the experiments. EEG signals were collected at 250 Hz sample rate using mobile EEG system with 8 channels. RMSSD, pNN50 ve SDSD were used for heart rate variability (HRV) analysis. EEG were pre-processed in order to reject artifacts. Then, the relative frequency band-power (FBP) and the phase-locking values (PLV) between each electrode pair were calculated

Results: The initial results showed that surgeons performed the tasks significantly faster ($p<0.01$), had significantly lower cognitive load ($p<0.05$) during String Pass. In time-domain ECG analysis, RMSSD, pNN50 ve SDSD values of surgeons were lower compared to the students. Beta power increased with task difficulty in surgeons and decreased in student group ($p<0.005$). We find theta-PLV differentiates between surgeons and students.

Conclusion: The preliminary findings of our study show that our multimodal approach increases the classification rate of the expert surgeons compared to students group. In order to explain EEG pattern differences in connectivity analysis, we can mention that motor skill acquisition induces continuous changes in gray matter thickness and myelination, which affects neuronal synchrony.

Keywords: Surgical education, EEG, HRV, cognitive load, motor learning

O-64

Control of a brain-machine interface by freely moving rats in a one-dimensional two-target reaching task

Syed Muhammad Talha Zaidi[1], Samet Kocatürk[1], Tunçer Baykaş[2], Mehmet Kocatürk[3]

[1]Department of Biomedical Engineering, Istanbul Medipol University, Istanbul, Türkiye; [2]Department of Computer Engineering, Istanbul Medipol University, Istanbul, Türkiye; [3]Research Institute for Health Sciences and Technologies (SABITA), Istanbul Medipol University, Istanbul, Türkiye

Objective: Nonhuman primates are commonly used to study the performance of brain-machine interfaces (BMIs). Rodents are mostly not preferred in BMI research due to their limited cognitive and visual abilities. In this work, our goal was to examine the capability of rats, by developing a new behavioral paradigm, for a complex BMI task such as controlling a robotic actuator.

Methods: A behavioral setup and paradigm was developed to direct the attention of rats from inside the cage to a robotic arm outside the cage for reaching distant targets. Three rats were chronically and bilaterally implanted with two 16-channel microelectrode arrays in the primary motor cortex (AP=+1.5 mm, ML=±2.5 mm, DV=1.2 mm). Shaping procedures were developed to enable rats to modify cortical activity to reach one of two opposite targets using the robotic actuator.

Results: All three rats involved in the study were enabled to acquire one of two randomly selected targets using the robotic actuator with at least 78% accuracy. A total of 16 pairs of units were examined in neuroprosthetic control and 9 of them exhibited the necessary activity modulations to reach selected targets. In addition, two out of three rats were capable of reversal learning, where the mapping between the activity of motor cortex units and the robotic actions were reversed.

Conclusion: Our results indicate that rats are capable of controlling a motor neuroprosthesis intentionally to reach distant targets provided that a fine-tuned behavioral setup and paradigm are employed. We believe the rodent behavioral paradigm introduced here offers a cost-effective and practical alternative for studying the performance of novel BMI technologies. Using the present behavioral paradigm the role of other brain circuits, besides the motor cortex, in neuroprosthetic control can be investigated and in light of the new findings more viable BMIs that operate by monitoring the activity in multiple brain structures can be developed for paralyzed patients.

Funding: TÜBİTAK Grants #115E257 and #117E286.

Keywords: Motor cortex, neuroprosthetics, brain-machine interface.

O-65

A novel experimental setup to study multisensory integration in Zebrafish

Orhun Koç, İsmail Uyanık

Department of Electrical and Electronics Engineering, Hacettepe University, Ankara, Türkiye

Objective: Animals perceive signals of different speeds and propagation patterns, such as light and sound, from their environments via various receptors in their bodies, and they construct a neural representation of their environment. Our goal is to identify the dynamics of the filtering mechanisms adopted by animals to combine signals perceived by different sensory organs during their free behaviors.

Methods: In this study, we developed a unique experimental setup to analyze the multisensory integration of freely-swim-

ming Danio rerio for target tracking during rheotaxis. We built a flow tunnel for zebrafish to perform rheotaxis. We placed a D-shaped cylindrical tube in the test area to obscure the flow in certain regions. Zebrafish naturally prefer to swim in the low flow-speed regions that occur behind these obstacles to avoid getting dragged with the flow. Zebrafish perceive the obstacles using the visual and mechanosensory stimulations in the water using their eyes and lateral line. A unique aspect of our design is that the visual and mechanosensory cues can be controlled independently, thanks to our special dual-motor actuation mechanism. This way, we can stimulate the relevant sensory organs synchronously or independently, enabling the identification of the dynamics of multisensory integration adopted by the CNS.

Results: In this study, we repeated the target tracking experiments for N=3 zebrafish, and estimated the frequency response of the dynamics of the multisensory integration process. A key finding of our studies is that visual stimuli alone are not sufficient to initiate the fish, but mechanosensory stimuli are. Zebrafish reduces behavioral variability in the presence of both stimuli via multisensory integration.

Conclusion: Our findings show that simple superposition models can not capture the dynamics of multisensory integration unless both sensory cues are available. In general, the dynamics of multisensory integration necessitate hybrid model structures. Superposition models are most likely to fit when both stimuli are available.

Keywords: Multisensory integration, rheotaxis, zebrafish, tracking, sensory conflict

O-66

Investigation of sensory reweighting in weakly electric fish during multisensory integration

Alp Demirel, İsmail Uyanık

Hacettepe University, Ankara, Türkiye

Objective: Animals benefit from diverse sensory organs that capture various sensory signals to make sense of the environment. These signals, combined by the central nervous system (CNS), serve to increase the quality and speed of processing for the sensory information. Our goal is to reveal how the CNS weights sensory signals from different sensory organs during multisensory integration and how the CNS dynamically updates these weights.

Methods: In this study, we built an experimental setup that utilizes the natural refuge tracking behavior of Apteronotus albifrons, a species of weakly electric fish. These fish hide inside refuges and track their movements when needed due to their innate shelter-seeking behavior. To achieve this, Apteronotus constantly integrates visual and electrosensory signals. Our experimental setup utilizes the natural refuge tracking behavior of these fish. It consists of a refuge that moves on a single axis and a camera that captures fish movements. We used a translucent refuge to generate electrosensory signals in our experimental setup. In the dark, movements of this refuge create electrosensory signals for the fish. To generate visual cues, we used a mini projector attached to the refuge. This allows us to deliver synchronized or independent visual and electrosensory cues to the fish.

Results: In our study, we experimented with N=5 fish with synchronous and independent sensory stimuli. Our results showed that electrosensory stimulation was sufficient to stimulate the refuge-tracking behavior but not the visual stimuli.

Conclusion: We are currently investigating the dynamic sensory reweighting by gradually adding different frequency stimulations to model the multisensory integration process in these fish. This way, we aim to reveal the cost functions associated with sensory reweighting during multisensory integration.

Keywords: Multisensory integration, system identification, neuroethology

O-67

Slow wave EEG oscillations during sustained attention to response task

Zehra Ülgen[1], Kurtuluş Mert Küçük[2], Christina Schmiedt-Fehr[3], Canan Başar-Eroğlu[2]

[1]Department of Biophysics, Dokuz Eylül University, Izmir, Türkiye; [2]Department of Psychology, Izmir University of Economics, Izmir, Türkiye; [3]Institute of Psychology, University of Bremen, Bremen, Germany

Objective: Although event related oscillations during attentional tasks have been studied comprehensively in the literature, EEG delta and theta during sustained attention task performance has not been extensively examined in the literature. The aim of our research group was to investigate the changes in slow wave oscillations (Delta and Theta) during attentional processes.

Methods: Electroencephalography (EEG) of 13 healthy participants was recorded at the Fz, Cz, Pz, Oz locations during the auditory SART task which is a long and repetitive task requires withholding the response to the rare target stimuli. Time frequency decomposition was conducted via wavelet convolution using a Morlet-wavelet from 0.5 to 4 Hz (Delta) and 4 to 8 Hz (Theta). Average amplitude was calculated within 750 ms time window after the stimulus onset.

Results: Delta $F(3.36)=33.96$, $p<.001$ and theta $F(1.68, 20.10)=29.32$, $p<.001$ activity increased at mid-frontal region at the beginning of the experiment both in time domain (digital filtering) and time-frequency domain. However, decrease in fronto-central theta $F(2.24)=3.55$, $p<.05$, $r=.36$ activity was observed toward the end of the experiment.

Conclusion: The changes in attention has been investigated based on new analytical methods event related oscillations (EROs) and inter-trial coherence (ITC) with respect to time domain and the localization of brain in the SART. Overall, sustained attention shown to increase fronto-central delta and theta activity during especially in behavioral inhibition process. This strong frontal midline delta and theta activity which is known to be parallel to executive control also occurs in inhibition control reported consistency with the literature. This increase was attenuated together with decreased delta and theta ITC towards the end of the experiment. Decrease in delta and theta activity can be associated with mental fatigue and decreased attention.

Keywords: EEG, sustained attention, delta band, theta band

O-68

Impaired occipital connectivity during motion reversals in healthy older adults

Kurtuluş Mert Küçük[1], Birgit Mathes[2], Canan Başar-Eroğlu[1]

[1]Department of Psychology, Izmir University of Economics, Izmir, Türkiye; [2]University of Bremen, Bremen, Germany

Objective: Perceptual processing is impaired during healthy aging (+60 years). Age-related impairment is reflected in slowed perceptual discrimination and decreased occipital cortex functioning. Dysfunction in top-down modulation of low-level areas is also thought to contribute to perceptual deficits in older adults. This study aimed to identify age-related alterations in theta (4-7.5 Hz) connectivity patterns at occipital and frontal areas during an unambiguous apparent motion task.

Methods: EEG recordings of 13 young (Mage=23.38 SD= 2.32) and 13 older adults (Mage=62.3 SD=4) were obtained during an apparent motion task. Participants observed moving dots and pressed a button whenever the motion direction of the dots was changed. EEG was transformed into time-frequency domain via wavelet convolution (4–7.5 Hz). Inter-electrode phase differences were calculated using phase locking index (PLI) for each channel pair and standardized using baseline connectivity. Significant increases in connectivity were analyzed in three-time windows (t1=0–250 ms; t2=250–500 ms; t3= 500–750 ms). Significant connectivity pairs were compared between the groups using averaged estimates of frontal and occipital ROIs. Bonferroni correction was used in post-hoc comparisons.

Results: Young group showed the highest connectivity during 250–500 ms window for both ROIs ($p<.05$). This temporal modulation did not reach significance in older adults. Occipital PLI estimates were significantly lower in older adults compared to young adults at t2 and t3 windows ($p<.05$). Occipital Hubness was also lower in older compared to young adults at t2 window ($p<.05$). No group differences were observed at frontal ROIs.

Conclusion: Topography and timing of age-related differences indicate impairments in motion binding and disturbed transfer of perceptual information between the occipital cortex and other regions. Intact frontal connectivity in older adults indicates functional top-down processing of task demands at later stages. These findings indicate impaired bottom-up transfer of information in older adults which may explain the slowed perceptual decision-making process.

Keywords: Perceptual binding, aging, EEG, phase connectivity, theta.

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Investigation of event-related delta and theta oscillations in deductive and probabilistic reasoning

Emir Faruk Sevim[1], Yasin Yıldırım[2], Esra Dalmızrak[1], Esra Ünsal[1], Bahar Güntekin[3]

[1]Department of Neuroscience, Graduate School of Health Sciences, Istanbul Medipol University, Istanbul, Türkiye; [2]Department of Physical Therapy and Rehabilitation, Faculty of Health Sciences, Istanbul Medipol University, Istanbul, Türkiye; [3]Department of Biophysics, School of International Medicine, Istanbul Medipol University, Istanbul, Türkiye

Objective: The reasoning can be divided into two in terms of the inference process and the truth values that the results can take: deductive reasoning (DR) and probabilistic reasoning (PR). The aim of this study is to investigate the neural correlates underlying DR and PR processes.

Methods: The neural correlates of DR and PR were investigated by analyzing EEG event-related delta and theta responses. 20 healthy participants (9 women) aged 18 to 30 years were included in the study. Participants were asked to decide on the truth values of the inferences displayed on the screen in writing. Inferences requiring different types of reasoning were randomly shown to the participants during the experiment. Delta responses were analyzed in two different time windows, early (0–600 ms) and late (600–1200 ms), while theta responses were analyzed in a single time window (0–300 ms).

Results: Higher delta power was found in frontal and central regions in PR responses, and in parietal and occipital regions in DR responses in both early and late time windows ($p<0.001$; $p=0.041$). Higher delta power was found in right hemisphere in PR in late time window ($p=0.014$). Early delta responses were significantly higher than late delta responses in all electrode locations ($p=0.004$). While there was no significant difference between reasoning types in early delta responses, a significant difference was found in favor of PR in late delta responses

(p=0.011). Higher theta power was found in DR responses in parietal and occipital regions (p=0.019).

Conclusion: DR was found to cause higher activation in posterior regions, and PR in anterior and right regions. Our result has revealed that two different types of reasoning can be distinguished from each other in terms of brain dynamics.

Keywords: Deduction, EEG, event-related oscillations, probabilistic, reasoning

O-70

An investigation of WM-related brain oscillations after 24-hour sleep deprivation

Harun Yırıkoğulları[1], Esra Dalmızrak[1], Bahar Güntekin[2]

[1]Department of Neuroscience, Graduate School of Health Sciences, Istanbul Medipol University, Istanbul, Türkiye; [2]Department of Biophysics, School of Medicine, Istanbul Medipol University, Istanbul, Türkiye

Objective: Working memory (WM) is an active system that allows learning and retaining a limited amount of information for a short period of time. It is known that sleep deprivation has a negative effect on many cognitive functions, including working memory. Sleep is crucial for human beings and is essential for daily functions. For this purpose, our study aimed to examine the effects of 24-hour sleep deprivation on working memory performance, along with the event-related brain oscillations by the EEG method.

Methods: 30 healthy young adults were included in our study (15 rested, 15 sleep deprived). After the 24-hour of deprivation, an EEG session was conducted, and the verbal 2-back task was performed to evaluate working memory performance during recording. Success rates and reaction times were recorded. EEG recordings were analysed in delta (0.5–3.5 Hz), theta (4–7 Hz) and alpha (8–13 Hz) frequency bands by event-related power spectrum and phase-locking analyses.

Results: The sleepiness scores were significantly higher in the SD group (p<001). The behavioural results showed that the total success rates of the SD group decreased (p<.048), while the reaction times were prolonged (p<.025). According to the EEG findings, the SD group showed decreased event-related delta power responses in the fronto-central region during the presentation of target stimuli (p<.05). The fronto-central theta power responses also decreased in the SD group regardless of stimulus type (p<.05). The SD group showed decreased parieto-occipital alpha phase-locking compared to the control group. However, this location-group interaction in the alpha band was marginally significant (p=.066).

Conclusion: Delta and theta responses in the fronto-central region and alpha responses in the parieto-occipital region play a role in working memory and these oscillations are affected by sleep deprivation. To conclude, prolonged wakefulness affects attentional processes that lead to decreased working memory performance and WM-related oscillatory responses.

Keywords: Brain oscillations, EEG, sleep deprivation, working memory

O-71

Event-related delta responses during the discrimination of hand images with perspective perception

Burcu Dilek[1], Ebru Yıldırım[2], Lütfü Hanoğlu[2], Bahar Güntekin[2]

[1]Trakya University, Edirne, Türkiye; [2]Istanbul Medipol University, Istanbul, Türkiye

Objective: Evaluation of the right-left discrimination with personal perspectives is important as it provides information about body perception. In recent years, there have been studies indicating that delta responses are associated with three-dimensional perception and depth perception. Our study aimed to evaluate event-related delta responses during the discrimination of hand visuals with perspective perception.

Methods: 11 healthy right-dominant (3 female, 8 male; 38.36 years) participants were included in the study. EEG recordings were made from 32 channels with the BrainAmp device with a sample rate of 500 Hz and band limits of 0.01–250 Hz. Hand visuals were presented in two different situations as "1st person perspective perception (0°)" and "3rd person perspective perception (180°)". Event-related power spectrum analysis (0–400 ms) and phase locking (0–800 ms) analysis were performed in the delta frequency band (1–4 Hz). ANOVA with repeated measures was used for statistical analysis.

Results: At delta band powers; for right-hand images, 1st person perspective responses were higher than 3rd person perspectives, however this value did not reach statistical significance (F(df=1,10) =4.090, p= .071). In delta phase locking analysis, for left hand images, 1st person perspective responses were statistically higher than 3rd person perspective (F(df=1,10) =22.746, p<0.001).

Conclusion: Detection of perspective perception through delta responses in hand discrimination cognitive task confirms that delta responses are associated with visuospatial memory. In addition, reaching higher responses in the hand recognition task from the perspective of one's own body perception confirms the information that egocentric visuals are perceived more easily. As a result, delta event-related responses can be used as an important parameter in assessing body image through personal perspective. More comprehensive studies are needed to examine the lateralization effect of images with perspective perception.

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Keywords: Brain oscillations, hand lateralization task, delta

O-72

Bilateral tactile stimulation modulates memory and electrophysiological brain activity

Anıl Berk Delikaya, Tolga Esat Özkurt

Middle East Technical University, Ankara, Türkiye

Objective: Saccade Induced Retrieval Enhancement (SIRE), which refers to memory performance enhancement along with alternating horizontal eye movements, has been of great interest within recent cognitive neuroscience literature. Although rarely, SIRE was also achieved through bilateral tactile stimulation (BLS). There have been two main routes of explanation regarding the SIRE in literature: interhemispheric interaction (IHI) and top-down attentional control (AC) hypothesis. While IHI states that SIRE effect occurs due to the increased interhemispheric communication, AC emphasizes the activity in the frontoparietal attention network. In our study, we investige the neuromodulatory effects of BLS during retrieval based on the aforementioned hypotheses.

Methods: Data consisted of EEG recordings and behavioral responses of twenty university students over a face recognition memory task acquired in METU Neurosignal Lab. In the encoding stage, subjects were presented with human face images. In testing stage, subjects were presented with the encoded human face images intermixed with new face images and asked whether presented stimuli was old or new with and without BLS. Imaginary coherence was computed for six different frequency bands between 11 homologous electrode pairs. Mean ERP amplitudes were calculated for N100 (60–124ms) and P200 (124–190ms) components.

Results: While behavioral analysis showed that subjects have higher response biases ($p<0.05$) in BLS condition ($M=-0.431$) than the control condition ($M=-0.596$), ERP analysis revealed the significant main effect ($p<0.01$) that N100 component had higher amplitude in BLS ($M=-2.9$, $SD=1.9$) compared to the control condition ($M=-1.82$, $SD=1.09$). Moreover, interhemispheric EEG coherence analysis revealed that subjects showed increased connectivity for BLS condition between FT7-FT8 in delta frequency band ($p=0.006$).

Conclusion: Higher response biases and increased N100 amplitudes indicate that BLS modulates top-down attentional control, whereas increased imaginary coherence in BLS condition could be accepted as evidence for IHI. Our research suggest that both explanatory models are not exclusive, but complementary.

Keywords: Bilateral tactile stimulation, recognition memory, EEG, interhemispheric interaction, top-down attentional control

O-73

Mu activity as the indicator of proactive inhibitory control in Stroop test

Mehmet Ergen[1], Merve Akyıldız[2]

[1]Department of Physiology, School of Medicine, Acıbadem Mehmet Ali Aydınlar University, University, Istanbul, Türkiye; [2]Neuroscience PhD Program, Acıbadem Mehmet Ali Aydınlar University, University, Istanbul, Türkiye

Objective: In the Stroop color-word test, it has been shown that in addition to the reaction time prolongation in incongruent stimuli (Stroop effect), it is affected by congruency of the preceding stimuli. This sequence effect, known as conflict adaptation, leads to an implicit expectation of conflict for the upcoming stimulus, and this expectation brings about controlled slow response to even congruent trials. We investigated the effect of conflict expectation on EEG responses in the Stroop test.

Methods: 6 female and 5 male volunteers participated in the study. During the EEG recording of the participants, the computer-based Stroop test (80% congruent and 20% incongruent). Event-related oscillations in the stimulus-locked EEG were compared between congruent stimulus trials preceded by 3 to 5 congruent trial (CC) and congruent stimulus preceded by an incongruent stimulus (IC). The non-parametric cluster-based permutation test of the FieldTrip toolbox was used for statistics of the spatio-temporal differences between the CC and IC conditions of oscillations in 4–15 Hz range.

Results: 12–13 Hz total activity at pre-stimulus [-100 0 ms] and post-stimulus [200–450 ms] was significantly lower in the IC condition than in the CC condition ($p<0.01$ for both time windows). This alpha band desynchronization effect was significantly located over fronto-central region. Fronto-central total theta activity was greater in IC condition at [500 600 ms] ($p<0.05$).

Conclusion: Although IC is a color-word compatible stimulus condition, the expectation of conflict from the previous stimulus leads to prolonged reaction time. Mu desynchronization, starting before the stimulus and continuing after the stimulus, seems to reflect the proactive suppression of the button response. Even though IC is non-conflicting stimulus condition, greater conflict related theta response suggests that those non-conflicting stimuli were somewhat processed as if they have conflict, due to the conflict expectation brought about by the preceding conflicting stimulus.

Keywords: conflict adaptation, Stroop test, mu desynchronization, EEG, event related oscillations

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Determination of the effect of hand and foot movements on speech motor planning in stuttering with the contingent negative variation

Özlem Öge Daşdöğen[1], Gökçer Eskikurt[2], Zeynep Küçük[3], Çiğdem Ulaşoğlu-Yıldız[2], Adnan Kurt[4], Sacit Karamürsel[4]

[1]Department of Speech and Language Therapy, Faculty of Health Science, İstinye University, Istanbul, Türkiye; [2]Department of Psychology, Faculty of Humanities and Social Sciences, İstinye University, Istanbul, Türkiye; [3]Department of Psychology, Faculty of Science and, Literature, Haliç University, Istanbul, Türkiye; [4]Department of Physiology, School of Medicine, Koç University, Istanbul, Türkiye

Objective: Stuttering is a speech disorder characterized by blocks, prolongations, repetitions, and/or tic-like movements occurring in the oro-facial area or extremities, known as secondary behaviors that may accompany stuttering. Although the exact cause of stuttering is elusive, it is known that one of its neural markers is the impairment in motor programming of speech. One of the potentials used to measure the electrical activity of the brain in the motor preparation phase of speech is the "contingent negative variation" (CNV). The aim of this study is to determine whether the limb movements accompanying speech in stuttering have a facilitating or disrupting effect on the motor preparation process of speech.

Methods: Three participants with stuttering and seven fluent participants were included in the study. To detect CNV prior to speech and accompanying limb movements, six channels (C3, Cz, C4, P3, Pz, P4) were used in four different conditions (speech only, hand tapping while speaking, foot tapping while speaking, hand and foot tapping while speaking) recorded. Statistical analysis to determine the difference between two groups (normal and stuttering) inter-subject factor and condition (speech, hand + speech, foot + speech, hand + foot + speech, for CNV in the central and parietal areas according to four different conditions), region (C and P), channel (3, z, 4), and within-subject factors with 2 × 4 × 2 × 3 repeated measure ANOVA.

Results: The group effect was not significant, but CNV is more negative in those with stuttering (-0.93±0.53) than in fluents (-0.19±0.35). Region main effect is significant (Huynh-Feldt $F(1,8)=8.288$, $p=0.021$, $\eta2=0.509$), CNV (-0.8±0.37) in the central area (1.51±0.8) is more negative than parietal (-0.32± 0.28). Group x Condition x Region x Channel interaction is significant [$F(6, 48)=2.405$, $p=0.041$, $\eta2=0.231$]. A borderline significant difference is found for Condition × Channel interaction [$F(6, 48)=2.221$, $p=0.057$].

Conclusion: The limb movements accompanying speech facilitate the motor preparation phase of speech in those with stuttering. It shows that the secondary behavior of those with stuttering supports the fluency of speech. Conducting the study with larger sample groups will contribute to our knowledge about the etiology of both stuttering and secondary behaviors during stuttering.

Keywords: EEG, simultaneous motor movement, stuttering, motor programming, contingent negative variation

O-75

Interhemispheric asymmetry in human brain connectome: quantitative analysis of association tracts via diffusion tractography

Şahin Hanalioğlu[1], Şiyar Bahadır[1], Beyazıt Kayaoğlu[2], Sema Nur Kibrit[2], Ahmet Veli Karacan[2], Efe Gözen[2], Ülkü Uğurlu[2], Burak Erdilli[2], Kader Karlı Oğuz[3], Taghi Khaniyev[4]

[1]Department of Neurosurgery, Faculty of Medicine, Hacettepe University, Ankara, Türkiye; [2]Faculty of Medicine, Ankara University, Ankara, Türkiye; [3]Department of Radiology, Faculty of Medicine, Hacettepe University, Ankara, Türkiye; [4]Department of Industrial Engineering, İhsan Doğramacı Bilkent University, Ankara, Türkiye

Objective: Although human brain appears to be macroscopically symmetrical, it is known that the connectivity of the human brain varies to a certain extent between the right and left hemispheres. In this study, we aimed to investigate whether the thicknesses of the major cortico-cortical association tracts differ between hemispheres.

Methods: Diffusion images of 106 randomly selected subjects from the Human Connectome Project (HCP) dataset were processed using DSI Studio, fiber counts of 17 major association tracts were extracted via deterministic tractography. Mean fiber counts were compared between two hemispheres.

Results: The difference between two hemispheres was statistically significant in 15 of the 17 tracts examined. The five tracts with the greatest difference between fiber counts were arcuate fasciculus, frontal aslant tract, cingulum frontal parietal, superior longitudinal fasciculus 1st and 2nd bundles. Arcuate fasciculus (80214±6561 vs 41524±5528, $p<0.000001$), cingulum frontal parahippocampal (16812±2529 vs 14641±2252, $p<0.000001$), frontal aslant (54453±4579 vs 29757±2396, $p<0.000001$), middle longitudinal fasciculus (24983±4015 vs 17900±1953, $p<0.000001$), uncinate fasciculus (22476±2053 vs 18949±1952, $p<0.000001$) and vertical occipital fasciculus (12624±1346 vs 8874±1169, $p<0.000001$) fiber counts were higher in left hemisphere whereas cingulum frontal parietal (24835±3294 vs 48943±4499, $p<0.000001$), cingulum parahippocampal parietal (13469±1534 vs 18253±1976, $p<0.000001$), cingulum paraolfactory (8800±912 vs 18603±2478, $p<0.000001$), inferior frontooccipital fasciculus (104115±9432 vs 115823±10351, $p<0.000001$), inferior longitudinal fasciculus (82324±7717 vs 95698±8404, $p<0.000001$), parietal aslant (24590±2485 vs 32405±3312, $p<0.000001$), superior longitudinal fasciculus 1st bundle (27936±3243 vs 34744±4769, $p<0.000001$), 2nd bundle (67590±5188 vs 88174±10808, p<

0.000001), 3rd bundle (22864±2595 vs 39729±2595, p <0.000001) fiber counts were higher in right hemisphere. There was no difference between two hemispheres in cingulum parahippocampal and extreme capsule fiber counts.

Conclusion: There are significant differences between hemispheres in terms of thickness of the major association tracts. These differences in fiber counts point to the structural connectivity basis of hemispheric asymmetry and lateralization in the human brain.

Keywords: Connectome, tractography, white matter, fiber, tract

O-76

Confocal microscopy image classification for the mushroom body in Drosophila melanogaster

Maral Dicle Maral, Fatma Başak Aydemir, Arzu Çelik
Boğaziçi University, Istanbul, Türkiye

Objective: In the Drosophila melanogaster (fruit fly) brain, mushroom body structure is specialized for learning and memory functions and is comparable to the human hippocampus. Mutations generated in orthologs of genes responsible for proper axon guidance and functional connectivity in the human hippocampus cause similar connectional problems in the mushroom body. Due to the complexity of the morphology of the mushroom body, it is difficult to interpret the structural changes and requires extensive training of the researchers that are involved. To minimize the time required to classify and interpret the morphological phenotypes as well as the interpretation differences between individuals analyzing the data we aim to make use of artificial intelligence tools.

Methods: Supervised learning is a technique in which models are trained with labeled data to predict the label of the unseen test data. We perform binary classification for fly genotypes, experimenting with shallow machine learning algorithms; SVM (support vector machines), decision tree, naive bayes classifiers and ensemble algorithms: random forest and adaboost. We consider nine different Drosophila melanogaster genotypes in 399 male and female fruit fly samples. Our data is split into training and validation sets by a 0.1 ratio. We optimize the hyperparameters of the best performing classifiers—adaboost and SVM.

Results: We report the precision, recall and F1 measures of the classifier models. Our macro F1 score is 0.6 for SVC. We attain 0.81 F1 score for mut67.3 genotype using SVC as our best-performing classifier. F1 scores for other classes vary between 0.75 and 0.53. We obtained an F1 score of 0.70 for wild type, 0.666 for class mut22.3, 0.60 for mut44.2, 0.58 for mut1.2, 0.60 for mut19.1 and 0.48 for mut67.1.

Conclusion: We demonstrate that machine learning techniques can be utilized to classify different fruit fly genotypes automatically using confocal images of the mushroom body as input. While our results are promising additional data are needed to improve the performance of the classifier models and claim generality.

Keywords: Machine learning, developmental neuroscience, Drosophila melanogaster

O-77

Resting-state fNIRS and machine learning based assessment of vitality

Bora Mert Şahin, Aykut Eken
TOBB University of Economics and Technology, Ankara, Türkiye

Objective: Wellbeing is the potential for self-realization and the ability to cope with stress. Vitality is a concept of wellbeing, which measures person's energy that is accessible for mental and physical activity. Although there are studies on wellbeing prediction using self-report-based tests, their reliability is controversial due to being subjective approaches. Potential markers of vitality are needed to understand the mechanism that represents the vitality. We used Machine Learning and fNIRS to reveal potential biomarkers of vitality.

Methods: We used a rs-fNIRS dataset by Goldbeck et al., 2019. It includes data from 43 subjects, divided into two groups of high vitality (HV) and normal vitality (NV) by a questionnaire. Artefacts such as Mayer waves, respiration and heartbeat were removed using band-pass filters. Motion artefacts and baseline shifts were removed using wavelet-based artefact removal. To use as input for our ML algorithms, functional connectivity matrices were acquired using Pearson's correlation (CC) and DTW. Features were selected by using SVM with linear kernel. We trained and tested multiple classifiers for our ML algorithm such as Nearest Neighbors, Linear SVM, RBF SVM, Gradient Boosting, Naïve Bayes, Linear Discriminant Analysis and Quadratic Discriminant Analysis.

Results: We found the highest accuracy for CC-Fuse (HbO and Hb combined) with the classifiers Linear SVM (mean±std: 0.82±0.04) and the highest accuracy for DTW-Fuse with Naïve Bayes classifier (mean±std: 0.80±0.02). These accuracy values were obtained by connections between Supramarginal Gyrus-Primary Somatosensory Cortex, Somatosensory Association Cortex-Primary Somatosensory Cortex and Somatosensory Association Cortex-Supramarginal Gyrus.

Conclusion: We found that rs-fNIRS data can be used with ML to classify individuals by their vitality levels. We also showed that sub-regions in Parietal Lobe may include potential biomarkers for vitality and that fNIRS is important for biomarker detection since it is inexpensive and more mobile compared to fMRI.

Keywords: Resting-state, fNIRS, Vitality, well-being, dynamic time warping, functional connectivity, Machine learning

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The integrative position of attention networks between cognitive, sensory and motor modules

Hüden Neşe[1], Ahmet Ademoğlu[1], Tamer Demiralp[2]

[1]Institute of Biomedical Engineering, Boğaziçi University, Istanbul, Türkiye; [2]Department of Physiology, Istanbul Faculty of Medicine, Istanbul University, Istanbul, Türkiye

Objective: Graph theory is an efficient tool widely used in neuroscience. While brain regions form the nodes, relationships between brain regions form the edges. Although temporal relations in fMRI studies have mostly been evaluated with correlation coefficients between broadband fluctuations of the BOLD signal, phase-based approaches can provide more refined results. This study, in which it is assumed to be possible for a node to interact with different modules simultaneously in different frequency bands and thus display an integrative feature between the modules, aims to examine the interactions of brain intrinsic connectivity networks (ICN) in the frequency domain.

Methods: Resting state fMRI data (N=96) from Human Connectome Project were decomposed into three frequency bands (0.011–0.038Hz, 0.043–0.071Hz, and 0.076–0.1Hz) and brain graphs were created using an atlas developed by Schaefer et al., consisting of 400 parcels assigned to 7 ICNs. The consistency of the phase difference between the parcel pairs was calculated for each frequency band using the sliding window Fourier Transform. The modular structure of connectivity matrices was determined using consensus clustering. In addition, the hubness of the parcels was examined by calculating the participation coefficients and z-scores.

Results: Consistently, three modules were obtained: visual network-centered, somato-motor network-centered and one including cognitive networks. The nodes of dorsal and ventral attention networks are distributed over these three modules. Some nodes, predominantly in two attention networks, showed different module participation in different frequency bands simultaneously and were therefore called integrative nodes. In addition, the dorsal attention network had significantly higher z-scores than the other networks, and the ventral attention network had significantly higher participation coefficients.

Conclusion: Frequency domain analysis based on phase consistency of brain networks reveals that certain nodes of attention networks play an integrative role between cognitive and sensory or motor modules via signals in different frequency bands.

Keywords: Graph theory, phase-based connectivity, frequency domain, modularity, attention networks

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Comparison of the contamination level of cardiac signal in functional MRI with gas manipulations applied in different protocols

İdiz İset[1], Elif Kurt[1], Onurhan Karatay[2], Ali Bayram[1]

[1]Department of Neuroscience Aziz Sancar Experimental Medicine Research Institute, Istanbul University, Istanbul, Türkiye; [2]Department of Physiology, Istanbul Faculty of Medicine, Istanbul University, Istanbul, Türkiye

Objective: Functional MRI with Gas manipulation is a method that uses carbon dioxide as a stimulus and measures the response of cerebral vessels. While cerebrovascular reactivity provides information about diseases, it may also contribute to more reliable results of functional MR imaging. There are studies on the effectiveness of alternative stimulation protocols in the literature, but the level of the confounding effects on the different protocols has not been adequately examined. In this study, it is aimed to compare the mixing effect of the cardiac signal in the gas manipulation scans performed with the commonly used block design and sinusoidal design.

Methods: In the study, images of 10 healthy volunteers (19–21 years, 5 women) taken with a 3T MR (Siemens) device were used. Images are sourced from the Oxford University Research Archive (Blockley et al. Data acquired to investigate new approaches to cerebrovascular reactivity mapping using MRI. Oxford University Research Archive 2017. doi:10.5287/bodleian: Xk48adQAO). Gas manipulations were performed in protocols containing 45- and 120-second blocks and 60-second cycles. The brain was segmented using structural MR images and the gray-matter, white-matter, and CSF masks were created, and the mean-in-mask signals of the preprocessed functional data were found. The correlation values calculated between these mean signals and the envelope of the cardiac signal were converted to z-values. Values of the block and sinusoidal protocols were compared with the Wilcoxon signed-rank test using SPSS-21.

Results: Wilcoxon signed-rank test showed that the correlation of gray-matter, white-matter, and CSF signals with cardiac signals did not differ statistically between the block and sinusoidal protocols (Z=-0.866 p=0.386).

Conclusion: Monitoring cardiac signals during gas manipulation functional MRI is necessary for both block and sinusoidal protocols. The block and sinusoidal protocols compared in this study did not differ in the level of contamination with the cardiac signal.

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Keywords: Cerebrovascular reactivity, functional MRI, gas manipulation

O-80

The relationship between neural networks of space, time and number perception: a meta-analysis of neuroimaging studies

Hazal Şimşek Ünver[1], Burcu Sirmatel Bakriyanik[2], Beyza Doğanay Erdoğan[3], Metehan Çiçek[1]

[1]Department of Physiology, Faculty of Medicine, Ankara University, Ankara, Türkiye; [2]Department of Interdisciplinary Neuroscience, Graduate School of Health Sciences, Ankara University, Ankara, Türkiye; [3]Department of Biostatistics, Faculty of Medicine, Ankara University, Ankara, Türkiye

Objective: Perceptions of space, time, and number are very important in maintaining normal daily life. However, their neurobiological mechanisms have not been clearly elucidated. ATOM theory (A-Theory-Of-Magnitude), which is one of the most accepted ideas, proposes that these three perceptions occur through partially overlapping neural networks in the context of magnitude. Numerous neuroimaging studies have been conducted on this theory. In our study we aimed to bring together the results of fMRI studies on space, time, and number perceptions, and show the interaction of neural networks underlying these three perceptions.

Methods: As a result of the literature review; 19 articles for space perception, 38 for time perception, and 31 articles for number perception were determined eligible for analysis. Activation coordinates taken from the articles were run through the "GingerALE" meta-analysis program, which uses a statistical method called "Activation Likelihood Estimation" (ALE). A total of 7 meta-analysis results were obtained, including the conjunction analyzes performed in addition to the meta-analysis results for each perception.

Results: Frontoparietal ALE maps were observed for space, time, and number perceptions, and additional basal ganglia activations were observed for time perception. Frontoparietal and insular activations were prominent in double conjunction analyses (E.g. space-number conjunction). In the triple (space-time-number) conjunction analysis, activation was observed in the right inferior parietal, inferior frontal, and anterior insular cortices.

Conclusion: Our conjunction analysis results support that perceptions of space, time, and number occur through partially overlapping neural networks. The parietal and prefrontal cortex regions shown in the triple conjunction analysis are regions suggested to be important in the ATOM theory. The third region, the insula, is a cortical region associated with interoception and salience of stimuli, and insular activation has been reported in previous studies related to space, time, and number perception. The common activation sites shown in our results support the ATOM theory.

Keywords: Magnetic resonance imaging, meta-analysis, time perception, space perception, maximum likelihood estimation

O-81

An investigation on the effect of conflict in supra-second time bisection

Hayriye Aktaş-Dinçer[1], Merve Balık[2], Didem Gökçay[3]

[1]Fatih Sultan Mehmet Vakıf University, Istanbul, Türkiye; [2]Ludwig-Maximilians-Universität, Munchen, Germany; [3]Department of Health Informatics, Middle East Technical University, Ankara, Türkiye

Objective: We used behavioral measures to understand conflict resolution in time perception. We investigated whether the participants' supra-second time judgments are affected by two adjectives ('short' versus 'long') that are congruent or incongruent with the stimuli.

Methods: 28 adults (14 F, mean age 23.07 years) participated in two experiments, where the stimuli are presented with variable durations in the range of 1.25–2.5 seconds: 1) Standard time bisection task, where the stimulus is a red circle, 2) A similar time bisection task where the stimulus is a word ('short' or 'long') displayed under congruent or incongruent durations. The participants responded by indicating whether the stimulus is displayed for a short or long period. The reaction times and accuracies of the shortest (1.25 sec) and the longest (2.5 sec) durations are analyzed using the Wilcoxon Signed Ranks test.

Results: In terms of accuracy, there was a ceiling effect in both experiments: accuracies ranged between 90–94 %, without significant differences between conditions. In terms of reaction times, in the first experiment, there was no significant difference between the shortest and longest stimuli. However, in the second experiment which contained congruent versus incongruent words along with the longest versus shortest durations, mean reaction times were significantly ($p<0.05$) less for the shortest (1135 msec) than the longest (1508 msec) duration. Furthermore, the congruency effect was observed in faster responses for the longest stimuli: congruent (1455 msec) and incongruent (1562 msec) cases differed significantly ($p<0.05$).

Conclusion: This study contributes to the time perception literature by investigating the interference of executive functions. When supra-second time bisection involves conflict, the interference occurs on the order of 2.5 seconds. A priming effect, causing the participants to slow down, exists only during judgments of the longest stimuli (2.5 sec). Furthermore, the congruency effect is observed exclusively for the longest stimuli.

Keywords: Time bisection, conflict resolution

O-82

The relationship between brain hemodynamic response during the working memory task and the depression score

Özge Keleş[1], Erol Yıldırım[2]

[1]Bartın University, Bartın, Türkiye; [2]Istanbul Medipol University, Istanbul, Türkiye

Objective: Depression is a complex disorder that can be caused by psychosocial and biological conditions and it not only effects mood disorders, but also cognitive functions such as memory, decision making, psychomotor speed and attention. As a result of the studies, some findings indicate that depressed individuals perform worse in neuropsychological tests than healthy individuals, while other studies indicate there is no difference between the two groups. In addition to behavioral finding on this subject, neuroimaging studies are also being carried out. These findings suggest that there are functional and anatomical differences at the cortex and subcortical levels in prefrontal lobe.

Methods: This study is consisting of two parts, behavioral and neuroimaging using functional near infrared spectroscopy (fNIRS). BDI was applied to the participants and two groups were formed as low and high according to their scores. The average age of the group with lower BDI score is 23.9±3.04; the average age of the higher group with higher BDI score is 22.2+2.28. A visuospatial 2-back task, which includes 4 different stimulus types with neutral, emotional, verbal, and nonverbal qualities, was applied to the participants.

Results: No significant differences were observed between the two groups in behavioral analyzes based on the correct numbers of the participant in each stimulus type. However, when fNIRS results were examined, it was found that the group with the high BDI scores showed more activation in the right prefrontal cortex during the visuospatial 2-back task compared to the group with low BDI scores.

Conclusion: Although the fNIRS results are consistent in the literature, behavioral findings support some of the findings in literature, while contradicting others. It is thought that the reason for this may be that participants are young, and the 2-back task is not difficult enough.

Keywords: Depression, fNIRS, N-back, PFC, working memory

O-83

Investigation of the effect of pulsed electromagnetic field on cognitive functions via NMDA receptor

Murat Korkmaz[1], Ayşe Demirkazık[2]

[1]Tokat Gaziosmanpaşa University, Guidance and Psychological Counseling Application and Research Center, Tokat, Türkiye; [2]Department of Biophysics, Faculty of Medicine, Sivas Cumhuriyet University, Sivas, Türkiye

Objective: Activation of the NMDA receptor is required for the induction of Long-Term Potency (LTP). With the development of technology, artificial electromagnetic fields have been built. Current neuroscience studies have revealed the effect of electromagnetic field exposure on cognitive functions. Our aim is to evaluate the effect of exposure to a Very Low Frequency Pulsed Electromagnetic Field (ELF-PEMA) on cognitive functions through the N-methyl-D-aspartic acid receptor (NMDAR) pathway.

Methods: In the study, 6 groups were performed with 42 Wistar Albino rats as Sham, PEMA, Agonist, Antagonist, PEMA Agonist and PEMA Antagonist. While ELF-PEMA exposure was applied to the PEMF, PEMF Agonist and PEMF Antagonist groups as 5 mT every other day for 165 minutes for 15 days, they were only kept inside the solenoid every other day. Sham, Agonist and Antagonist groups were kept in the solenoid mechanism for 165 minutes daily for 15 days. The NMDAR agonist NMDA (15 mg/kg; i.p.) and the NMDAR antagonist MK-801 (0.1 mg/kg; i.p.) were injected into the Agonist, Antagonist, PEMF Agonist and PEMF Antagonist groups. Morris Water Maze (MWM) and Passive Avoidance tests were applied to all groups. IBM SPSS.22 program was used for statistical analysis. The conformity of the quantitative data to the normal distribution was tested with the Kolmogorov-Smirnov, Shapiro-Wilk test and graphical evaluations. Wilcoxon Signed Ranks test was used for in-group comparisons of non-normally distributed parameters. Significance was evaluated at the $p<0.05$ level at least.

Results: The change in the percentages of time spent in the target area in the MWM test, which measures the spatial learning and memory performance of ELF-PEMF via the NMDA receptor, does not show a statistically significant difference in intergroup comparisons ($p>0.05$). A statistically significant difference was found between the last1 passive avoidance data according to the groups ($p=0.001$; $p<0.01$). As a result of paired comparisons; the final1 passive avoidance data of the control group were higher than the EMA Antagonist and Antagonist groups ($p=0.015$; $p=0.025$; $p<0.05$, respectively).

Conclusion: ELF-PEMF did not affect spatial memory performance through the NMDA receptor, but it did affect episodic memory and anxiety-like behaviors.

Funding: This study was supported by Sivas Cumhuriyet University Scientific Projects Coordination Unit (Project No: T-898).

Keywords: Pulsed electromagnetic field, cognitive function, nmda

O-84

Latent toxoplasma gondii infection associated with suicidality in mood disorder patients

Ömer Faruk Demirel[1], Özer Akgül[2], Ersel Bulu[3], Ezgi Tanrıöver Aydın[1], Nuray Uysal Cesur[1], Cana Aksoy Poyraz[1], Yaşar Ali Öner[2]

[1]Department of Psychiatry, Istanbul University-Cerrahpaşa, Cerrahpaşa School of Medicine, Istanbul, Türkiye; [2]Department of Medical Microbiology, Istanbul Aydın University School of Medicine, Istanbul, Türkiye; [3]Department of Neurosciense, Brain and Neurodegenerative Disorders Research Laboratory, Institute of Neurological Science / Department of Psychiatry, Istanbul University-Cerrahpaşa, Cerrahpaşa School of Medicine, Istanbul, Türkiye

Objective: T. gondii infection has an impact on human behavior and etiological association with some psychiatric conditions such as schizophrenia and bipolar disorder. Herein, we would like to present preliminary outcomes of an observational study of healthy controls and suicide attempted mood disorder patients.

Methods: Case-control study approach was preferred. Ethical clearance was sought with B.30.2.AYD.0.00.00–480.2/217 protocol number. Eligible a total of 147 BD and 161 MD patients as a case group, and 310 volunteers, without any history of psychiatric diagnosis and suicide attempt, as a control group was included. The data of mood disorder patients diagnosed with SCID-5 were collected from the Department of Psychiatry, Istanbul University-Cerrahpaşa. To detect the prevalence of the latent T.gondii infection, T.gondii IgG and DNA were assessed by ELISA and real-time PCR. All relevant data were evaluated by statistical methods.

Results: There were no statistical differences between patients and healthy individuals regarding age and gender. Overall, T. gondii seropositivity rates were calculated as 57.1% in BD, 29.2% in MD, 64.8% in suicide attempters, and 21.3% in healthy individuals. Number of patients attempted to suicide, irrelevant the diagnosis, was significantly linked with T. gondii positivity detected by ELISA (OR= 12.44; 95% CI= 6.85–22.57; p< 0.001) and PCR (OR= 2.32; 95% CI= 1.26–4.28; p= 0.006). To conduct the binary logistic regression, the presence of T. gondii status was adjusted with sociodemographic data. Stratified analyses of the T. gondii seropositivity was a predictor in BD (OR= 3.56; 95% CI= 2.19–5.80; p< 0.001) and suicide attempters (OR= 17.17; 95% CI= 8.12–36.28; p< 0.001).

Conclusion: We speculate that T. gondii has a relationship between suicidal behavior on the mood disorders and etiology of BP. In conclusion, prospective further research focusing on this association is needed.

Keywords: Mood disorders, suicide attempt, toxoplasma gondii, etiology, seromolecular

O-85

Determining the relationship between the performance of stroke individuals belonging to three cognitive assessment tools

Aleyna Uçar, Dilan Günerhan, Zeynep Fidanlık, Özlem Öge Daşdöğen, Serkan Bengisu

Istinye University, Istanbul, Türkiye

Objective: Conceptualization and language impairment in individuals who develop aphasia after stroke may be caused by cognitive difficulties, language or exacerbated.This study was compared the three assessment tools used in the evaluation of cognitive performance in terms of measurement characteristics applied to individuals with aphasia in the acute period after stroke and determine the correlation between them.

Methods: The cognitive performance of the participants who were determined to have aphasia with Aphasia Rapid Test (ART) sensitive to aphasia in individuals in the acute post-stroke period and who agreed to participate in the study were evaluated by the Montreal Cognitive Assessment (MOCA), Cognitive Assessment Scale for Stroke Patients (CASP) and Mini-Mental State Examination (MMSE). 14 participants were diagnosed with aphasia in the acute post-stroke period and two groups of 14 healthy participants matched in terms of age, sex, and education levels were compared in terms of their cognitive performance. Also, Pearson correlation analysis was performed between the scores obtained from cognitive assessment tools within the groups.

Results: In all results, the aphasia group performed less than healthy participants (p=0.001; p<0.01).The highest total scores were obtained from CASP, MMSE, and MOCA.There was a positive correlation between the scores of both groups from the three scales. While the highest correlation between these three evaluation tools was determined between MMSE and MOCA (r=.920, p<0.01), CASP, which was developed to measure cognitive performance in aphasia, showed a high correlation with MMSE (r=.554, p<0.05) and MOCA (r=.521, p>0.05)

Conclusion: Consequently, the three assessment tools were correlated with each other. CASP, has a higher correlation with MMSE than MOCA. So, MMSE is more valid than MOCA. The use of aphasia-specific scales such as CASP or the development of scales in this direction may provide a reliable assessment of the cognitive component of aphasia.

Keywords: Aphasia, aphasia cognitive assessment, cognitive assessment scale for stroke patients, mini mental test, montreal cognitive assessment.

O-86

Adaptation of Oxford Cognitive Screen into Turkish: validity and reliability study in stroke patients

Özlem Oğuz[1], Bülent Toğram[2]

[1]Üsküdar University, Speech and Language Therapy, Istanbul, Türkiye; [2]Speech and Language Therapy, İzmir Bakırçay University, Izmir, Türkiye

Objective: It is crucial to assess any cognitive issues that stroke survivors may have for the treatment and rehabilitation procedure to be effective. In terms of scope and user limitations, cognitive assessment tests used in our country have several disadvantages. Therefore, the validity and reliability analyses of the "Oxford Cognitive Screen (OCS)", a well-known cognitive assessment test, were conducted in this study.

Methods: The study included 92 healthy participants (37 women and 55 men) and 114 stroke survivors (72 men and 42

women). Participants with strokes were divided into three groups: "right," "left," and "bilateral." The majority of study participants (n=66, 57.89%) had left hemisphere injury, while the minority of patients (n=5, 4.38%) had bilateral damage. 'Participant Information Form, The Oxford Cognitive Screening Test (TR), Aphasia Language Assessment Test, Montreal Cognitive Assessment Test, Barthel Activities of Daily Living Index, and "Beck Depression Test" were used to collect data. The Spss package program was used to analyze the data. Internal consistency-objectivity-stability-equivalence analyses were conducted as part of the reliability analysis, and the validity of the content-structure-criterion was also assessed.

Results: The OCS-TR scale could be used to assess the cognitive capabilities of Turkish-speaking stroke participants, according to data acquired after validity and reliability analyses.

Conclusion: The commonly used MMSE and MOCA were shown to be insufficient for detecting post-stroke cognitive impairment, especially as they are insensitive to complex cognitive issues, and the accuracy of the data obtained has been questioned. Moreover, MMSE and MOCA scales are insufficient for the purpose of performing a more comprehensive and subtest-specific assessment since they cannot provide detailed information in evaluating the cognitive abilities of stroke participants and are mostly completely dependent on verbal output. Another assessment tool has become necessary and the OCS-TR scale will meet this necessity as a valid and reliable measurement tool, according to the validity and reliability data obtained.

Keywords: Stroke, cognitive skills, Oxford Cognitive Screen

O-87

Argument structure processing in aphasia: an eye-tracking study

Özgür Aydın[1], Ayşen Köse[2], Aydan Baştuğ Dumbak[2], Meral Didem Türkyılmaz[3]

[1]Department of History and Geography, Linguistics, Faculty of Language, Ankara University, Ankara, Türkiye; [2]Department of Speech and Language Therapy, Faculty of Health Sciences, Hacettepe University, Ankara, Türkiye; [3]Department of Audiology, Faculty of Health Sciences, Hacettepe University, Ankara, Türkiye

Objective: Arguments that contribute to verb meaning are labeled as thematic roles. For instance, sentences containing the verbs düşmek/koşmak have no object arguments (intransitive), whereas sentences containing the verbs düşürmek/koşturmak are determined to have objects (transitive). Intransitive verbs differ in what kind of roles their subjects take, which is postulated by the Unaccusative Hyphothesis: The subject of the intransitive verb düşmek takes a theme role, while the subject of the intransitive verb koşmak takes an agent role. Previous studies on agrammatic aphasia were based on the assumption that verbs with a greater number of arguments are more difficult to process, as predicted by the influential Argument Structure Complexity Hypothesis (ASPH). There are many cases in Turkish where transitive verbs are derived from intransitive verbs with causative morphemes. Thus, Turkish provides a suitable environment to test the transitivization effect in agrammatic aphasia. The aim of this study is 1) to reveal the effect of transitivization on the online sentence processing in Turkish-speaking agrammatic aphasia and, 2) whether there is a processing difference between the intransitive verb types.

Methods: In this study, participants [aphasia (n=18) & control (n=18)] listened to sentences (n=160) including these four types of verbs. While listening, two pictures in which one of two pictures was strongly related to the argument of the verb were shown on the screen and eye movements were monitored.

Results: Linear mixed effect model revealed that the main effects of group and verb type were significant for accuracy and reaction time. The results of GAMM analysis showed that the group effect in transitive verbs was significant, but not in intransitive verbs.

Conclusion: These findings confirm the ASPH, but reveal that there is no hierarchy of difficulty for agrammatic aphasia among the verb types that differ according to the Unaccusative Hyphothesis.

Funding: This study is supported by TÜBİTAK (number: 11S608).

Keywords: Aphasia, argument structure, transitivization, unaccusative verbs, Argument Structure Complexity Hypothesis

O-88

Effect of reading direction on pseudoneglect phenomenon

Elmas Gülcan Atalar, Özgür Aydın

Department of Interdisciplinary Neuroscience, Ankara University, Ankara, Türkiye

Objective: In healthy individuals, the dorsal attention network is represented bilaterally in both hemispheres, while the ventral attention network is lateralized to the right hemisphere. As a result of this lateralization, there is an attentional bias towards the left visual area. This bias is called "pseudoneglect". The present study aimed to examine the effect of reading direction on the pseudoneglect.

Methods: The study was conducted with a total of 67 participants (38 M, mean age=34; sd=12.56) with reading direction from left to right (Turkish-Monolingual), right to left (Arabic-Monolingual), or bidirectional (Turkish-Arabic Bilingual. Arabic-Turkish Bilingual). The experiment was based on detecting the visual signal presented in the left or right peripheral area, following neutral face stimuli.

Results: Response time in the left-signal condition of the Arabic- Monolinguals (mean=902 ms) was significantly longer than that of the Turkish-Monolinguals (mean=439 ms) ($t=3.24$; $p<0.01$). This difference was significant in the 20–35 age range, it disappeared around the age of 40. There was no difference in response times in the bilingual groups who have experience of bidirectional reading. The pupil size of the Turkish-Monolinguals was larger than the Arabic-Monolinguals in both left and right signal conditions, this difference persisted in almost the entire time of 3000 ms. In the bilingual groups, the pupil size of Turkish-Arabic bilinguals was larger than the Arabic-Turkish bilinguals in the 1500–1700 ms section only in the left position condition.

Conclusion: Although attention was dominant in the left spatial area in left to right readers, this dominance disappeared in bidirectional readers. These findings show that although there is a physiological dominance of attention towards the left-peripheral area in healthy individuals, this dominance is modulated by age and cultural factors such as reading direction.

Keywords: Pseudoneglect, reading direction, bilingualism

O-90

Vaccine hesitancy and decision making under uncertainty

Hasan Demirci, Ahmet Fatih Sarıkaya, Hanife Merve Çatan, Ülkü Tankut

Department of Psychology, University of Health Sciences, Istanbul, Türkiye

Objective: Since it is assumed that individuals make their decisions about vaccination by comparing risks, risk perception is among the important factors affecting vaccination. Numerous studies show that the interpretation of risk is often not based on a rational approach but on the "uncertainties" approach, where doubts arise despite scientific evidence. The decision to vaccinate can be influenced by cost-benefit analysis and emotional processes. The aim of the study is to compare the decision-making processes of vaccinated (V+) and unvaccinated (V-) individuals under uncertainty.

Methods: The study included 70 V- and 70 V+ participants matched for age, sex, and education. Sociodemographic Data Form, Beck Depression Inventory (BDI), Beck Anxiety Inventory (BAI), Barratt Impulsivity Scale Short Form (BIS-11-SF), Vaccine Hesitancy Scale (VHS), and Iowa Gambling Test (IGT) were administered to the participants.

Results: A statistically significant difference was found between V- and V+ in terms of VHS sub-dimensions and total scores ($p<0.001$). A statistically significant difference was observed between the groups in the IGT-5 sub-dimension ($p<0.05$). Although there was no statistically significant difference in IGT-total and other sub-dimensions, V- participants were more likely to choose from a risky deck. A statistically significant negative correlation was found between IGT-5 and the benefit of vaccination, solutions for not getting vaccinated, and VHS-total score ($r=-.21$, $p<.05$, $r=-.23$, $p<.01$, $r=-.19$, $p<.05$, respectively). Similarly, there was a statistically significant negative correlation between the IGT-Total score and the sub-dimension of solutions not to be vaccinated ($r=-.20$, $p<.05$).

Conclusion: In the task of making decisions under uncertainty, the V- group made more choices from disadvantageous and risky decks in the long term and was prone to take risks under uncertainty. The impact of emotional processes should be taken into account in the risk assessment against vaccination.

Keywords: Vaccine hesitancy, decision making, risk taking, uncertainty

Poster Presentations

(P-01 — P-60)

P-01

Which face represents me? The neural responses of a face transplant patient to his previous and current face

Evrim Gülbetekin[1], Seda Bayraktar[1], Ömer Özkan[2], Özlenen Özkan[2], Hilmi Uysal[3], Halil Ömer Çolak[4], Abdullah Utku Şenol[5], Ayhan Şavklıyıldız[4]

[1]Department of Psychology, Faculty of Letters, Akdeniz University, Antalya, Türkiye ; [2]Department of Plastic and Reconstructive Surgery, Faculty of Medicine, Akdeniz University, Antalya, Türkiye; [3]Department of Neurology, Faculty of Medicine, Akdeniz University, Antalya, Türkiye; [4]Department of Electrical and Electronics Engineering, Faculty of Engineering, Akdeniz University, Antalya, Türkiye

Objective: To examine the neural responses of a face transplant patient (FTP) for his old and new faces.

Methods: One FTP and ten male control subjects participated in the study. Previous and current facial photographs of the participants and photos of strangers were used as stimuli. Participants 'own faces (previous or current) or strange male faces were presented in the experimental sessions. The participants were asked to discriminate between their own faces and other faces. Stimuli were presented by E-Prime 3.0. After the presentation of fixation dot for 2 sec., stimuli were randomly presented for 1000ms. ITI was 2200 ms. Brain signals were recorded via 64channel EEG system. N170 amplitudes were derived from posterior electrode sites O1/O2, P7/P8, and PO7/PO8. N170 responses were determined (100–250 ms) via Brain Vision Analyzer. ERPs were averaged from 200 ms before to 1000ms after stimulus onset.

Results: Repeated measures ANOVA was conducted to determine the effects of stimulus on N170 responses for each electrode site. A significant stimulus effect was found for O1 $F(2, 18)=7.36$, $p=.005$, $\eta p2=.45$ and P7 $F(2,18)=7.36$, $p=.033$, $\eta p2=.31$. The amplitude of P7 for previous faces (M=-9.79, SS=4.78) was higher than that for their current faces (M=-7.5,SS=4.28) in the controls. The amplitude of O1 for previous faces (M=-9.79, SS=4.78) was also higher than that for their current faces (M=-7.5, SS=4.28). On the other hand, the N170 responses of FTP for each category (P7: previous=-22.47; current= -11.12; strange= -16.33; O1: previous= -17.38; current= -9.78; strange= -12.20) were higher than that of the controls. Descriptive statistics indicated that FTP responded to his current face like the control group; however, his responses for his previous face and other faces were higher than that of the controls.

Conclusion: FTP adopted its new face as in the control group; however, his responses to his old face were different in comparison to the controls. This study is a part of the research project supported by Akdeniz University Scientific Research Projects Coordination Unit. Project Number: SBA-2019-4254.

Keywords: Face, face perception, face transplantation, self-face perception

P-02

Investigation of brain functional connectivity in the scene perception process

Ulaş Ay[1], Tamer Demiralp[2]

[1]Istanbul University, Hulusi Behçet Life Sciences Research Laboratory - Neuroimaging Unit, Istanbul, Türkiye; [2]Department of Physiology, Istanbul Faculty of Medicine, Istanbul University, Istanbul, Türkiye

Objective: People can reliably and quickly recognize objects and scenes composed of many objects. Although the existence of various cortical regions in the visual system during the perception of scenes has been defined, the interconnectivity of these regions, both among themselves and with other brain regions, has not been sufficiently studied yet. This pilot study aims to examine the connectivity changes that occur in the brain during the perception of the scenes with the psychophysiological interaction model based on intrinsic connectivity networks.

Methods: Functional magnetic resonance imaging (fMRI) data were collected from 4 healthy participants during the scene perception task. CONN software was used in the analysis of fMRI data. In terms of intrinsic connectivity networks, 100 cortical regions were defined, and the interconnectivity of these regions in the psychophysiological interaction model was examined using the network-based statistics method. Connection threshold uncorrected $p<0.005$; network threshold was determined as $p<0.05$ by applying family-wise error correction.

Results: In addition to increased connectivity within the visual network, it was found to increase the connectivity of the visual network with the frontoparietal network and the dorsal attention network. Besides, it was determined that the connectivity of the dorsal attention network within itself and with the ventral attention network increased.

Conclusion: It is assumed that scene perception is mainly based on visual modality. Our findings reveal that various

attention networks may have an important role in the perception of scenes in addition to the visual network.

Funding: This study was supported by TUBITAK (Project No: 122S654).

Keywords: Scene perception, functional magnetic resonance imaging, intrinsic connectivity networks, psychophysiological interaction, network-based statistic

P-03

Assessing the neurovascular reactivity during physiological tasks with fNIRS

Emre Yorgancıgil, Ata Akın, Sinem Burcu Erdoğan, Gülnaz Yükselen

Acıbadem Mehmet Ali Aydınlar University, Istanbul, Türkiye

Objective: Functional near infrared spectroscopy (fNIRS) has gained interest as a mobile imaging technology for interpreting the neuro-vascular coupling mechanism in the human brain. Physiological-task induced alterations leads to an increased local metabolic rate of oxygen consumption which results in an increase in local oxygenated blood flow called hemodynamic activity. Cerebral reactivity concept is vasodilation and vasoconstriction response of cerebral arterioles during the cerebral blood flow changes. In our study, we aimed to measure how cerebral reactivity and hemodynamic activity changes with applying series of physiological conditon and tasks.

Methods: We applied a series of physiological tasks to participants to assessing cerebrovascular reactivity in prefrontal (PFC) and occipital (OFC) regions of cerebral cortex. 9 healthy participants (6 males, 3 females) attended in our study. Four different physiological condition and tasks (light stimuli, hyperventilation, hypoventilation and head down, wait and head up) were executed by participants in a random order with three repeats each physiological task. fNIRS recordings were taken while the participants executed the physiological tasks.

Results: Preliminary data of the fNIRS recordings demonstrated that recording quality is better at PFC locations than OFC locations across all participants with all experimental tasks. Head movements triggered the strongest hemodynamic activity than all other physiological tasks, statistically strong significant in PFC locations (Max amplitude mean difference=17.4, $p<0.001$). In PFC regions, head movements were responded with higher hemodynamic activity than hypoventilation and light stimuli (Max amplitude mean difference=9.4, 12.9; $p<0.05$).

Conclusion: At the first look, better signal quality shows that fNIRS method is well suited for PFC regions to measuring cerebrovascular reactivity. Head movements has ruling effect on hemodynamic activity while light stimulus was responded with lowest hemodynamic activity. fNIRS is mobile and has naturalistic enviroment friendly settings which creates robust signal with less motion artefact, so can be a proper neuroimaging method to assessing cerebrovascular reactivity with breath and head movement tasks in healthy people.

Keywords: Cerebrovascular reactivity, hemodynamic activity, fNIRS

P-04

Investigation of the effect of different emotion content on time perception in auditory modality

Ayşe Esra Karakaya, Edanur Alış, Ecenur Çimen, Zeynep Yıldız

Fatih Sultan Mehmet Foundation University, Istanbul, Türkiye

Objective: Current studies show that time perception and emotions are related, and emotions may play a role in subjectivity. This study aimed to investigate the role of emotions on time perception.

Methods: "verbal time estimation" method was used to examine the effect of positive and negative emotions on time perception. To eliminate the order effect problem, the participants were divided into two groups (A and B groups), using the counterbalancing technique. Group A received positive emotional auditory stimulus (PAS), neutral auditory stimulus (white-noise) and negative emotional auditory stimulus (NAS); group B received, NAS, neutral content and PAS for 300 sec, in this order. The SAM (Self Assessment Manikin) form and the Post-Auditory Modality Measurement Form were utilised to measure the mood after each stimulus and get estimation of duration from participants.

Results: One-Way Analysis of Variance for Dependent Samples performed to examine to explore if there is a statistically significant difference between the mean scores of the four measurement points obtained from the SAM test scores; a significant difference was observed between the mean scores ($F(1-33)=781.268$; $p<0.001$, $n2=0.96$). This shows that manipulation affected the participants' emotions. Wilcoxon Signed-Rank Test was used to compare the percentage of difference (PDD) in estimating the duration of the positive emotional auditory modality and the percentage of difference in estimating the duration of the neutral condition; PDD average was significantly lower than the neutral condition ($p<0.05$). It was found that the participants' mean percent difference in estimating the negative affect modality duration (NDD) was significantly lower than the mean difference percentage in estimating the duration in the neutral condition ($p<0.01$). However, when the time perception was tested in PDD compared to NDD, no statistically significant difference was found ($p>0.05$).

Conclusion: These results show that the emotional-auditory modality affects time perception regardless of its content. Moreover, positive and negative emotions change the time perception in the direction that time flows fast.

Keywords: Emotion manipulation, subjective time, time perception

P-06

Comparison of theory of mind skills across different phases of the menstrual cycle

Özge Yılmaz

Department of Interdisciplinary Neuroscience, Ankara University, Ankara, Türkiye

Objective: Hormonal fluctuations during the menstrual cycle (MC) is associated with a variety of psychological changes. It is known that emotion recognition and empathy skills are increased during the ovulation period. Theory of Mind (ToM) is a complex skill with affective and cognitive components and it is not yet known whether this skill is altered during the MC. The purpose of this study is to investigate the ToM skills of women in different phases of MC.

Methods: Information on MC length, how many days have passed since their previous menstruation and factors affecting MC and gonadal hormones were collected from 256 females between 22–25 of age and they were given two ToM tasks [Humor Comprehension and Appreciation Test (HCAT) and Reading the Mind from the Eyes Test (RMET)] on the same day. Data from participants who declared factors impacting MC (n=21) and cycles out of the 25–32 days range (n=27) were excluded from the dataset. MC phase was determined for each participant (n=208) based on the information they provided and ToM scores were compared between three groups [menstruation (n=44), proliferative (n=72) and secretory (n=92)] with ANOVA. Then the participants in the periovulation phase (PO, n=56) were grouped and ToM scores were compared against the others (n=152) with independent samples t-test.

Results: There was no difference in ToM scores between the women in menstruation, proliferative and secretory phases. PO group scored higher on the mentalizing subscales of the HCAT but not the non-mentalizing subscale or RMET; $t(206) = -2.262$, $p=0.025$.

Conclusion: Although no difference was observed among three phases of MC, women in the periovulatory period displayed higher cognitive ToM skills compared to women in other phases.

Keywords: Menstrual cycle, theory of mind, ovulation, estradiol

P-07

Effect of sound localization ability on FPS players' performance

Yunus Emre Balcı[1], Elif Toprak[2], Filiz Yönyüksel[1], Itır Kaşıkçı[3]

[1]Department of Psychology, İstanbul Commerce University, İstanbul, Türkiye; [2]Department of Electrical and Electronics Engineering, Yeditepe University, İstanbul, Türkiye; [3]Department of Psychology, Bahçeşehir University, İstanbul, Türkiye

Objective: Sound localization is the ability to locate sound sources. In first person shooter (FPS) games, player can use this skill to detect an approaching target even though it is not within the sight. The aim of this study is to examine relationship between the sound localization skills of FPS players and their game success.

Methods: Eight players (1 female) between ages of 18–24 participated. They had no past or current auditory impairment and were playing FPS games for at least five years. Players were grouped as good (5) and bad (3) according to success level. In this study, footsteps were heard from three of 4 speakers placed around computer screen while gunfire was heard from one of them. Participant was asked to localize gunfire. 6 sets with 64 trials were given. Gunfire was apparent in half of sets (easy condition) and hidden in other half (hard condition). Behavioral data was recorded with MATLAB, EEG with 19-channel MITSAR Smart-BCI system and Win-EEG software.

Results: Correct answers of good players were higher than incorrects in both conditions ($p<0.043$). Good players showed more negative N2 amplitudes in easy condition corrects compared to incorrects ($p<0.001$) and shorter N2 latencies compared to hard condition ($p<.001$). All answers (correct+incorrect) of both groups gave more negative amplitudes at hard ($p<0.001$) shorter latencies at easy condition ($p<0.001$).

Conclusion: Increasing N2 amplitudes at hard condition points difficulty of task and shortening of N2 latencies at easy condition points fastening of detection. Good players' correct answers having shorter latencies at easy condition compared to hard condition signifies early detection. Data collection phase of this research continues.

Keywords: Sound-localization, EEG, first person shooter, FPS, video game

P-08

The relationship of brain hemodynamic responses to anxiety score during an emotional working memory task

Özge Keleş, Ersin Yavaş

Bartın University, Bartın, Türkiye

Objective: Anxiety has adverse behavioral outcomes that affect daily life. Also, it is believed that stress-induced anxiety some-

how limits memory capacity. Studies show that there is a material-specific hemispheric asymmetry in the working memory process; the ventrolateral part of the prefrontal cortex is related to keeping information online, the anterior portion is the central executing of the working memory, and the dorsolateral part is connected to manipulating information. The left ventrolateral region is verbal, and the right ventrolateral area is related to the retention of non-verbal material. Hence, in the present study, the hemodynamic recording primarily compromised the prefrontal cortical regions.

Methods: Our work consists of two parts; behavioral assessment by performing Beck Anxiety Inventory (BAI) and cognitive assessment by performing Near Infrared Spectroscopy (fNIRS). Participants were given the BAI prior to experiment and they were assigned into two separate groups based on higher or lower scores obtained from the BAI.

Results: The average age for the group with higher anxiety score is 22.28, while the group with lower anxiety score is 22.14. Analysis showed that there is no significant sex difference between groups. To assess the working memory, a visual-spatial 2-back task including emotional facial stimuli has been applied to participants. The current study showed no significant difference between high and low anxiety-scored groups in behavioral analysis based on the correct number of participants. Further, the fNIRS analysis showed no significant difference between channels.

Conclusion: Our results consisted of previous studies that show anxiety, to some degree, has no significant impact on working memory. It is thought that the reason why we did not see a significant difference between the groups in our study may be due to the small sample size and the fact that the 2-back task was not difficult enough.

Keywords: Anxiety, FNIRS, N-back, PFC, working memory

P-09

Determination of the relationship between sulfide toxicity and depression by behavioral experiments

Narin Derin, Mustafa Munzuroğlu, Ceren Kencebay Manas, Çiğdem Saraç

Akdeniz University, Antalya, Türkiye

Objective: In this study, it has been aimed to determine the relationship between sulfide toxicity and the pathophysiology of depression using behavioral experiments.

Methods: One hundred Wistar rats (3-month-old - male) were divided into 4 groups as control (K), S25, S100 and S260 in our study. S25, S100 and S260 groups were given sodium metabisulfite by gavage at a dose of 25 mg/kg/day, 100 mg/kg/day and 260 mg/kg/day, respectively, for 35 days. The control group was given tap water by gavage for the same period of time. Upon completion of the gavage application, all groups were subjected to the open field, elevated plus maze and sucrose preference test to determine depression levels.

Results: In the elevated plus maze test, the time spent in the open arm by the S260 group was significantly higher compared to the K group (0.01). In the open field test, it was determined that the total distance taken by the S25, S100 and S260 groups was higher than the K group, but this difference was not statistically significant. Evaluating the time spent in the inner quadrants in the open field test, it was observed that the time spent by the S25 ($p<0.01$), S100 ($p<0.05$) and S260 ($p<0.01$) groups was significantly higher than the K group. In the sucrose preference test, it was determined that the amount of sugary water consumed by the S25 and S100 groups was lower than the K group, but this difference was not statistically significant. The sugary water consumed by the S260 group was found to be significantly higher than the K group ($p<0.05$).

Conclusion: The findings obtained from behavioral experiments indicate that sulfide toxicity may trigger depression.

Funding: This study is supported by Akdeniz University within the framework of scientific research projects (TDK-2021-5579).

Keywords: Depression; sulfites; behavioral tests

P-10

Evaluation of phonological working memory in secondary progressive multiple sclerosis

Melis Buse Altun[1], Özlem Öge Daşdöğen[2], Melih Tütüncü[3]

[1]Department of Health Sciences, Istinye University, Istanbul, Türkiye; [2]Department of Health Sciences, Fenerbahçe University, Istanbul, Türkiye; [3]Department of Neurology, Cerrahpaşa Faculty of Medicine, Istanbul University-Cerrahpaşa, Istanbul, Türkiye

Objective: Multiple sclerosis is an inflammatory demyelinating disease that affects the central nervous system, with neuroinflammation and neurodegeneration that can involve the cortex and deep gray matter, being more intense in the white matter. Various motor, sensory, cerebellar and cognitive symptoms can be observed in multiple sclerosis. Cognitive impairment is a feature of multiple sclerosis, but it is not known exactly when and to what extent cognition is affected in patients with multiple sclerosis. Working memory is one of the most important structures in performing cognitive functions. Working memory is defined as the system or systems necessary for keeping information in mind while performing complex tasks such as reasoning, understanding and learning. Although the number of studies examining phonological working memory in individuals with secondary progressive multiple sclerosis is limited, there is evidence of influence. The aim of this study is to eval-

uate phonological working memory in individuals with Secondary Progressive Multiple Sclerosis.

Methods: Three secondary progressive multiple sclerosis and 10 healthy participants participated in the study. Mini-Mental State Examination Test was applied to the participants and people with normal cognitive skills who scored between 24–30 were included in the study. Turkish Nonword Repetition Test consisting of 16 words was applied by matching age, gender, and education levels. The words were played to the participants via computer software and the participants were asked to repeat the words they heard. The number of repeated correct words was examined.

Results: Participants with secondary progressive multiple sclerosis performed fewer correct word repetitions than healthy participants (Mann Whitney U test; U=1; p=0.016<0.05). While healthy participants could repeat seven nonwords correctly on average, participants with SPMS had an average of two nonword repetitions.

Conclusion: Findings from this study indicate that phonological working memory may be affected in patients with secondary progressive multiple sclerosis. It is thought that studies with larger sample groups in order to examine the influence of phonological working memory in multiple sclerosis subtypes may present different phonological working memory phenotypes in different multiple sclerosis types.

Keywords: Nonword repetition, working memory, phonological working memory, multiple sclerosis, Secondary progressive multiple sclerosis (SPMS)

P-11

C-Fos expression in the hippocampus following conditioned context aversion learning in mice

Çınar Furkan İlhan[1], Esra Ülke[1], Gonzalo Urcelay[2], Sezen Kışlal[1]

[1]Department of Psychology, Middle East Technical University, Ankara, Türkiye; [2]School of Psychology, University of Nottingham, Nottingham, UK

Objective: The high emetogenicity of chemotherapy results in cancer patients developing anticipatory nausea and vomiting (ANV). ANV is an example of classical conditioning which occurs as a result of associations between contextual cues in the hospital and chemotherapy-induced illness. In this study, we investigated the neural correlates of ANV by assessing c-Fos expression (a putative marker of neuronal activity) after conditioned context aversion (CCA) learning, an animal model of ANV that we have successfully developed.

Methods: Twelve-week-old CD1 male mice were divided into two control groups; NaCl-Context B (n=18) and LiCl-Context A (n=18); and one experimental group LiCl-Context B (n=18). During conditioning, animals in the LiCl-Context A group received injections of LiCl in their home cages (Context A). Animals in NaCl-Context B and LiCl-Context B groups received injections of NaCl and LiCl in the conditioning context (Context B), respectively. Six animals of each group were perfused exactly 1 hour after the conditioning for the evaluation of c-Fos expression. CCA memory was tested with the remaining 12 animals in a 15-minute retention trial 72 hours after the conditioning. Amount of water intake was used as an index of aversion.

Results: During the retention test, LiCl-Context B group exhibited significantly decreased water consumption compared to the controls (LiCl-Context A and NaCl-Context B), indicative of successful CCA development (p<0.001). c-Fos expression of LiCl-Context B group was significantly higher in the CA1-CA2 (p<0.001) and the dentate gyrus (DG) (p<0.001) subregions of the hippocampus compared to controls.

Conclusion: The establishment of an association between a context and illness correlates with specific neuronal c-Fos expression within the CA1-CA2 and DG indicating a role for the hippocampus in the formation of CCA. Future studies should investigate the causal involvement of this brain region in the establishment of CCA.

Keywords: Mice, anticipatory nausea, conditioned context aversion, c-Fos, hippocampus

P-12

The effects of GABAergic or cholinergic ventral pallidal lesions on cognitive & affective processes

Cem Sevinç[1], Cemal Akmeşe[1], Sahar Halim[1], Güneş Ünal[2]

[1]Department of Cognitive Science, Boğaziçi University, Istanbul, Türkiye; [2]Department of Psychology, Boğaziçi University, Istanbul, Türkiye

Objective: We assessed the modulatory effects of Ventral Pallidum (VP) GABAergic and cholinergic neurons on cognitive and affective processes via selective immunotoxin lesions.

Methods: GAT1-Saporin (n=8), 192-IgG-Saporin (n=8), or PBS (vehicle, n=8) were stereotaxically injected into the VP of 24 male Wistar rats. Forced swim test (FST), open field test (OFT), elevated plus maze (EPM), Morris water maze (MWM), and fear conditioning were performed. Activity in the OFT, EPM, and MWM were analyzed using DeepLabCut. Four rats received intraventricular colchicine injections following fear conditioning. Immunofluorescent antibodies were used to visualize parvalbumin (PV), choline acetyltransferase (ChAT), and γ-aminobutiric-acid (GABA) immunoreactive neurons. Leu-enkephalin labeling was used to determine VP borders. Statistical tests were performed in GraphPad-Prism. Between-group analyses were done using one-way or two-way ANOVA.

Results: GAT1-Saporin ($p<0.05$) and 192-IgG-Saporin ($p<0.05$) reduced behavioral despair in the FST. Similarly, GAT1-Saporin ($p<0.05$) and 192-IgG-Saporin ($p<0.05$) increased active climbing in the FST. No difference was observed in general locomotor activity or anxiety-like behaviors assessed in the OFT or EPM. Cholinergic lesions impaired spatial memory in the MWM ($p<0.05$). During the acquisition phase of fear conditioning, GABAergic lesions caused more frequent jumping ($p<0.05$) while both lesions led to enhanced darting ($p<0.05$). The 192-IgG-Saporin group showed reduced freezing ($p<0.05$) in the same context extinction trials, whereas both lesion groups froze less ($p<0.05$) during novel context extinction when compared to the vehicle group.

Conclusion: The GABAergic and cholinergic VP neurons contribute to behavioral despair and passive fear responses by suppressing active coping. These neuronal groups may constitute therapeutic targets in the treatment of affective disorders.

Funding: This research was funded by an EMBO Installation Grant to GU.

Keywords: Ventral pallidum, GABA, acetylcholine, depression, active coping

P-13

Assessing the therapeutic effects of ketamine on behavioral despair and anxiety models

Dilan Gökalp, Güneş Ünal

Department of Psychology, Behavioral Neuroscience Laboratory, Boğaziçi University, Istanbul, Türkiye

Objective: This study assesses the effect of ketamine, an atypical antidepressant binding to the N-methyl-D-aspartate receptor (NMDAr), on affective processes. The therapeutic effects of ketamine are tested in behavioral despair, fear conditioning, and anxiety-like behavior models.

Methods: Adult male Wistar rats were used (n=16). forced swim test (FST), open field test (OFT), and elevated plus maze (EPM) were conducted. After a 21–26 days break, classical fear conditioning was done. The experimental group (n=8) was intraperitoneally injected saline 40 minutes before and ketamine (10 mg/kg, 1 ml/kg) 30 minutes before FST Day 2 and fear extinction training. The vehicle group received twice saline in the same procedure as the experimental group. Immobility in FST was measured using DBscorer; ezTrack was used to analyze OFT, EPM, and Fear Conditioning. Student's t-test and two-way ANOVA were used to analyze behavioral tests in GraphPad Prism 9.4.1.

Results: The experimental group exhibited less immobility in the FST ($p<0.05$), and there was no difference between the groups in the OFT. Experimental animals spent more time in the open arm ($p<0.05$) of the EPM, without a difference in the total distance traveled. There was no between-group difference in fear extinction training and testing. The experimental group displayed less freezing in the 9th cue of the first extinction training, which did not sustain in subsequent trials.

Conclusion: A single injection of ketamine (10 mg/kg) decreased behavioral despair and showed an anxiolytic effect. This dose also facilitated a transient decrease in extinction behavior. These results highlight the potential of ketamine as an effective treatment for anxiety disorders in addition to its therapeutic role in clinical depression.

Funding: This research is supported by Boğaziçi University Research Fund Grant 19344.

Keywords: Behavioral despair, anxiety, fear conditioning, ketamine

P-15

Research on autism spectrum disorder in rodents: behavioral experiments

Ayşen Çalıkuşu, Elif Gülçiçek Topa Abbasoğlu, Meltem Bahçelioğlu

Gazi University, Ankara, Türkiye

Objective: Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder that appears in the first years of life (1–2 years), characterized by severe lack of social interaction and communication, and repetitive and stereotypical behaviors. It has a heterogeneous etiology thought to include genetic and environmental factors. Therefore, there is no single effective treatment for ASD. There are limitations to the studies that can be done in humans to investigate the etiology and pathophysiology of ASD and to develop alternative treatment methods. For this reason, researches are carried out especially on rodents. It is very important to create rodent models of ASD, to test the validity of the model and to determine the effectiveness of treatment methods. The aim of this review is to inform the researchers by evaluating the behavioral experiment models that can be applied in rodent models with ASD.

Methods: A comprehensive literature search was conducted using Pubmed, Scopus, Science Direct and Google academic search engines without year limitation.

Results: The mechanisms that can be used in rodent models of Autism Spectrum Disorder focus on the three main symptoms of the disorder, and anxiety, which is very common in ASD, is also included in these studies. Generally used behavioral experiment models are social interaction tests (Three-Chamber Sociability and Social Novelty Test, etc.), learning and memory tests (Morris Water Maze Test, Novel Object Recognition etc.), repetitive behavioral tests (Marble Burying Test, etc.) and anxiety tests (Open Field Test, Elevated Plus Maze Test, etc.).

Conclusion: In this review, showing the experimental setups that can be used in rodents for which the OSB model has been created will guide the researchers on this path.

Keywords: Autism spectrum disorder, Behavioral tests, Rodent, Social deficits, Social Behavior

P-16

Evaluation of neurodevelopmental parameters in valproic acid induced rat autism model

Kübra Karadağ, Volkan Tümer, Ahmet Mert Ertunç

Department of Medical Pharmacology, Faculty of Medicine, Hacettepe University, Ankara, Türkiye

Objective: Autism spectrum disorder (ASD) is a neurodevelopmental disorder characterized by impaired social interaction, restricted interests, repetitive behaviors and sensory abnormalities. ASD etiopathogenesis is unknown. ASD is frequently accompanied with diseases such as epilepsy, attention deficit hyperactivity disorder. Although medical treatment can be applied for comorbidities, there is no medical treatment for the core symptoms of autism, such as social interaction disorder. The aim of the study is to evaluate possible neurodevelopmental differences in valproic acid (VPA) induced rat autism model, which is an autism model with high face validity, formed by environmental insult during pregnancy.

Methods: A single subcutaneous injection of 400 mg/kg VPA was administered to pregnant Sprague Dawley rats on the prenatal 12th day to perform the autism model. For the control group, 0.9 % subcutaneous saline was administered on the 12th prenatal day. Autism model group was formed with 12 litters (7 males, 5 females) taken from the same mother. Starting from the postnatal 4th day (PND4), height and body weight measurements were made on spesific days, and eye opening stage were followed. For motor development monitoring, forelimb and hindlimb grasping reflexes and postures were evaluated starting from PND4, and self-righting, cliff avoidance, gait and negative geotaxis tests were performed. Maternal scent preference test was performed at PND14.

Results: In the negative geotaxis test performed in PND15, the test completion time of male rats was shorter than that of females ($p<0.05$). Male and female autistic rats' data in eye opening evaluation and forelimb grasping, self-righting, cliff avoidance and posture tests were comparable.

Conclusion: Our data suggest that there is a prominent gender difference in valproic acid induced autism model rats in terms of motor development and sensory development.

Funding: The data of the study were obtained within the scope of project number 19851 supported by Hacettepe University Scientific Research Projects Unit.

Keywords: Autism, valproic acid, neurodevelopmental disorders

P-17

Investigation of the effects of oxotremorine and amitriptyline on the development of morphine dependence in mice

Evrim Zeren Birer[1], Asiye Nurten[2], Nurhan Enginar[1]

[1]Department of Medical Pharmacology, Istanbul Faculty of Medicine, Istanbul University, Istanbul, Türkiye; [2]Department of Physiology Faculty of Medicine, Istanbul Yeni Yuzyıl University, Istanbul, Türkiye

Objective: Adaptive changes have been proposed to occur in the cholinergic and noradrenergic systems in morphine dependence. Noradrenaline reuptake inhibitor amitriptyline has been shown to attenuate dependence development. Muscarinic receptor agonists and acetylcholinesterase inhibitors also exhibit similar effects. However, the findings obtained with the muscarinic and noradrenergic antagonists are contradictory. Amitriptyline has a marked anticholinergic activity. Thus, attenuation of morphine dependence may change when it is administered with a cholinergic agonist. In this study, contribution of cholinergic system to development of dependence was evaluated in mice implanted with morphine pellets and given amitriptyline and/or the muscarinic agonist oxotremorine.

Methods: Balb/c male mice were administered subcutaneously with saline, 10 mg/kg amitriptyline, 0.1 mg/kg oxotremorine or 10 mg/kg amitriptyline and 0.1 mg/kg oxotremorine combination twice daily for 3 days. Following the first injections, mice were implanted with placebo or morphine pellets and were assigned to groups consisting of 6–8 mice. On day four, the animals were injected with 1 mg/kg naloxone and weight loss, jumping and other signs (diarrhae, urination, tremor) were evaluated. One-way ANOVA and Tukey tests were used for statistical evaluation.

Results: Significant drug effect was detected with ANOVA. According to TUKEY test weight loss was higher only in the amitriptyline-morphine group ($p<0.01$). Number of jumps and other signs were higher in the control-morphine ($p<0.05$; $p<0.001$), amitriptyline-morphine ($p<0.001$), oxotremorine-morphine ($p<0.001$) and amitriptyline-oxotremorine-morphine ($p<0.05$) groups. Compared to control-morphine group (30 ± 5.5), number of jumps did not change in the amitriptyline-morphine (51 ± 9.4), oxotremorine-morphine (59 ± 12) and amitriptyline-oxotremorine-morphine (35 ± 7.5) groups whereas other signs were lower in the amitriptyline-oxotremorine-morphine group ($p<0.05$).

Conclusion: Naloxone-induced morphine withdrawal signs in mice were partially enhanced by amitriptyline and alleviated by amitriptyline and oxotremorine combination. These data may provide support for the similar findings related to the roles of amitriptyline-mediated noradrenergic and oxotremorine-mediated cholinergic mechanisms in the development of morphine dependence.

Keywords: morphine, dependence, oxotremorine, amitriptyline

P-18

Investigation of electrical and behavioral effects of diet on TMNLepR neurons in mice

Zehra Yağmur Erol, Yavuz Yavuz, Bayram Yılmaz

Department of Physiology, Faculty of Medicine, Yeditepe University, Istanbul, Türkiye

Objective: Neuronal histamine produced by histamine neurons in tuberomammillary nucleus (TMN) in the posterior hypothalamus affects wakefulness by stimulating hypothalamic neurons. However, the underlying mechanism(s) is not yet fully understood, may be related to nutrition. Leptin has an important role in various obesity-related orexigenic and anorexigenic neural pathways. Thought that sleep and wakefulness problems experienced by obese people may also be related to the leptin-histamine mechanism. Currently, there is no study examining a relationship between histaminergic neurons and leptin receptor neurons (LepR) in TMN about food intake. In our study, we aimed to examine electrophysiological and behavioral effects of high-fat diet (HFD) on LepR neurons in TMN region in LepR-Cre transgenic mice.

Methods: Thirty-six female and male transgenic LepR-Cre mice were used, half of the mice were fed a standard diet (SD), while other half were fed a chronic HFD for six weeks. For electrophysiological studies, Cre-recombinase-enzyme-dependent AAV-CAG-Flex-GFP virus was intracranially injected into TMN, and electrical activity alterations in neurons were recorded by patch-clamp technique. Behavioral effects were examined using elevated plus maze test. Adeno-associated-viruses containing hM3D receptor (for activation), hM4D receptor (for inhibition) and GFP (control group) were injected into TMN. Chronic activation/inhibition was performed intraperitoneally administration of N-Oxide Clozapine. Group analyses were performed using Student's t-test and One-Way ANOVA.

Results: Firing frequency of LepR neurons was significantly decreased in mice fed on HFD ($p<0.05$). In behavioral tests, inhibition of these neurons caused a significant decrease in distance and speed in SD-fed mice, but not in chronic HFD-fed mice. Additionally, the duration of immobility during the experiment significantly increased in inhibition group ($p<0.05$).

Conclusion: In this study, the electrophysiological and behavioral effects of LepR neurons in TMN in mice fed a chronic HFD were investigated for the first time. Our findings have shown that HFD affects neuronal activity and behavioral characteristics in LepR-Cre transgenic mice.

Keywords: Leptin, histamine, electrophysiology, behavioral tests

P-19

Investigation of the effects of sensory salience on target tracking performance of zebrafish during rheotaxis

Şevval İzel Solmaz[1], İsmail Uyanık[2]

[1]*Department of Bioengineering, Hacettepe University, Ankara, Türkiye;* [2]*Department of Electrical and Electronics Engineering, Hacettepe University, Ankara, Türkiye*

Objective: Sensory salience defines how well a cue stands out from surroundings and plays a critical role in the behavioral control of animals. Our goal is to examine the effects of sensory salience on behavioral performance by modeling the target tracking behavior of zebrafish during rheotaxis.

Methods: In this study, we developed a speed-controlled flow tunnel for zebrafish to perform rheotaxis. Zebrafish tend to maintain their position with minimal energy consumption by orienting their bodies downstream during rheotaxis. If an obstacle is placed in the test area, they interrupt the flow speed. We expect the fish to swim in these areas, where the flow speed is bearable. Our setup includes a linear actuator to control the movements of this obstacle. We generate visual and mechanosensory stimulus for the fish using semi-cylindrical (D prism) shaped obstacles placed in the water. In this study, we experimented with N=3 adult zebrafish with different flow speeds (~0.1 m/s - ~1 m/s), obstacle diameters (2, 3 and 4 cm), and presence/absence of illumination to change the sensory salience. We estimated the frequency response of the fish using different frequency stimulus profiles in the range of 0–2 Hz.

Results: We observed that the fish performed better in the presence of light. This was expected as the fish can benefit from both visual and mechanosensory signals in this condition. Reducing the diameter of the D-prism-shaped obstacle also reduces the salience of both visual and mechanosensory stimuli. Accordingly, this change degrades the tracking performance of the fish.

Conclusion: Zebrafish continuously integrate multisensory integration using visual and mechanosensory stimuli while target tracking during rheotaxis. Decreasing the sensory salience reduces the state estimation performance of the fish, and hence the target tracking performance. In the future, we aim to model the sensorimotor control process of zebrafish using sensory salience.

Keywords: Sensory salience, rheotaxis, zebrafish, multisensory integration, computational neuroscience

P-20

Analysis of movement mechanisms of zebrafish during rheotaxis via deep learning

Deniz Eren Bozkurt, Orhun Koç, İsmail Uyanık

Department of Electrical and Electronics Engineering, Hacettepe University, Ankara, Türkiye

Objective: Zebrafish orient their bodies toward the flow to maintain their station. These fish prefer station-keeping behind the obstacles, which obscure the flow to minimize energy consumption. If these obstacles move, zebrafish track their movement to avoid getting dragged with the flow. We aim to analyze the movement mechanisms adopted by zebrafish during this target tracking behavior.

Methods: We developed an experimental setup, which enables zebrafish to perform rheotaxis. We placed a D-shaped cylindrical obstacle with a diameter of 5 cm into the water to obscure the flow in desired regions. We move this obstacle via a linear actuator in the horizontal direction using sinusoidal trajectories of different frequencies within the range of 0.05–2 Hz. We conducted five repetitions for N=3 zebrafish. We recorded the response of the fish to the movements of the obstacle using a camera at 25–100 Hz. We used DeepLabCut to track the body movements of the zebrafish to understand the movement mechanisms adopted by zebrafish while tracking the target obstacles. We labeled 8–13 points on the body of the zebrafish and tracked these points on video records. We used these tracks to digitize the body oscillations during target tracking.

Results: Zebrafish utilize tail oscillations to move their bodies in the lateral axis. Using these oscillations, zebrafish generate the necessary thrust to move their bodies to the left and right. We observed that these oscillations are correlated with the body movements of this fish.

Conclusion: The correlation between the tail oscillations and the body movements of zebrafish allows us to infer a proxy of the neural controller using behavioral measurements. As an alternative to EEG and fMRI measurements, we plan to use tail oscillations as an approximation of the control output to understand the subblocks within the closed-loop feedback control system of zebrafish.

Keywords: Zebrafish, tail oscillations, rheotaxis, target tracking

P-21

Tracking the anal fin and nodal point of weakly electric fish using deep learning

Mustafa Doğukaan Elikuru[1], Emin Yusuf Aydın[2], Necip Gürler[1], Bahadir Çatalbaş[1], Ismail Uyanık[1]

[1]Department of Electrical and Electronics Engineering, Hacettepe University, Ankara, Türkiye; [2]Bioengineering Division, Hacettepe University, Ankara, Türkiye

Objective: The sensorimotor control processes in animals work as a closed-loop feedback control system. As a result, stimulus and behavioral responses only allow us to identify the closed-loop system dynamics, but it does not give enough information to identify neural controllers or the locomotor dynamics. We aim to estimate a proxy of the output of the neural controller of weakly electric fish during refuge tracking behavior. Our goal is to utilize deep learning techniques to track the movements of the anal fin and the nodal point.

Methods: We used an experimental setup to stimulate the refuge tracking response of the weakly electric fish by moving the refuge sinusoidally at certain frequencies (0.1 Hz, 0.55 Hz, 1.15 Hz). We recorded the behavioral response of N=3 fish (back and forth movements) at 100 Hz for 30 seconds. These fish swim forward and backward by applying thrust via generating counter propagating waves along their long anal fin. The fish modulates the location, termed nodal point, where these waves meet to control the thrust it applies in either direction. In this work, we use deep learning to track the movements of the anal fin and later the movements of the nodal point. As a result, we obtain a readout of the output of the neural controller using kinematic measurements from the closed-loop control system.

Results: Deep learning techniques yield successful results in tracking the anal fins. However, tracking the nodal point requires measurements from multiple (5–10) frames. The estimated trajectories of the nodal point is correlated with the velocity of the fish.

Conclusion: These results show that kinematic tracking of nodal points serves as an interim signal between the controller (neural control) and plant (locomotor dynamics), which allows estimating the dynamics of the neural controller and the locomotor dynamics. In our future work, we plan to develop a real-time algorithm to track the nodal point online.

Keywords: Sensorimotor control, anal fin, nodal point, deep learning

P-22

Modeling multisensory integration during refuge tracking of weakly electric fish

Fatmagül İbişoğlu[1], İsmail Uyanık[2]

[1]Department of Bioengineering Division, Hacettepe University, Ankara, Türkiye; [2]Department of Electrical and Electronics Engineering, Hacettepe University, Ankara, Türkiye

Objective: The CNS use multisensory integration to reduce noise and uncertainty in sensory signals and better interpret its environment. This study investigates the mechanisms of multisensory integration in animals using probabilistic approaches. These probabilistic approaches have been derived from the assumption that our sensory perceptions are noisy and affected by uncertainty. Our studies aim to understand how the CNS solves the integration problem of this noisy and ambiguous sensory information. In this context, we develop models that

describe how the brain combines signals from different sensory organs, using a dataset obtained with Eigenmannia virescens, a species of weakly electric fish.

Methods: In this study, we investigate the superposition and Bayesian models on a dataset, where Eigenmannia virescens utilizes visual and electrosensory feedback signals to track a moving refuge. This dataset allows us to investigate how two sensory signals flowing in parallel are combined in the brain during multisensory behavioral control. The dataset includes refuge tracking experiments on five adult fish with ten replicates of six stimulus profiles. The dataset includes results with water conductivity of 150 and 500 µS/cm in dark. We investigate the dynamics of multisensory integration by analyzing the response of the fish to each stimuli using frequency response analysis.

Results: In our study, analyses were carried out under the same environmental conditions at a specific stimulus frequency with three different experimental conditions: only visual, only electrosense, and both visual and electrosense applied simultaneously. We first tested a superposition model with fixed sensory weights. The unsuccessful results motivated us to use dynamically changing weights for the sensory information. Our findings showed that the fish dynamically modulates its sensory weights throughout the experiments.

Conclusion: In this study, we tested a model that weights the sensory information inversely proportional to their variance, yielding the more consistent information to be weighted more. Our analysis showed that this model is not sufficient to explain the dynamic sensory reweighting process in these fish, since it did not bring a statistically significant improvement as compared to random distributions. We continue developing new models based on Bayesian filters for modeling the dynamic reweighting process during multisensory integration.

Keywords: Multisensory integration, Bayes filter, weakly electric fish

P-23

The effects of sensory salience on the refuge tracking behavior of weakly electric fish

Ceren Şule Mardin[1], Fatmagül İbişoğlu[1], Emin Yusuf Aydın[1], Merve Öztaş[2], İsmail Uyanık[3]

[1]Bioengineering Division, Hacettepe University, Ankara, Türkiye; [2]Department of Biology, Hacettepe University, Ankara, Türkiye; [3]Department of Electrical and Electronics Engineering, Hacettepe University, Ankara, Türkiye

Objective: Weakly electric fish exhibit shelter seeking behavior via hiding inside refuges in their natural habitats. These fish benefit from visual and electrosensory cues while exhibiting this behavior. Our goal is to examine the effects of the sensory salience on the refuge tracking behavior. This will help to understand the relation between sensory salience and behavioral performance.

Methods: We used an experimental setup with a 3D-printed refuge, which is moved via complex stimulation trajectories using a linear actuator. We track the refuge and the fish using image processing and estimate its frequency response. We experimented with N=5 Apteronotus albifrons under different sensory conditions considering the sample sizes used in the literature. We repeated the experiments for 54 sensory conditions; illumination: dark, loess, and light, refuge structure: with/out windows, refuge length: 7, 14, 21 cm, conductivity: low, medium, and high. We used N-way ANOVA to investigate the effects of sensory salience on the tracking performance of the fish.

Results: Tracking performance of the fish is evaluated based on the gain and phase lag between the stimulus and the fish. Ideally, the gain should 1, corresponding to equal amplitude, and the phase lag should be 0, corresponding to a delay-free tracking. Our results showed that illumination plays a critical role in the tracking performance as the performance degrades (lower gain, increased phase alg) in the dark. The length and structure of the refuge also have significant effects on the tracking response of the fish. Increasing the water conductivity deteriorated the tracking performance by adding additional phase lag to the response of the fish.

Conclusion: In this study, we manipulated the salience of the sensory information for the two major sensory organs used by the weakly electric fish during refuge tracking. As a future work, we plan to reveal the effects of sensory salience on the multisensory integration by modeling the sensory perception of weakly electric fish.

Keywords: Weakly electric fish, sensory salience, active sensing

P-24

Investigation of flow speed on the active sensing movements of weakly electric fish

Emin Yusuf Aydın, İsmail Uyanık

Hacettepe University, Ankara, Türkiye

Objective: Weakly electric fish prefer to hide in shelters in water in their natural habitat. If these shelters move, the fish follow these shelters by also using active sensing movements when necessary. Thanks to this unique feature, weakly electric fish are often used as animal models for active sensing research. However, a majority of the studies in the literature are limited to stationary environments unlike their natural habitats with continuous water flow. Different than the literature, this study aims to examine the effects of flow speed on the active sensing movements of weakly electric fish.

Methods: In line with our aim, we built an experimental setup, where the fish can perform refuge tracking behavior under water flow. We connected the refuges a linear actuator that moves in a single linear dimension. The back-and-forth movements of the refuge generate the necessary visual and electrosensory cues for the fish. In our experiments, we used a complex stimulus as a combination of sinusoidal signals of 13 different frequencies in the range 0–2 Hz. We experimented with N=3 Apteronotus albifrons under various conditions, such as flow speed (0–20 cm/s), illumination (0–300 lux), and refuge structures (with/out windows). We performed five replicates for each fish under each sensory condition.

Results: We verified that absence of illumination increased the amount of active sensing movements as previously reported in the literature. Besides, we observed that flow speed also increases the active sensing movements by reducing the tracking gain and increasing the phase lag.

Conclusion: The modeling and transferring the contribution of active sensing movements to the engineering applications requires a solid understanding of its biological motivations. In this context, conducting these analysis in the presence of water flow is of critical importance in understanding the natural motivation of these fish.

Keywords: Active sensing, weakly electric fish, refuge-tracking behavior, computational neuroscience

P-25

GABA-mediated hyperalgesic effect of tranexamic acid

Ferda Serdoğan[1], Kemal Tolga Saraçoğlu[1], Uğur Aykın[2], Metehan Akça[3], Cumaali Demirtaş[2], Yunus Emre Sürmeneli[2], Elif Akova[1], Ayten Saraçoğlu[4], Tamer Kuzucuoğlu[1], Mehmet Yıldırım[2]

[1]Department of Anesthesiology and Intensive Care, University of Health Sciences, Kartal Dr. Lütfi Kırdar City Hospital, Istanbul, Türkiye; [2]Department of Physiology, Hamidiye Medical School, University of Health Sciences, Istanbul, Türkiye; [3]Department of Physiology, Medical School, Tokat Gaziosmanpaşa University, Tokat, Türkiye; [4]Department of Anesthesiology and Intensive Care, Medical School, Marmara University, Istanbul, Türkiye

Objective: It has been reported in clinical studies that tranexamic acid (TXA), used as an antifibrinolytic agent, may cause postoperative hyperalgesia. However, there is no evidence in the literature regarding mechanisms by which TXA performs this effect. In the presented experimental study, it was aimed to behaviorally examine mechanism of action of TXA for development of pain through GABA and glycine receptors.

Methods: A total of 64 male Sprague-Dawley rats were divided into 8 groups and used in the experiments (SBU-HADYEK-2020-03/03). Dynamic plantar test was used to determine pain threshold of the animals, and open field and rotarod tests were used to examine the motor behaviors. Experimental groups were given physiological saline (control), 1 mg/kg TXA, 5 mg/kg TXA, 25 mg/kg TXA, 100 mg/kg gabapentin (GABA receptor analogue), 300 mg/kg taurine (glycine receptor agonist), 100 mg/kg gabapentin+25 mg/kg TXA, 300 mg/kg taurine+25 mg/kg TXA were injected intraperitoneally. After injections, animals were tested in open field apparatus for locomotor activity, rotarod apparatus for demanding motor activity, and dynamic plantar apparatus for mechanical pain threshold, respectively. Behavioral data were analyzed using the Mann-Whitney-U test after Kruskal-Wallis.

Results: It was established that TXA doses (1, 5 and 25 mg/kg) did not have a negative effect on motor behaviors. It was appointed that glycine receptor agonist taurine caused an increase in locomotor activity ($p<0.05$) and the number of defecations ($p<0.05$), which is an indicator of anxiety. All TXA doses (1, 5 and 25 mg/kg) were found to decrease mechanical pain threshold ($p<0.05$). However, mechanical pain threshold was found to be significantly increased in taurine+TXA group compared to 25 mg/kg TXA group ($p<0.05$).

Conclusion: It was concluded that TXA caused hyperalgesia at all doses used and this effect was realized by antagonism of GABA receptors.

Funding: This study was supported by SBU-BAP (Project no: 2020/116)

Keywords: Tranexamic acid, pain, motor behavior, GABA, glycine

P-26

A new rodent visuomotor skill learning paradigm enabling control of a cursor on a PC monitor

Ahsan Ayyaz[1], Hilal Bulut[1], Bihter Özhan[1], Mehmet Kocatürk[2]

[1]Department of Biomedical Engineering, Istanbul Medipol University, Istanbul, Türkiye; [2]Research Institute for Health Sciences and Technologies (SABITA), Istanbul Medipol University, Istanbul, Türkiye

Objective: Control of a cursor on a PC monitor using a joystick is a common paradigm to study the neural mechanisms involved in visuomotor skill learning in human and non-human primates. In this paradigm, the aim of the subject is to correct the trajectory of the cursor to reach a target appearing on the monitor. However, this paradigm, even for reaching a single target in one-dimensional space, has not been available for rodents yet.

Methods: In this work, we present a novel behavioral paradigm that allows rats to control a cursor on a PC monitor by operating levers for reaching stationary targets. The control of the cursor is performed in a one-dimensional space depending on the limited cognitive and visual capabilities of rats. The behavioral setup mainly consists of a cage with transparent walls and a PC monitor outside the cage used to demonstrate a

cursor and targets to be acquired using the cursor. Shaping procedures were developed to move the cursor toward a selected target and correct the trajectory of the cursor using lever press/release sequences.

Results: Using the present paradigm, three out of four rats were enabled to perceive the trajectory of the cursor and achieve the success criteria (i.e., 75% accuracy in 40 consecutive trials) after 52±12 days of training, with a training session duration of 2.5 to 3 hours per day.

Conclusion: The rats were able to detect the error in the trajectory of a cursor based on the visual feedback provided and the results showed that the rats have the visuomotor ability to perceive and correct the error in the trajectory. We believe the present rodent behavioral paradigm can be used in studying the neural mechanisms underlying the closed-loop control of a cursor and in brain-machine interface research.

Funding: TÜBİTAK Grants #118S072 and #117E286.

Keywords: Motor skill learning, visual feedback, visuomotor skill.

P-27

Classification of right and left hand motor imaginary EEG signals at cortical level with artificial neural networks

Mustafa Yazıcı[1], Mustafa Ulutaş[1], Mukadder Okuyan[2]

[1]Department of Computer Engineering, Karadeniz Technical University, Trabzon, Türkiye; [2]Department of Physiology, Karadeniz Technical University, Trabzon, Türkiye

Objective: Brain computer interfaces (BCIs) enable individuals to communicate with the environment through brain activities. Taking into account the Brodmann fields, this study has achieved high classification accuracy in the motor imagery of right and left hand by using computed source signals for a 22-channel-EEG recording.

Methods: BCI-Competition-IV-Data-sets-2a recorded from nine volunteers are used in this study. Participants were asked to image their right and left hands movements while their EEG signals were recorded. The data is filtered in the mu band (8–13 Hz) at first. Then Brainstorm with sLORETA is used to compute source potentials and these are mapped to Brodmann's cortical regions in brain lobes. 72 data are used for each subject, during classifier's training and testing. Averaged Broadman region signals' features are extracted by common spatial patterns (CSP) method and an artificial-neural-network (ANN) is used for classification. The accuracy of the method is computed by dividing the number of correctly classified test samples by the total number of tests.

Results: Source signals corresponding to cortical motor imagery areas are classified in this study. Right and left primary motor areas of the hands (M1H_L and M1H_R) have been included in each combination corresponding to hand movements. To find out best possible accuracy, quadruple combinations of 12 regions of S1H, CMA, SMA, pSMA, PMd and PMv regions of both right and left lobes in addition to M1H_L and M1H_R regions have been used. For the dataset, 75.35% classification accuracy on the average is obtained while 94.17% and 62.08% were the highest and the lowest accuracies respectively.

Conclusion: Classification accuracy of the method is obtained for right and left hand motor imagery. While the success is good for some subjects, it is below the target value for others. The results of classification of hand motor imageries by EEG neuroimaging are consistent with the results reported in the literature.

Keywords: EEG, Brain computer interface, motor imagery

P-28

Altered functional connectivity of the claustrum in Alzheimer's and Parkinson's disease: a resting-state fMRI study

Sevilay Ayyıldız[1], Halil Aziz Velioğlu[2], Behçet Ayyıldız[1], Bernis Sütçübaşı[3], Lütfü Hanoğlu[4], Zübeyir Bayraktaroğlu[5], Süleyman Yıldırım[6], Alper Atasever[7], Burak Yulug[8]

[1]Anatomy PhD Program, Graduate School of Health Sciences, Kocaeli University, Istanbul, Türkiye; [2]Department of Women's and Children's Health, Karolinska Institute, Stockholm, Sweden; [3]Department of Psychology, Faculty of Humanities and Social Sciences, Acıbadem Mehmet Ali Aydınlar University, Istanbul, Türkiye; [4]Department of Neurology, School of Medicine, Istanbul Medipol University, Istanbul, Türkiye; [5]Department of Physiology, International School of Medicine, Istanbul Medipol University, Istanbul, Türkiye; [6]Department of Medical Microbiology, International School of Medicine, Istanbul Medipol University, Istanbul, Türkiye; [7]Department of Anatomy, International School of Medicine, Istanbul Medipol University, Istanbul, Türkiye; [8]Department of Neurology, School of Medicine, Alanya Alaaddin Keykubat University, Antalya, Türkiye

Objective: The claustrum is suggested to mediate various functions from the motor to the cognitive and is considered a multimodal computing network due to its reciprocal connections with almost all cortical as well as subcortical structures. Although the structural connectivity of the claustrum has been involved in several neurodegenerative diseases, specific changes in functional connectivity of the claustrum remain unclear.

Methods: The structural and resting-state functional magnetic resonance imaging (rs-fMRI) data were acquired from healthy controls (HC) (n=15), Alzheimer's disease (AD) (n=16), and Parkinson's disease PD (n=12) subjects at Istanbul Medipol University using Philips Achieva 3T. Seed-based functional connectivity (FC) analysis was performed using CONN toolbox on rs-fMRI and voxel-based morphometry analysis of T1-weighted structural images was performed with the Computational

Anatomy Toolbox using seeds predefined by Krimmel for the claustrum.

Results: The claustrum was found functionally connected to large-scale networks such as salience, default mode, executive, sensorimotor, visual, and language networks in the HC. While decreased FC was observed between the left claustrum and sensorimotor cortex, supplementary motor area, supramarginal gyrus, insula, temporal pole, paracingulate gyrus, and superior temporal gyrus in PD compared to HC, no significant difference was found comparing the HC and AD. Decreased connectivity was found between the claustrum and the sensorimotor cortex, supplementary motor area, cingulate gyrus, supramarginal gyrus, insula, and planum polare in PD compared to AD. Moreover, the structural results show no significant difference in claustrum volume between PD and AD groups and significantly decreased volume in bilateral claustrum in AD and PD compared with HC.

Conclusion: Hence there were no differences in the claustrum volumes between PD and AD groups so the FC may offer more precise findings in distinguishing changes for claustrum in AD and PD. The present study is the first to have demonstrated and compared FC of claustrum in healthy aging, AD, and PD.

Keywords: Resting state functional connectivity, claustrum, Alzheimer's disease, Parkinson's disease

P-29

Increased coherence in EEG 6–9 Hz during visual stimulation in migraine

Kübra Canbaloğlu[1], Mehmet Ergen[2], Tuba Erdoğan-Soyukibar[3], Elif Ilgaz-Aydınlar[3]

[1]Acıbadem Mehmet Ali Aydınlar University, Graduate School of Health Sciences, Istanbul, Türkiye; [2]Department of Physiology, School of Medicine, Acıbadem Mehmet Ali Aydınlar University, Istanbul, Türkiye; [3]Department of Neurology, School of Medicine, Acıbadem Mehmet Ali Aydınlar University, Istanbul, Türkiye

Objective: Sensory symptoms such as cutaneous allodynia, photophobia, phonophobia and osmophobia accompany headache in migraine attacks. Cortical hyperexcitability is claimed to be involved in migraine and thalamo-cortical dysrhythmia is one of the proposed mechanisms. In line with this theory, visual evoked potentials (VEP), frequency spectrum power and coherence during visual stimulation was investigated in our study.

Methods: 0.25 and 1 degree size pattern reversal locked EEG responses were recorded from 13 participants with chronic and high frequency episodic migraine, aged 18–55 years old and 10 healthy participants. Complex spectral power density was calculated and intra/inter hemispheric coherence was calculated for those frequencies. Participants' allodynia and photophobia scores were evaluated. Group comparisons were carried by repeated measures ANOVA.

Results: 6–9 Hz intrahemispheric coherence (between parietal and occipital regions) was significantly higher in EEG from migraine patients, compared with healthy controls (p=0.001). There was no significant difference in amplitudes and latencies of N75, P100, N145 potentials. Spectral power density was also comparable similar in two groups.

Conclusion: Higher intrahemispheric coherence between parietal and occipital electrodes in 6–9Hz seem to indicate greater synchronization in migraine specific to this frequency band. Our result might be a manifestation of thalamo-cortical dysrhythmia and related cortical hyperexcitability.

Keywords: Migraine, EEG, visual evoked potentials, coherence

P-30

Volumetric changes of thalamic nuclei in Alzheimer's disease continuum

Emre Harı[1], Elif Kurt[2], Ali Bayram[2], Çiğdem Ulaşoğlu-Yıldız[3], Burak Acar[4], Tamer Demiralp[5], Hakan Gürvit[6]

[1]Neuroimaging Unit, Hulusi Behçet Life Sciences Research Laboratory, Istanbul University, Istanbul, Türkiye; [2]Department of Neuroscience, Aziz Sancar Institute of Experimental Medicine, Istanbul University, Istanbul, Türkiye; [3]Department of Psychology, Faculty of Humanities and Social Sciences, Istinye University, Istanbul, Türkiye; [4]Department of Electrical-Electronics Engineering, Faculty of Engineering, Boğaziçi University, Istanbul, Türkiye; [5]Department of Physiology, Istanbul Faculty of Medicine, Istanbul University, Istanbul, Türkiye; [6]Department of Neurology, Behavioral Neurology and Movement Disorders Unit, Istanbul Faculty of Medicine, Istanbul University, Istanbul, Türkiye

Objective: It is known that neurofibrillary tangles associated with neuronal loss in Alzheimer's disease (AD) start from the transentorhinal cortex and spread to the paralimbic structures. Although the hippocampus is at the center of AD studies, memory is processed in a large neurocognitive network with subcortical components, including the thalamus. For this purpose, it was aimed to examine the detailed volumetric changes of thalamic nuclei at different scales in AD.

Methods: MRI data of participants with a diagnosis of 20 AD dementia (ADD), 30 mild cognitive impairment (MCI) and 30 subjective cognitive impairment (SCI), who did not differ in terms of age, education and gender, were included. The segmentation process was carried out individually with FreeSurfer software. The thalamus was divided into sub-nuclei groups as anterior, medial, posterior, lateral and intralaminar nuclei, and volume values were obtained. The volumes of the thalamic nuclei in both hemispheres were averaged and normalized using the intracranial volume. In order to examine the changes in volumes between groups, ANCOVA analysis was performed

by defining age, education and gender as covariates. Bonferroni correction was applied to results for multiple comparison correction.

Results: Statistically significant volume reduction was detected only in the medial group among the groups. When the medial group was examined in detail, volume reduction was detected in the magnocellular part of the mediodorsal nucleus (MDm). In post-hoc analyses, volume decreases were detected in MCI and ADD compared to SCI in MDm. No statistically significant difference was found between ADD and MCI groups.

Conclusion: MDmc, which is associated with memory in the literature, is particularly affected in the MCI stage of the disease. This finding has been interpreted to have the potential for a biomarker for the prodromal stage of the AD.

Funding: Present work was supported by TÜBİTAK (Project Nr: 114E053) and IU-BAP (Project Nr: 2019K12-149071).

Keywords: Alzheimer's disease, thalamus, volumetry, magnetic resonance imaging

P-31

Whole structural brain MRI segmentation in GBM patients with deep learning methods

Batuhan Sözer[1], Alperen Sözer[2], Mustafa Çağlar Şahin[2], Kerem Nernekli[3]

[1]Department of Interdisciplinary Neuroscience, Ankara University, Ankara, Türkiye; [2]Department of Neurosurgery, Gazi University, Ankara, Türkiye; [3]Department of Radiology, Stanford University Medical Center, Stanford, CA, USA

Objective: The goal of this study is to create an anatomic brain atlas of patients with glioblastoma (GBM) and controls using deep learning methods.

Methods: Gazi Brains 2020 dataset is used for this study. The dataset contains 50 controls and 50 GBM patients. Each patient has its corresponding segmentation mask containing 15 labels. In contrast to other segmentation models in the literature, our proposed model is a modified version of U-Net with RES blocks, which uses all the available sequences (FLAIR, T1-Weighted, T2-Weighted MRI sequences) as input to segment the regions of the brain. Our proposed model consists of three encoders consisting of 5 resblock and max-pooling layers, one bottleneck, and three decoders consisting of 5 resblock and transposed convolution layers to increase the resolution to its original size. There are separate encoders and decoders for each MRI sequence. Also, a U-Net architecture with residual skip connections with only FLAIR sequence as input was trained with the same dataset to compare with our proposed model.

Results: After training, our proposed model can segment 15 different parts of the human brain. The results showed that the model could correctly highlight tumors and anatomical corruptions due to the tumor if present. Furthermore, we have achieved a 63% of mean dice coefficient score, which is 3% better than our baseline model. Although 3% quantitative improvement may seem insignificant, qualitative analysis shows a significant difference between the two models.

Conclusion: Our results demonstrate that the proposed model achieves better results than other baseline models in segmenting GBMs and other anatomical structures. In addition, since the dataset contains anatomical structures that are corrupted by the tumor, our model can be used to highlight changes in neuroanatomy due to the presence of cancer. Observed qualitatively, the proposed model has been shown to more accurately segment the shape of the tumor which is beneficial for morphological and volume analyses in clinical applications.

Keywords: Glioblastoma, magnetic resonance imaging, structural MRI, deep learning, convolutional neural networks

P-32

EEG emotion data classification using graph signal processing

Sevde Büşra Bayrak[1], Ahmet Ademoğlu[1], İpek Şen[2]

[1]Boğaziçi University, Istanbul, Türkiye; [2]Bilgi University, Istanbul, Türkiye

Objective: Emotion assessment is a survival phenomenon in order to understand human behavior for danger avoidance, communication, and decision-making. The purpose of this study is to classify the 30-channel EEG signals obtained in response to 250 pleasant and 250 unpleasant pictures which are randomly presented to 13 different subjects with different mean valence and arousal scales (7.13 / 2.96) and (4.99 / 5.02) in the IAPS database. The data is borrowed from Istanbul University, Electro-Neuro-Physiology Research and Application Center.

Methods: A graph is constructed by mapping each electrode location upon a unit sphere and a connectivity matrix is formed based on the nearest neighbors of each electrode corresponding to a node. The graph Laplacian matrix is determined by taking the difference between the degree and connectivity matrix of the graph. As the first step, data are filtered temporally into the delta, theta, alpha, beta, and gamma EEG bands. In the second step, they are projected onto a subspace formed by the eigenvalues and eigenvectors of the graph Laplacian matrix. An optimal graph spectral domain is determined by graph filters upon which the data is projected for classification.

Results: 10-fold cross-validation along with SVM using radial and linear kernel functions are employed. Classification performance across frequency bands reaches approximately to %80 for each kernel on test

data consisting of pleasant and unpleasant pictures. The accuracy increases to %93 (RBF) and %84 (linear) when graph spectral filtering is applied before the classification algorithm. Moreover, accuracy rises even to slightly higher levels as %94 (RBF) and %85 (linear) when the spectral filtered signal is retained in the graph frequency domain.

Conclusion: Our results show that graph spectral decomposition enhances the emotion classification performance with regard to pleasant and unpleasant conditions when compared with preprocessing based only on temporal filtering.

Keywords: Electroencephalography (EEG), support vector machines, graph signal processing

P-33

Classifying developmental dyscalculia and identifying related anatomical structures with deep learning

Batuhan Sözer[1], Burcu Sırmatel Bakrıyanık[1], Kerem Nernekli[2], Metehan Çiçek[3]

[1]Department of Interdisciplinary Neuroscience, Ankara University, Ankara, Türkiye; [2]Department of Radiology, Stanford University Medical Center, Stanford, CA, USA; [3]Neuroscience and Neurotechnology Center of Excellence, Ankara, Türkiye

Objective: Developmental dyscalculia is a specific learning disability that affects the normal acquisition of arithmetic skills. The main objective of this study is to create an explainable artificial intelligence (AI) for the classification of dyscalculia.

Methods: A dataset containing 12 dyscalculia patients and 13 healthy age-matched controls was used in this study. To test the accuracy of the trained model, 8 samples were isolated and the remaining were used for model training. After the raw DTG data is passed through a series of preprocessing steps, fractional-anisotropy (FA) images, eigenvalues, and eigenvectors were extracted to create directionally-encoded-color (DEC) images. Preprocessed data was then used to train VGG and ResNet architectures each consisting of eight 3D convolutional blocks and one dense layer with a sigmoid activation function as the output layer. 3D-ResNet architecture was implemented by adding residual skip connections to the VGG model. Gradcam algorithm was applied to see the differences in convolutional layers between patients and controls.

Results: Five-fold cross-validation was used to ensure the validity of the metrics. After the measurements on the test set for the VGG architecture, the mean accuracy was 80%±14%, the mean sensitivity was 80.6%±20%, and the mean specificity was 86.4%±19%. For ResNet architecture, the mean accuracy was 90%±10.5%, the mean sensitivity was 93.2%±15.2%, and the mean specificity was 86.4%±18.6%. Based on the activation maps extracted with gradcam for the VGG architecture, AI was seen to distinguish between dyscalculics and controls by looking at the genu of the corpus callosum.

Conclusion: Our proposed model was able to distinguish between dyscalculia patients and controls. With the implementation of the gradcam algorithm, we visualized the anatomical structures used by the model to make decisions and identified a region of interest for dyscalculia. Previous neuroimaging studies showed increased frontal region activation in dyscalculia. Consistent with this, the difference between patients and controls in the anterior corpus callosum may indicate problems in the interhemispheric connections.

Keywords: Dyscalculia, diffusion tensor imaging, deep learning, convolutional neural networks, gradcam

P-34

Microfabrication and implantation of ultraflexible microelectrodes for recording neural signals

Zeki Semih Pehlivan[1], Ahsan Ayyaz[2], Bashir Bwogi[2], Halise Erten[2], Meral Yüce[1], Yasemin Yüksel Durmaz[4], Bengi Ünal[3], Hasan Kurt[4], Mehmet Kocatürk[4]

[1]Sabancı University Nanotechnology Reseach and Application Center (SUNUM), Sabancı University, Istanbul, Türkiye; [2]Department of Biomedical Engineering, Istanbul Medipol University, Istanbul, Türkiye; [3]Department of Psychology, Çanakkale Onsekiz Mart University, Çanakkale, Türkiye; [4]Research Institute for Health Sciences and Technologies (SABITA), Istanbul Medipol University, Istanbul, Türkiye

Objective: Ultraflexible and ultrathin microelectrode arrays hold great potential to achieve perfect biocompatibility and provide reliable signal transmission between the brain tissue and neuroprosthetic devices. However, achieving these physical and chemical properties and preserving them during chronic use present challenges in fabrication and implantation procedures. In this work, we present the techniques we developed for these procedures.

Methods: Eight-channel microelectrode arrays were manufactured using microfabrication techniques that can be applied in a clean room facility with photolithography equipments and a thermal evaporator. Gold was used for recording sites and interconnects due to its inertness, and SU8 was used for passivation layers due to its high durability and tensile strength. A shuttle device was developed for insertion of the microelectrode array into the brain tissue. One male adult Wistar rat was chronically implanted with the microelectrode array in the motor cortex.

Results: The microelectrode array allowed detection of neural spikes even 153 days after the implantation surgery. Immunohistochemical analyses performed following this period demonstrated formation of astrocytes in the microenvironment around the implanted microelectrode array as an indicator of acute injury during the implantation surgery. No increase in microglial activity showed absence of continuing neuroinflammatory response, which is a critical measure of reliable integration with the brain tissue.

Conclusion: Our preliminary results based on abiotic and biotic characterization investigations indicate that the ultrathin and ultraflexible microelectrode arrays are promising candidates for long-term monitoring of the extracellular neural signals and can be used as a versatile platform for the development of other biosensor technologies.

Funding: TÜBİTAK Grant #118S072.

Keywords: Microelectrodes, electrophysiology, neuroprosthetics

P-35

Investigation of functional connectivity network in Parkinson's disease with machine learning methods

Can Soylu[1], Ani Kıçik[2], Ali Bayram[3], Hüden Neşe[4], İ. Hakan Gürvit[5], Tamer Demiralp[1]

[1]Department of Physiology, Istanbul Medical Faculty, Basic Medical Sciences, Istanbul University, Istanbul, Türkiye; [2]Department of Physiology, Demiroğlu Bilim University, Istanbul, Türkiye; [3]Department of Neuroscience, Aziz Sancar Institute of Experimental Medicine, Istanbul University, Istanbul, Türkiye; [4]Institute of Biomedical Engineering, Boğaziçi University, Istanbul, Türkiye ; [5]Department of Neurology, Istanbul Medical Faculty, Division of Medical Sciences, Istanbul University, Istanbul, Türkiye

Objective: Parkinson's disease (PD), which is clinically characterized by motor symptoms, is a neurodegenerative disease accompanied by cognitive disorders. Resting state functional connectivity can be measured by functional magnetic resonance imaging (fMRI) method. The basic elements of functional connectivity (FC) are the nodes, which represent neuroanatomical areas, and the edges, which represent the functional relationship between them. Machine learning (ML) algorithms that learn complex relationship patterns in FC matrices obtained in this way are used to support the clinical diagnosis of PD. In this study, the relationship between the motor and cognitive symptoms of Parkinson's patients and the edge data of the patients' FCs was examined with the help of ML algorithms.

Methods: Resting state fMRI (rs-fMRI) data of 55 Parkinson's patients (age: 60.2±8.5) followed in the Behavioral Neurology and Movement Disorders Unit of Istanbul Faculty of Medicine and Stroop Test, Judgement of Line Orientation Test (JLO), and Unified Parkinson's Disease Rating Scale (UPDRS) scores were evaluated. FC values between seed regions were calculated using CONN (https://web.conn-toolbox.org/) software. For the ML application, support vector machine (SVM) and random forest algorithm were used. Feature selection is included in all algorithms.

Results: When the data set with FC edge values, Stroop test, JLO and UPDRS scores was evaluated with the SVM algorithm, various FC patterns predicted test and scale scores with 0.83, 0.90 and 0.63 estimation accuracy, respectively, and in the trial with the random forest algorithm, 0.83, 0.55 and 0.90 estimation accuracy has been obtained.

Conclusion: The results reveal that neuropsychological test and scale scores can be predicted with high performance by evaluating various FC patterns with ML algorithms in PD. By expanding these analyzes, it may be possible to differentiate the neural basis of impairment in specific cognitive domains.

Support: This study was supported by the Istanbul University BAP, project number: 2019K12-149071.

Keywords: Parkinson's disease, functional connectivity networks, NPT, machine learning

P-36

Effects of TDP-43 overexpression on neuronal morphology and synaptic terminal activation in the motor cortex

Elif Polat Çorumlu[1], Barış Can Çakır[2], İrem Armağan[3], Emel Ulupınar[1]

[1]Health Sciences Institute, Department of Interdisciplinary Neuroscience, Eskişehir Osmangazi University, Eskişehir, Türkiye; [2]Faculty of Medicine, Eskişehir, Eskisehir Osmangazi University, Eskişehir, Türkiye; [3]Faculty of Medicine, Hacettepe University, Ankara, Türkiye

Objective: TarDNA-binding protein-43 (TDP43) is a DNA/RNA-binding protein that was first identified as the primary component of ubiquitinized and hyper-phosphorylated cytosolic aggregates in postmortem tissues of patients with ALS. Overexpression of this protein, whose deficiency results in embryonic lethality, causes toxicity and cell death. In this study, it was aimed to examine the changes in neurons and synaptic terminals in the motor cortex following TDP-43 overexpression in rats.

Methods: While experimental group has received viral vector (AAV9-pCMV-TDP43-GFP) containing cytomegalo virus promoter (CMV), green fluorescent protein (GFP) and native TDP43 sequences packaged in Adeno-Associative Virus (AAV) serotype-9; physiological saline (SF) was injected through the tail vein of the control group. Injections were administered to Sprague-Dawley male rats at the postnatal 30th day at a dose of 6.4x1012 gc/ml (n=5, each group). Two weeks after the injection, the phenotypic characterizations of the rats were determined through the cat-walk and the horizontal ladder test to evaluate the gross and fine motor skills, respectively. Animals were perfused intracardiacally at the end of 4th week, motor cortex sections (lateral 1.90–2.90), immunohistochemically stained with Neun and synaptophysin antibodies, were analyzed via systematic randomized sampling method.

Results: Stride length of the experimental group was significantly higher than the control group. In the horizontal ladder test, the total score of the experimental group was lower than

those of the control group (p<0.01). The synaptic terminal activation per unit area in layers 2–3 and 5 of the motor cortex did not differ between groups. However, in the same region, the number of NeuN (+) neurons per unit area was significantly lower (p<0.05) in the experimental group and this difference was observed only in layer 5.

Conclusion: Our data showed that overexpression of TDP43 causes regression in motor skills. Morphological studies indicate that behavioral change may originate from the cortical motor neurons and there might be a compensatory alteration in synaptic terminals in the early stage.

Funding: This work was supported by TUBITAK (Project No: 1919B012004851).

Keywords: TDP-43, synaptophysin, motor neuron, motor cortex

P-37

Effects of angiotensin-III on blood-brain barrier integrity

Ecem Ayvaz[1], Ahmet Umur Topçu[2], Sena Birsen Güçlü[2], Mustafa Onur Yıldırım[2], Bülent Ahıshalı[3], Mehmet Kaya[4]

[1]Koç University Research Center for Translational Medicine (KUTTAM), Koç University, Istanbul, Türkiye; [2]School of Medicine, Koç University Istanbul, Türkiye; [3]Department of Histology and Embryology, School of Medicine, Koç University, Istanbul, Türkiye; [4]Department of Physiology, School of Medicine, Koç University, Istanbul, Türkiye

Objective: The blood-brain barrier (BBB), constituted by brain capillary endothelial cells, regulates the neuronal microenvironment, whereas its breakdown is strongly linked with neurodegenerative diseases/disorders. Although angiotensin-II (ANG-II) is well-known to disrupt BBB, the impact of ANG-III, a peptide hormone synthesized by cleavage of aspartic acid from ANG-II by aminopeptidase A, on BBB integrity has not been investigated yet. The aim of the present study was to evaluate the effects of ANG-III on an in vitro model of BBB using mouse brain microvascular endothelial cell line (bEnd.3). Additionally, the impact of ANG-III was also tested at 6, 12, and 24 hours following serum starvation.

Methods: The cytotoxicity of ANG-III administered at the concentration of 10, 25, 50, 100, 250, 500, and 1000 nM was assessed by sulforhodamine B (SRB) assay, while BBB integrity was evaluated by measuring the permeability of sodium-fluorescein (NaF) tracer.

Results: The cell density of the barrier-type endothelial cells without serum starvation did not change significantly with any of the tested ANG-III concentrations and administration durations, while the endothelial cells exposed to 24-hour serum starvation showed significantly decreased cell density values following 25, 250, and 1000 nM ANG-III treatment compared to ANG-III untreated controls (p<0.01). No essential alteration in NaF permeability of the endothelial cells without serum starvation was observed by administration of the tested range of concentrations of ANG-III for various administration durations, except for 500 nM for 12 hours which caused a significant increase compared to untreated controls (p<0.01). On the other hand, upon 24-hour serum starvation, ANG-III treatment at the concentration of 25, 100, 250, and 1000 nm significantly increased the NaF permeability of endothelial cells with respect to untreated controls (p<0.01).

Conclusion: Our data suggest that ANG-III causes disruption of BBB integrity essentially in starvation conditions.

Keywords: Blood-brain barrier, angiotensin-III, hypertension, brain microvascular endothelial cells

P-38

A mutation in the mammalian target of rapamycin (mTOR) protein complex increases autophagy, and is not affected by the proinflammatory drug copper sulfate in the brain of zebrafish (Danio rerio)

Serena Sevdiye Aktürk[1], Beyza Özen[1], Narin Ilgım Ardıç-Avcı[1], Dilan Çelebi-Birand[2], Michelle M. Adams[3]

[1]Interdisciplinary Program in Neuroscience, Aysel Sabuncu Brain Research Center, İhsan Doğramacı Bilkent University, Ankara, Türkiye; National Nanotechnology Research Center (UNAM), İhsan Doğramacı Bilkent University, Ankara, Türkiye; [2]Biftek Inc. Ankara, Türkiye; Interdisciplinary Program in Neuroscience, Aysel Sabuncu Brain Research Center, İhsan Doğramacı Bilkent University, Ankara, Türkiye; National Nanotechnology Research Center (UNAM), İhsan Doğramacı Bilkent University, Ankara, Türkiye; [3]Interdisciplinary Program in Neuroscience, Aysel Sabuncu Brain Research Center, İhsan Doğramacı Bilkent University, Ankara, Türkiye; UNAM, İhsan Doğramacı Bilkent University, Ankara, Türkiye; Department of Psychology, İhsan Doğramacı Bilkent University, Ankara, Türkiye

Objective: Inflammation, a prominent feature of aging, results from dysregulation of various pathways, such as mTOR signaling. Activation of the mTOR pathway contributes to aging by increasing proinflammatory cytokines through the modulation of various cellular mechanisms. TOR signaling is suppressed in animals with the ztor±genotype due to TOR haploinsufficiency. As a proinflammatory compound, copper sulfate (CuSO4) has been shown to induce inflammation in adult zebrafish. This study investigated whether copper sulfate treatment would reverse the less-active mTOR pathway in ztor±animals.

Methods: Forty-three-month-old ztor±animals (n=3) and their wild-type siblings (n=3) were maintained in standard conditions and then treated with 25µM copper sulfate (CuSO4) for 1 hour. Then the brain and gill tissues were collected and snap-frozen. Genotyping was performed from the gill tissues. Gene expression levels of proinflammatory and autophagy markers in the brain were completed by qPCR. All statistical tests were conducted in R(4.2.0) programming language. Before the statistical analyses, diagnostic tests were applied to both fold

change and log2 expression values for gene expression results. Shapiro Wilk and Levene's Tests were used to check the normality and homogeneity of variances assumptions.

Results: Genotypes of old ztor±mutants and their wild-type siblings were confirmed. No significant difference was observed in the CuSO4-treated fish with respect to the gene expression levels of the two proinflammatory cytokines, COX-2 (p= 0.273) and TNF-a (p=0.385). However, a significant difference was seen between ztor±and wild-type animals in the expression levels of lc3b, an autophagy marker (p=0.03). Wild-type zebrafish showed higher lc3b gene expression levels compared to ztor±animals.

Conclusion: Our data suggest that in response to short-term copper sulfate treatment, which is thought to promote acute inflammation, wild-type animals require a more effective coping mechanism that results in increased autophagic response. Whereas the old ztor±animals may have already reached a maximized autophagic potential prior to the drug treatment. Therefore, copper sulfate would not have an effect. In conclusion, TOR signaling during brain aging is a crucial mechanism, and suppression of TOR signaling has been proposed to be involved in regulating the potential of autophagic mechanisms.

Funding: Supported by TÜBİTAK grant number 119S660.

Keywords: Neuroinflammation, ztor mutant, autophagy, acute inflammation

P-39

Investigation of effects of minocycline on the acclimatization of ventilation to hypoxia in the NTS

Kemal Erdem Başaran[1], Hatice Tanrıverdi[1], Mustafa Çağlar Beker[2]

[1]Department of Physiology, Erciyes University, Kayseri, Türkiye; [2]Department of Physiology, İstanbul Medipol University, İstanbul, Türkiye

Objective: Minocycline, an antibiotic with anti-inflammatory properties that inhibits the activation of glia cells, blocks the Ventilatory Acclimatization to Hypoxia (VAH). VAH is a time-dependent increase in ventilation involving plasticity in central nervous system respiratory centers persists after return to normoxia. The aim of our study, in which we want to show effects of anti-inflammatory drugs on respiration, is to test the role of glia cells in VAH formation with the minocycline (MIN) in the Nucleus Tractus Solitarius (NTS) of the rat brainstem because of hypoxia exposure.

Methods: In this study, 48 Sprague Dawley adult male rats were used. Subjects were divided into 4 groups as Moderately Acute Sustained Hypoxia (MASH), Severe Acute Sustained Hypoxia (SASH), Moderately Chronic Sustained Hypoxia (MCSH), and Severe Chronic Sustained Hypoxia (SCSH). Each group was divided into two subgroups with Saline (SA) administration, and MIN administration. ASH groups were exposed to 21% O_2 (3 days) in the normabaric chamber, and KSH groups were exposed to 13%–10% O_2 (3 days), and drug was administered. Ventilation, respiratory frequency, and tidal volume measurements were made with a Whole-Body plethysmography device. Brainstem sections were taken, and Glial Fibrillary Acidic Protein (GFAP) markers for astrocyte activation, Iba-1 markers for microglia activation were used for image analysis by immunofluorescence staining method fluorescence microscopy in the NTS. PRISM program was used for statistical analysis. Significance was accepted as statistical $p<0.05$.

Results: Examinations performed in the NTS, in MCSH groups, while no significant difference was observed in GFAP expression in MIN groups compared to SA groups, a significant decrease was found in Iba-1 expression. A significant increase in GFAP expression was found in MCSH groups compared to SA groups in MIN groups. Respiratory parameters were found to support these results.

Conclusion: Results show that effects of MIN on ventilation while VAH has occurred may depend on severities of hypoxia and may cause the decrease in ventilation through microglia cells.

Keywords: Brainstem, HVR, hypoxia, minocycline, neuroplasticity

P-40

Investigation of the effect of vaccinium macrocarpon in neuronal cell culture with H_2O_2 toxicity

Fatma Yeşilyurt[1], Irmak Ferah Okkay[2], Ufuk Okkay[1], Ahmet Hacımüftüoğlu[1]

[1]Department of Medical Pharmacology, Faculty of Medicine, Atatürk University, Erzurum, Türkiye; [2]Department of Pharmacology, Faculty of Pharmacy, Atatürk University, Erzurum, Türkiye

Objective: The mismatch between antioxidant levels and the rate of synthesis of pro-oxidants, particularly reactive oxygen species, causes oxidative stress (ROS). Excessive ROS production causes oxidative stress, which is a prevalent pathology that promotes neuronal cell death in neurological disorders. Cerebral ischemia, one of these diseases, creates superoxide via xanthine oxidase, and superoxide is the primary radical from which hydrogen peroxide (H_2O_2) is generated. H_2O_2, while not a free radical in and of itself, can alter the intracellular redox state of cells and transform into a more reactive hydroxyl radical, causing oxidative damage. Vaccinium macrocarpon (VM) is high in amount polyphenols and has anti-inflammatory and antioxidant properties. İn this study, the effect of VM on the damage induced by producing H_2O_2 toxicity in primary cortical neuron cultures will be investigated.

Methods: Neuron cells were received from the Medical Pharmacology department of Atatürk University (Erzurum, Turkey). H_2O_2 was utilized at 200 µM dosages and VM extract at 25, 50, 100, and 200 µM doses. After the prepared experimental groups were treated with neuron cells for 24 hours, their cytotoxicity was examined by MTT. TAC and TOS (total oxidant and antioxidant) values were assessed. The data was analyzed using SPSS and the one-way ANOVA approach.

Results: Viability was defined as 100% in the control groups and the other groups were rated accordingly. Cell viability increased at all doses in the VM groups, however, the highest viability was observed at VM 100 and 200 µM concentrations ($p<0.05$). Our TAS and TOS results are compatible with MTT.

Conclusion: Anti-oxidant and neuroprotective effects have been observed with VM against the damage caused by H_2O_2 in neurons, thus preventing neuronal cell death. In conclusion, VM represents a potential therapeutic agent against brain injury and related disorders.

Keywords: H_2O_2 toxicity, neuroprotection, vaccinium macrocarpon, primer neuron culture

P-42

Investigation of the role of Toxoplasma gondii infection in the pathophysiology of Alzheimer's disease

Ayhan Çetinkaya[1], Serhat Gökdaş[2], Muhammed Nur Öğün[3], Kerem Yaman[4], Şule Aydın Türkoğlu[3], Canan Akünal Türel[3], Şerif Demir[5], Erol Ayaz[4]

[1]Department of Physiology, Faculty of Medicine, Bolu Abant İzzet Baysal University, Bolu, Türkiye; [2]Department of Interdisciplinary Neuroscience, Graduate Institute, Bolu Abant İzzet Baysal University, Bolu, Türkiye; [3]Department of Neurology, Faculty of Medicine, Bolu Abant İzzet Baysal University, Bolu, Türkiye; [4]Department of Parasitology, Faculty of Medicine, Bolu Abant İzzet Baysal University, Bolu, Türkiye; [5]Department of Physiology, Faculty of Medicine, Düzce University, Düzce, Türkiye

Objective: Alzheimer's disease (AD) is a neurodegenerative disease that manifests itself with cognitive symptoms by affecting the cerebral cortex and hippocampus environment. amyloid plaques, neurofibrillary tangles and neuronal cell death play a role in the pathophysiological mechanism of AD. T. gondii is an important zoonotic parasite that settles in cardiac muscle, smooth muscle, eye and brain. The aim of the study is to investigate the behavioral and histopathological effects of pre-pregnancy T. gondii infection in the adult periods of the offspring to be born during and after pregnancy. Similar to the study, the effects of the effects of the parasite taken during pregnancy on mothers were investigated and the results were brought to the literature. The originality of our study was based on the offspring of the parasite taken before pregnancy, during and after pregnancy, and targeted the gap in the literature.

Methods: There are 5 groups in total: Group 1 (Mother Control), Group 2 (Mother Alzheimer's), Group 3 (Mother Toxoplasma), Group 4 (Mother Alzhimer+Toxoplasma), Group 5 (Mother Toxoplasma+Alzhimer). For Alzheimer's model, animals were given Aβ1-42 solution 4 µg/1 µL/side bilaterally intrahippocampally, and for T. gondii infection, an inoculum containing 1.5×106 parasites was prepared and administered intraperitoneally. Mother Groups were mated with healthy male rats simultaneously, and our experiment was planned as 8 puppies each according to power analysis. Our study tested whether the animals infected with T. gondii trigger Alzheimer's-like behaviors by detecting the presence of beta amyloid clusters in the brain according to the histopathological staining method with learning and memory tests when the pups reach adulthood.

Results: Although there was no statistical difference between Group1 (pup) and Group 4 (pup), according to the behavioral test ($p>0.05$). The difference between Group 1 and other groups was determined statistically ($p<0.05$). Although Aβ cluster was determined except for Group 1 according to Congo Red histological staining method, there was no statistically significant difference between the offspring groups ($p>0.05$).

Conclusion: In the light of these data, T. gondii parasite showed Alzheimer's-like morphological changes, but it was not statistically significant.

Keywords: Alzheimer's disease, Toxoplasma gondii, Behavioral tests, Congo red staining

P-43

Effects of overexpression of α-synuclein on mRNA expression levels of JUN, RELA, HMGA1, TP53, and SMAD3 in HEK293T culture

Ebru Keskin[1], Merve Alaylıoğlu[2], Zuhal Yurttaş[2], Tugay Çamoğlu[2], Büşra Şengül- Yediel[1], Pelin Sordu[2], Duygu Gezen-Ak[2], Erdinç Dursun[2]

[1]Department of Medical Biology, Cerrahpaşa Faculty of Medicine, Istanbul University-Cerrahpaşa, Istanbul, Türkiye; [2]Brain and Neurodegenerative Disorders Research Laboratory, Department of Neuroscience, Institute of Neurological Sciences, Istanbul University-Cerrahpaşa, Istanbul, Türkiye

Objective: Alpha-synuclein (-syn), is a cytosolic protein, involved in functions such as synaptic function, neuronal plasticity, learning, development, phosphorylation, cellular differentiation, and regulation of dopamine uptake. α-syn toxicity affects synaptic vesicles, ER, Golgi, lysosomes and nucleus, and disrupts interorganelle communications. Parkinson's disease (PD) is the second most common neurodegenerative disease, characterized by the loss of dopaminergic neurons in the sub-

stantia nigra and the accumulation of α-syn protein. Recent studies have shown that α-syn can localize in the nucleus of different cell types, bind to nuclear DNA, regulate histone modification and affect the expression of many genes. Based on this information, we aim to investigate whether α-syn pathology we created by overexpressing SNCA affects the genes that encode general transcription factors(TFs) rather than directly regulating gene expression.

Methods: In our study, PD-like pathology was established with overexpression of α-syn in the HEK293T cell line. Treatments were carried out at 48, 72 and 96 hours. TFs potentially associated with α-syn were determined using the TRRUSTv2 database, and the effect of α-syn on the mRNA expression levels of selected transcription factors (JUN,RELA HMGA1,TP53, SMAD3) was investigated using the qRT-PCR technique. Experiments were repeated 3 times independently of each other. In GraphPad InStat DTCG3.06 software, the data distribution was statistically evaluated first with one-way ANOVA followed by Tukey-Kramer multiple comparison test or first with Kruskal Wallis and then with Dunn's multiple comparison test, depending on whether it was normal or not.

Results: According to our results, the mRNA expression of JUN, HMGA1 significantly decreased in SNCA group (the group with α-syn overexpression) compared to control, while the RELA expression increased ($p<0.01$, $p<0.01$, $p<0.01$, respectively). Our findings also show alteration of the expression of TP53 and SMAD3.

Conclusions: These results suggest that α-syn can alter the expression of general TFs and thus play a role in regulating the expression of many genes regulated by general TFs.

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Keywords: α-synuclein, Parkinson disease, transcription factor, HEK293T cell line

P-44

The effect of amyloid beta 1-42 protein on transcription factors

Pelin Sordu[1], Merve Alaylıoğlu[1], Zuhal Yurttaş[1], Tugay Çamoğlu[1], Büşra Şengül[2], Ebru Keskin[2], Duygu Gezen-Ak[1], Erdinç Dursun[1]

[1]Brain and Neurodegenerative Diseases Research Laboratory, Department of Neuroscience, Institute of Neurological Sciences, Istanbul University-Cerrahpaşa, Istanbul, Türkiye; [2]Department of Medical Biology, Cerrahpaşa Faculty of Medicine, Istanbul University-Cerrahpaşa, Istanbul, Türkiye

Objective: Alzheimer's disease (AD) is characterized by the accumulation of intraneuronal neurofibrillary tangles and amyloid beta plaques formed by hyperphosphorylated microtubule-associated tau protein. These changes in their pathological processes may also include minor changes in the expression of some genes. A limited number of studies have reported that Aβ1-42 has the capacity to bind to DNA, act as a transcription factor (TF), and alter the expression levels of various genes. In line with this information; It has been hypothesized that Aβ1-42, which can interact with DNA, may also make these adjustments by altering the expression of intracellular TFs.

Methods: Using the FpClass and TRRUST databases, we determined how the expressions of possible TFs, which we think may interact with Aβ1-42, change in response to the administration of toxic (10 μM) and non-toxic (0.09 μM) doses of Aβ1-42 peptide in HEK293T cells, by RNA isolation at 24, 48 and 72 hours following the application, followed by qRT-PCR technique.

Results: It was found that SMAD3 mRNA expression level increased in the group treated with 10 μM Aβ1-42 at the 48th hour of the treatments compared to the control group and the group treated with 0.09 μM Aβ1-42 ($p<0.05$, $p<0.01$). It was found that STAT3 mRNA expression level at the 24th hour of treatments increased in the group treated with 0.09 μM Aβ1-42 compared to the group treated with 10 μM Aβ1-42, and decreased at the 72nd hour ($p<0.01$, $p<0.05$). It was determined that the STAT3 mRNA expression level of the group treated with 10 μM Aβ1-42 at the 48th hour was higher than the group treated with 0.09 μM Aβ1-42 ($p<0.01$, $p<0.01$). It was determined that NFKB mRNA expression level at the 24th hour and ATF4 mRNA expression level at the 72nd hour of the treatments increased in the group treated with 10 μM Aβ1-42 compared to the control group and the group treated with 0.09 μM Aβ1-42 ($p<0.001$, $p<0.05$, $p<0.05$, $p<0.001$).

Conclusion: Our findings will contribute to obtaining basic information about the roles of Aβ1-42 in the cell, for which our knowledge about its endogenous functions is quite limited, and will help to reveal new information to elucidate the pathology of AD.

Funding: The study work was supported by the Research Fund of Istanbul University-Cerrahpaşa (Project No: 34211).

Keywords: Amyloid beta 1–42, transcription factor, gene expression

P-45

miR-122 is upregulated upon htt-siRNA silencing in SH-SY5Y cell model of Huntington's disease

Arkut Berkin Yetim[1], Ezgi Keske[1], Nagehan Ersoy Tunalı[1]

[1]İstanbul Medeniyet University, Istanbul, Türkiye

Objective: Huntington's Disease (HD) is one of the debilitating disorders of the central nervous system, where the causative

mutation is the CAG repeat expansion in the huntingtin (htt) gene. Despite intensive research, the molecular mechanisms could not be clearly identified. MicroRNAs (miRNAs) are post-transcriptional modifiers of gene expression and are regarded as promising molecules for understanding transcriptional dysregulation in health and disease conditions. miR-122 is proved to be involved in immune regulation, axonal development and cholesterol metabolism. In this study, we aimed to investigate the expression of miR-122 upon siRNA treatment against htt in SH-SY5Y cell model of HD.

Methods: SH-SY5Y cells were transfected with mhtt-YFP expression vector using Fugene6. mhtt expression was verified with fluorescent microscopy and qRT-PCR. Upon siRNA treatment against htt, mhtt expression was suppressed. Total RNA was isolated from the cells and cDNAs were synthesized. miR-122 expression levels were identified by qRT-PCR using SYBR Green. Data were analyzed with the ΔΔCT method. $p<0.05$ was considered to be significant.

Results: Upon co-transfecting the cells with mhtt and siRNA, mhtt expression was shown to be suppressed via fluorescent microscopy and qRT-PCR. miR-122 expression in siRNA-treated htt cell model was shown to be increased by 1,3 folds when compared to untreated cells expressing mhtt.

Conclusion: Our finding of significantly increased miR-122 levels in siRNA-treated HD cell model indicate an important role for this miRNA. Considering that miR-122 has roles in immune regulation and cholesterol metabolism, it can be concluded that mir-122 holds the potential to serve as a biomarker in HD.

Keywords: Huntington's disease, miR-122, huntingtin, siRNA

P-46

BDNF, NGF, and TRPM8 gene expression levels in rat brain tissues several experimental epilepsy models

Ayşegül Yıldız[1], Hayriye Soytürk[2], Aydın Him[1]

[1]Department of Physiology, Bolu Abant İzzet Baysal University, Bolu, Türkiye; [2]Institute of Graduate Studies Interdisciplinary Neuroscience, Bolu Abant Izzet Baysal University, Bolu, Türkiye

Objective: It was aimed to determine the gene expression levels of BDNF, NGF, and TRPM8 channels, which are neurotrophic factors, in the cortex and hippocampus regions of different epilepsy models. The purpose of the study was to determine whether there was a relationship between TRPM8 channels, BDNF, and NGF in the epileptogenesis process.

Methods: Twenty-four (n=6) male rats were used in this study. Control, acute, chronic, and genetic models were determined as experimental groups. PTZ was used to develop the acute and chronic epilepsy models. TRPM8, BDNF, and NGF gene expression levels were determined in the hippocampus and cortex tissue of rats by RT-PCR. One-Way-ANOVA and Post-Hoc-LSD tests were used for statistical analysis, and a p-value of <0.05 was considered significant.

Results: BDNF gene expression levels in the cortex region were significantly increased in the chronic group and the hippocampus in both acute and chronic groups compared to the other groups ($p<0.05$). NGF gene expression in the hippocampus was found to be significantly higher in the acute and chronic groups ($p<0.05$). TRPM8 gene expression levels were observed to be considerably lower in acute and chronic groups in the cortex and hippocampus ($p<0.05$).

Conclusion: Increased NGF and BDNF levels in the hippocampus relative to the cortex may indicate the function of epileptogenesis as a marker of neuronal regeneration. Although the TRPM8 channel is expressed in all models, its higher prevalence in the genetic model indicates that it may have a role in the pathophysiology of absence epilepsy. TRPM8 gene expression levels were low in both the cortex and hippocampus regions in acute and chronic epilepsy groups, and NGF and BDNF were high in the hippocampus region; which may cause decreased gene expression levels of TRPM8 channels. The results from the several experimental groups investigated were analyzed for the first time in the literature. BAIBU-BAP funded the research (Project No.2022.08.02.1553).

Keywords: Absence of epilepsy, BDNF, Epilepsy, NGF, TRPM8

P-47

Activation of TRESK channels inhibits TRPV1-mediated release of the migraine mediator calcitonin gene-related peptide

İbrahim Ethem Torun[1], Yasemin Baranoğlu Kılınç[2], Erkan Kılınç[1], Fatma Töre[3]

[1]Department of Physiology, Medical Faculty, Bolu Abant İzzet Baysal University, Bolu, Türkiye; [2]Department of Pediatrics, Bolu İzzet Baysal State Hospital, Bolu, Türkiye; [3]Department of Physiology, Medical Faculty, Atlas University, Istanbul, Türkiye

Objective: Calcitonin gene-related peptide (CGRP) released following activation of trigeminovascular system (TVS) has a central role in migraine pathophysiology. Since CGRP is released from TVS through neurotransmitter exocytosis, mechanisms to limit neuronal excitability can modulate CGRP release. TRESK potassium-leak channels stabilize neuronal excitability by facilitating hyperpolarizing potassium outflow. We therefore investigated effects of TRESK channel activation on basal and capsaicin-induced CGRP release from peripheral (duramater and trigeminal ganglion) and central (brainstem) structures of TVS in rats.

Methods: Adult Wistar male rats were separated 4 groups (n=24). Due to bilateral location, two duramaters and trigemi-

nal ganglia (n=6, 3 rats) and one brainstem (n=6 rats) preparations were prepared from one rat. Preparations continuously carbogenized in artificial cerebrospinal-fluid were treated with TRESK activator cloxyquin(50 ve 100 µM) alone or in combination with TRPV1 agonist capsaicin (100 nM), TRESK inhibitor A2764 (100 µM) and anti-migraine drug sumatriptan (30 µM), respectively. CGRP contents in superfusates were measured by ELISA. Data were analyzed by one-way repeated measures ANOVA.

Results: Capsaicin significantly induced CGRP release in duramater, trigeminal ganglion, and brainstem preparations compared to their controls, respectively ($p<0.001$). While both doses of cloxyquin significantly decreased capsaicin-induced CGRP release in these preparations ($p<0.05$), did not change baseline CGRP releases. A2764 reversed all effects of cloxyquin ($p<0.01$), confirming that the effect was due to activation of TRESK channels. While A2764 did not change basal CGRP release, it increased CGRP release compared to cloxyquin ($p<0.05$). Sumatriptan alone decreased capsaicin-induced CGRP release ($p<0.05$), while co-administered cloxyquin enhanced the effect of sumatriptan ($p<0.05$).

Conclusion: Activation of TRESK channels by cloxyquin inhibits TRPV1-mediated CGRP release from trigeminal afferents, trigeminal ganglion and brainstem trigeminal nucleus that are involved in initiation and transmission of migraine pain by modulating neuronal excitability. TRESK channels may be a promising new target in preventing pathological release of CGRP, which is a migraine mediator and target of current anti-migraine drug researches.

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Keywords: Migraine, trigeminovascular system, CGRP, cloxyquin, TRESK background potassium channels

P-48

Effects of neuroinflammatory mediators in the post-traumatic brain injury period

Kaan Erbakan[1], Zülehya Doğanyiğit[2], Enes Akyüz[3], Ayşe Kristina Polat[4], Alina Arulsamy[5], Mohd. Farooq Shaikh[5]

[1]Faculty of Medicine, Ordu University, Ordu, Türkiye; [2]Department of Histology and Embryology, Faculty of Medicine, Yozgat Bozok University, Yozgat, Türkiye; [3]Department of Biophysics, Hamidiye International Faculty of Medicine, University of Health Sciences, Istanbul, Türkiye; [4]Faculty of Medicine, Yozgat Bozok University, Yozgat, Türkiye; [5]Neuropharmacology Research Laboratory, Jeffrey Cheah School of Medicine and Health Sciences, Monash University Malaysia, Bandar Sunway, Malaysia

Objective: Traumatic brain injury (TBI) is an acquired disorder with neurological and cognitive sequelaes that affects approximately 74 million people worldwide annually. TBI has been subjected to multiple classification due to its risks associated with long-term neurological and neurodegenerative disorders. The emergence of these risks depends on the triggering of secondary molecular and cellular pathologies after injury. Neuroinflammation may be the most important of the secondary injury mechanisms, as it can exacerbate brain damage and lead to fatal consequences if prolonged. The aim of this review is to investigate the mediators involved in neuroinflammatory mechanisms functioning after TBI and to focus on their functional and pathological outcomes in both acute and chronic phases.

Methods: Academic databases including PubMed, ScienceDirect and Google Scholar were used to conduct a comprehensive literature review with examining the roles and outputs of mediators. More than 90 studies were examined and "traumatic brain injury", "cytokine", "neuroinflammation" were used as keyword.

Results: Cytokines include extensively studied interleukins (IL) such as IL-1(beta)β, IL-4, IL-6, IL8, IL-10, IL-18, IL-33, and tumor necrosis factor alpha (TNF-α). In addition, IL-2, interferon gamma (IFN-γ) and transforming growth factor-beta (TGF-β) may also have an important relationship with the pathogenesis of TBI. These neuroinflammatory mediators can exert their neurotoxic effects by triggering cell death, microglial activation, and increased catecholaminergic activity. In contrast, they may have a neuroprotective effect by supporting blood brain barrier integrity, stimulating oligodendrogenesis, balancing macrophage response, and increasing the expression of neurotrophic factors.

Conclusion: Interestingly, cytokines may have a neuroprotective role with anti-inflammatory effects in the acute phase while most of these may play pro-inflammatory roles in the chronic phase of TBI. IL-4, IL-10, TNF-α, IFN-γ and TGF-β have dual roles in relation to other cytokines. Early detection of the mediators and treatments for them may help develop more effective treatment options for TBI.

Keywords: Cytokines, neuroinflammation, brain injury, glia, interleukin

P-49

The effect of mechanical injury on axonal transport and axonal injury signalling mechanisms

Elçin Yenidünya Konuk[1], Gürkan Öztürk[2]

[1]Department of Medical Biology, Faculty of Medicine, Izmir Bakırçay University, Izmir, Türkiye; [2]Department of Physiology and SABİTA, International Faculty of Medicine, İstanbul Medipol University, Istanbul, Türkiye

Objective: The aim of this study is to clarify the mechanisms and how axonal transport is affected after acute injury in mouse primary sensory neuron culture.

Methods: In this study, how the axonal transport is affected by an axotomy with a laser beam in a neuronal culture model and the characteristics of signal mechanisms regarding injury were investigated. For this, primary sensory neuronal cultures were setup by dissociation of adult mouse dorsal root ganglia and the number and speed of particles transported in their outgrown axons in vitro were determined. With a laser beam, axons were cut at about 200 µm from the soma and transport occurring at 50 µm during 12 minutes was analysed. The number and speed of particles in branching or solitary axons or neighbouring ones were determined. Besides, pre and post axotomy levels of motor proteins dynein and kinesin, axonal injury marker APP, axonal protein tau and injury complex forming and importins were immunohistochemically analysed. A potential relationship between axonal injury and was investigated. Depolarization after axotomy was visualized with a special dye.

Results: The results showed that the number and speed of retrogradely transported particles were decreased after axotomy while not the number ($p<0.01$) but the speed of anterograde particles was reduced ($p<0.05$). These changes were not observed in neighbouring branches or axons. It was determined that strong depolarization occurred in the cell soma after axotomy ($p<0.01$) and this could function as a damage signaling mechanism. After axotomy, α importin decreased in the nucleus and distal axon ($p<0.05$), and α importin and α/β importin complex decreased in the soma ($p<0.05$).

Conclusion: In conclusion, this study has provided new and important data about how mechanical injury affects axonal transport in adult neurons and what may play significant role in injury signalling.

Keywords: Dorsal root ganglion, axonal transport, injury signals, dynein, kinesin

P-50

Acquirement more cells by prolonging the ependymal stem cell culture period

Emine Omer Oglou[1], Filiz Koncagül[2], Kamil Can Akçalı[3], Ömer Beşaltı[2]

[1]Department of Biology, Graduate School of Natural and Applied Sciences, Ankara University, Ankara, Türkiye; [2]Department of Clinical Sciences and Surgery, Faculty of Veterinary Medicine, Ankara University, Ankara, Türkiye; [3]Department of Biophysics, Faculty of Medicine, Ankara University, Ankara, Türkiye

Objective: Advances have been developed in medicine and although treatments, diseases that are difficult to reverse, such as spinal cord injuries (SCI), are still await solutions. Especially there is no method for reducing secondary damage. The aim of this study is to isolate, characterize and prolong the culture period of ependymal stem cells (EpSCs), which are the natural source of development in the embryonic and fetal period and self-renewal in the postnatal period, and which are thought to have the potential to repair SCI.

Methods: Spinal cord tissue of new born rats (n=5, PN=5) was used to source of EpSCs isolation. Tissues were divided into smaller and they were taken into the solution containing 0.05% Trypsin-EDTA and incubated at 37°C. The homogenized tissues were centrifuged. The supernatant was discarded and the pellet was transferred to 96-well U-bottom microplates with neurosphere medium containing 10% FBS. Microplates were incubated at 37°C under 5% CO2 conditions for 48 hours. The characterization of the obtained cells was done by conventional PCR through cDNA synthesized from total RNAs. CD24, CD34 and CD45 markers were analyzed.

Results: FBS was not used in the culture medium in the studies of isolation of EpSCs and their culture time was approximately 10 days. In our study, the culture time was extended up to 3 weeks in media with 10% FBS added to this control medium. The cells observed as CD24(+), CDD34(-), CD45(-) were confirmed to be EpSCs.

Conclusion: Surface markers of cells isolated from spinal cord tissue confirmed that they were SC. The culture times were extended to 3 weeks. It will be possible to obtain more cells. Whether potential to be used as a therapeutic in SCI will be analyzed in our future studies.

Funding: This study is supported by the TUBITAK 1001 project, "Comparison of Ependymal and Mesenchymal Stem Cell-derived Exosomes in Spinal Cord Injuries: Experimental Study" numbered 1200992.

Keywords: Ependymal stem cell, spinal cord, spinal cord injury, rat

P-51

Did you know that epigenetic reflections in synaptic plasticity have a function in memory and learning?

Oya İnceoğlu Tatar, Alev Kuru, Muhsin Konuk

Department of Molecular Neuroscience, Institute of Health Sciences, Üsküdar University, Istanbul, Türkiye

Objective: Looking at the literature, mostly cells in the hippocampus are responsible for memory and learning. The hippocampus, where long-term memory is organized, is part of the limbic system, and the limbic system is responsible for emotions and memory. In a study, it was determined that the relationship between this function, emotions and traumatic events affect memory and learning. Epigenetics is a factor that can prevent, initiate or change the level of functionality of some genes (deoxyribonucleic acid) on DNA by different methods without changing the DNA itself. It is the link between static DNA and the key mechanism in how the environment alters cellular function. It also enables learning and

storing a memory in the brain through the plasticity of experiences. In this review, the role of epigenetic mechanisms in learning, the formation and maintenance of memory is discussed, and it is aimed to contribute to memory strengthening studies in neuropsychiatric disorders by collecting data in the future.

Methods: It is aimed to contribute to PUBMED by collecting data from articles published by typing keywords such as epigenetics, learning and memory, and neuroplasticity.

Results: Studies on epigenetics and plasticity for memory and learning have increased significantly over the past decade. There are many reasons, one is the curiosity of how the brain works, the other is how to strengthen memory, the third is how to facilitate the learning process, but perhaps the most critical one is how to prevent memory loss in neurodegenerative diseases or regenerative diseases. creates lost memories after psychological or physical trauma. The role of plasticity for memory formation and learning is just beginning to be unraveled.

Conclusion: Understanding the different aspects of epigenetic mechanisms, recognizing the theory of ways of intervening in plasticity and epigenetic mechanisms will increase further in vivo studies, so this is important for future clinical evaluations and procedures.

Keywords: Epigenetics, learning, memory, neuroplasticity

P-52

Investigation of RFC1 in perivascular macrophages and human brain endothelial cell cultures

Dilan Bozanoğlu[1], Joe Kelk[2], Serena Seminara[2], Gizem Erol[2], Stefano Fumagalli[2], Müge Yemişçi[3]

[1]Institute of Neurological Sciences and Psychiatry, Hacettepe University, Ankara, Türkiye; [2]Department of Neuroscience, Mario Negri Institute for Pharmacological Research IRCCS, Milan, Italy; [3]Institute of Neurological Sciences and Psychiatry, Hacettepe University, Ankara, Türkiye; Department of Neurology, Faculty of Medicine, Hacettepe University, Ankara, Türkiye; Turkey Neuroscience and Neurotechnology Center of Excellence (NÖROM), Ankara, Türkiye

Objective: Reduced folate carrier 1 (RFC1) is highly expressed in central nervous system microvessels and have a role in folate transport. Recently, we found RFC1 increase in mice retina by ischemia. Here, we assessed whether RFC1 also changes in human brain microvascular endothelial cell cultures (hBMECs) by ischemia. We also investigated if RFC1 is expressed in brain tissue macrophages derived from induced pluripotent stem cells (IPSC), hence could be used in further studies.

Methods: We subjected hBMECs to 16 hours of hypoxia (0.5% O_2) and 4 hours of re-oxygenation in the presence of human serum. From human episomal IPSC, embryoid bodies were formed and cultured. Then, non-adherent cells were collected and preserved for 10 days in the media to obtain mature tissue macrophages (TM). hBMECs (n=4), embryoid bodies (n=7), and mature TMs (n=8) were harvested, homogenized and total RNA were extracted. RFC1 gene expression was assessed by qRT-PCR. Statistical analyses were performed with PRISM v.9.

Results: In hBMECs, RFC1 mRNA increased via hypoxia and re-oxygenation by 35-fold when compared to controls (t-test, $p<0.01$). Secondly, RFC1 mRNA was expressed in cells derived from IPSCs, and was higher in the immature embryoid body stage compared to mature TM (33%, t-test, $p<0.01$).

Conclusion: The increase of RFC1 expression in hBMECs by ischemia supports our previous results in mouse model of retinal ischemia. As such, RFC1 is accountable as a pathological mechanism activated in ischemic microvessels and could be a promising new target. Moreover, in terms of IPSC derived macrophages, the high RFC1 expression in their immature states is concordant with the embyonic development in human, and strenghtens the reliability of usage of these cells to study RFC1 in brain microvessels.

Keywords: RFC1, brain microvessels, IPSCs, hBMECs, ischemia

P-53

Therapeutic effects of esculetin on epileptiform activity, seizures, neuroinflammation and memory in different rat models of epilepsy

Ayşegül Danış[1], Yasemin Baranoğlu Kılınç[2], İbrahim Ethem Torun[3], Fatma Hancı[1], Erkan Kılınç[3]

[1]Department of Pediatric Neurology, Bolu Abant İzzet Baysal University, İzzet Baysal Training and Research Hospital, Bolu, Türkiye; [2]Department of Pediatrics, Bolu İzzet Baysal State Hospital, Bolu, Türkiye; [3]Department of Physiology, Medical Faculty, Bolu Abant İzzet Baysal University, Bolu, Türkiye

Objective: Modulation of processes that promote the mechanisms underlying seizures, such as neuroinflammation, together with anticonvulsant activity, are new targets in epilepsy treatment. We aimed to investigate effects of esculetin with anti-inflammatory activity on epileptiform activity, behavioral seizures, neuroinflammation and memory in seizure models induced by penicillin or pentylenetetrazole (PTZ).

Methods: PTZ and penicillin-induced general-groups using Wistar male-rats were divided into six subgroups each (n=7). Epileptic-models were established by intraperitoneal injection of 50 mg/kg PTZ or intracortical injection of 500 IU penicillin, respectively. 30 minutes before PTZ injection, vehicle was administered intraperitoneally to control and PTZ groups, 5, 10 and 20 mg/kg doses of esculetin to esculetin groups, and 5 mg/kg diazepam to positive-control group. Penicillin was administered instead of PTZ in penicillin-induced groups. Seizures in PTZ groups were measured by Racine-scale, memory by passive-

avoidance test, cortical and hippocampal activin-A, IL-1β, IL-6 and NF-kB levels by ELISA. Electrophysiological ECoG recordings were taken for 160 minutes in penicillin-induced groups and spike frequency and amplitude were analyzed in PowerLab-software. Data were compared by one-way ANOVA.

Results: In PTZ model, the 10 mg/kg esculetin produced anticonvulsant effects by prolonging onset-times of myoclonic-jerk and generalized tonic-clonic seizure, and by reducing seizure stage and duration of generalized tonic-clonic seizure ($p<0.05$), furthermore, it alleviated memory impairment and cortical and hippocampal activin-A, IL-1β, IL-6, and NF-κB levels ($p<0.05$). In penicillin model, while reducing the spike frequency ($p<0.001$), it did not affect their amplitude. As a positive-control, diazepam reversed the induced effects in both models ($p<0.01$), whereas esculetin did not appear to be superior to diazepam.

Conclusion: Esculetin dose-dependently exhibits anticonvulsant effects by improving the behavioral and electrophysiological characteristics of epileptic seizures. Esculetin exerts these effects by suppressing NF-κB pathway and pro-inflammatory cytokines production. Due to its anticonvulsant and anti-neuroinflammatory effects, esculetin may be promising for epilepsy treatment.

Keywords: Epilepsy, neuroinflammation, esculetin, seizure, epileptiform activity

P-54

Effect of the interaction of midazolam with antiepileptic drugs on behaviors in status epilepticus

Cumaali Demirtaş[1], Uğur Aykın[1], Metehan Akça[2], Yunus Emre Sürmeneli[1], Hava Yıldırım[3], Mehmet Yıldırım[1]

[1]Department of Physiology, Hamidiye Medical School, University of Health Sciences, Istanbul, Türkiye; [2] Department of Physiology, Medical School, Tokat Gaziosmanpasa University, Tokat, Türkiye; [3]Department of Medical Biology, Hamidiye Medical School, University of Health Sciences, Istanbul, Türkiye

Objective: Status epilepticus is an important health problem that causes loss of motor and cognitive functions due to neuronal cell damage as well as mortality. In this study, it was aimed to investigate effects of combined use of first and second-line antiepileptic drugs in treatment protocols of status epilepticus as a polytherapy option in the experimental status epilepticus produced with lithium-pilocarpine on motor and cognitive behaviors. Interaction of midazolam (MDZ), which is first-line treatment option for status epilepticus, with second-line antiepileptic drugs levetiracetam (LEV), lacosamide (LCM), valproic acid (VPA) and fosphenytoin (fPHT) was investigated. In this way, it is aimed to evaluate neuronal damage due to status epilepticus and polytherapy through motor and cognitive function tests at a possible polytherapy.

Methods: After dividing male Sprague-Dawley rats into 6 groups (n=8), the experimental status epilepticus with lithium-pilocarpine (5 mEq/kg–320 mg/kg) injection in groups other than control group (0.9%NaCl) was created (SBU-HADYEK-2020-03/15). Thirty minutes after onset of status epilepticus, MDZ (9 mg/kg), MDZ+LEV (9+200 mg/kg), MDZ+LCM (9+50 mg/kg), MDZ+VPA (9+300 mg/kg) or MDZ+fPHT (9+100 mg/kg) was injected intraperitoneally. Fifteen days after status epilepticus, open field for locomotor activity, rotarod for forced motor activity, radial arm maze for spatial memory, and passive avoidance tests for fear memory were applied. Data were statistically analyzed with Mann-Whitney-U test after Kruskal-Wallis.

Results: It was determined that antiepileptic drugs (LEV, LCM, VPA and fPHT) administered in combination with MDZ did not cause a negative effect on learning and memory compared to control group. On the other hand, it was determined that motor functions of animals treated with MDZ+fPHT were impaired both compared to control group and to MDZ group ($p<0.01$).

Conclusion: In the experimental status epilepticus, it was observed that LEV, LCM and VPA applied together with MDZ did not adversely affect both cognitive and motor functions.

Funding: This study was supported by SBU-BAP. Project no:2020/092.

Keywords: Status epilepticus, antiepileptic drug, learning, motor function

P-55

The effects of cloxyquin in pentylenetetrazole induced epileptic seizure model in rats

Didem Ayhan[1], Aydın Him[1], Erkan Kılınç[1], Şerif Demir[2]

[1]Department of Physiology, Bolu Abant İzzet Baysal University, Bolu, Türkiye; [2]Department of Physiology, Düzce University, Düzce, Türkiye

Objective: In the presented study it is considered that, activation of TRESK (TWIK related spinally-expressed potassium channels), which is member of the the two-pore potassium channel family, with its specific activator cloxyquin may affect epileptic seizure by stabilizing neuronal membrane potential and making difficult to stimulate. The possible effects of cloxyquine were investigated by using the acute experimental epileptic seizure model which induced with pentylentetrazole.

Methods: Seventy-two male Wistar rats which were randomly divided into nine groups used in study. Saline, dimethyl sulfoxide, valproic acid and five different doses of cloxyquine (0.1 mg/kg, 0.5 mg/kg, 1 mg/kg, 5 mg/kg, 10 mg/kg) were administered to the groups. After acute epilepsy was generated and video recordings taken; the first myoclonic jerk, latency and

seizure durations, the number of seizures, behavioral scores, survival rates of animals were examined. Chi-square, Shapiro-Wilk, Kruskal Wallis, Mann Whitney U tests, ROC, simple linear regression and The Spearman rank-order correlation coefficient analyzes were used for statistical analysis.

Results: In the study, there were no statistically differences between the groups in terms of seizure stages, first myoclonic jerk and latency durations. The most significant results in regard to better seizure stages, low number of seizures and not existing any death cases were seen in the groups which valproic acid (100 mg/kg) and 10 mg/kg of cloxyquin were administered. Survival rates according to seizure duration were statistically significant (Chi-square=26.074; p<0.001) and there was no death under the thirty-four seconds of seizure duration.

Conclusion: It is considered that the dose of 10 mg/kg of cloxyquin starts to be effective on epileptic seizure and reducing the seizure duration will also reduce deaths.

Funding: Bolu Abant İzzet Baysal University Department of Scientific Research Projects (Project number: 2020.08.02.1446)

Keywords: Epilepsy, pentylenetetrazole, cloxyquin, valproic acid, TRESK

P-56

The effect of TPV1 channel activator capsaicin on novel object recognition and Y-maze test in ketamine-induced schizophrenia model

Ferruh Karamangil, S. Sırrı Bilge

Department of Medical Pharmacology, Ondokuz Mayıs University, Samsun, Türkiye

Objective: Schizophrenia is a psychiatric disorder that is encountered in the community. Resistance to drugs used in schizophrenia and limitations due to their side effects necessitated the search for new drug targets. The disruption of thermoregulation and different responses to pain stimuli in patients with schizophrenia suggest that TRPV1 channels may have a possible role in the pathology of schizophrenia. The aim of this study was to investigate the effect of capsaicin in a ketamine-induced schizophrenia model in mice.

Methods: To induce schizophrenia-like psychotic behavior, ketamine (10 mg/kg, i.p.) was administered to C57BL/6 mice as a single dose. TRPV1 channel activator capsaicin was administered at 0.1, 1 and 3 mg/kg, i.p doses 30 minutes before ketamine. The new object recognition test and the Y-maze test were used to test the memory and learning impairment seen in schizophrenia. Risperidone (0.5 mg/kg, i.p.) was used as a positive control.

Results: While there was no significant effect on the time spent on discovering new objects at doses of 0.1 mg/kg and 1 mg/kg of capsaicin have a significant effect on discovering new objects at the dose of 3 mg/kg, it prolonged the decreased time significantly (p<0.05). In addition, ketamine significantly decreased the number of arm changes (p<0.05) in the Y-maze test. While capsaicin did not affect the number of arm changes reduced by ketamine at 0.1 (p<0.001) and 1 mg/kg (p<0.001) doses, it was found that capsaicin prevented this decrease significantly at 3 mg/kg (p<0.05).

Conclusion: TRPV1 agonism has been shown to reduce the negative effects of ketamine-induced psychosis on memory and motor coordination in a mouse model of schizophrenia. Given that TRPV1 channels are expressed in most sensory neurons in the central nervous system, our results suggest that capsaicin-induced activation of these channels has a regulatory role in ketamine-induced psychosis.

Keywords: Capsaicin, TRPV1 channels, schizophrenia, ketamine, mouse

P-57

TRPV1 channels have a role in ketamine-induced psychosis model of mice

Ferruh Karamangil, S. Sırrı Bilge

Department of Medical Pharmacology, Ondokuz Mayıs University, Samsun, Türkiye

Objective: Schizophrenia is a chronic psychiatric disorder the cause of which is unknown. It is considered to be a neurodevelopmental disorder that results from an interaction of genetic and environmental factors. Direct evidence for links between schizophrenia and TRP channels is lacking. Study of transient receptor potential (TRP) channels in these disorders is at an early stage and the potential of agents that activate or inhibit these channels remains speculative.

Methods: Mice were treated with ketamine (10 mg/kg, i.p.) to induce schizophrenia-like psychosis behavior in C57BL/6 mice. Role of TRPV1 channels were assessed by capsaicin treatment (0.1, 1 and 3 mg/kg). Risperidone was used as positive control (0.5 mg/kg, i.p.). Stereotypic behavior investigated by grooming and rearing. Locomotion was evaluated by rotarod and open field tests.

Results: Our results demonstrated that ketamine did not affect rotarod performance and locomotion. However, ketamine caused significant increase in stereotypic behavior compared to control (grooming p<0.05 and rearing p<0.05). Capsaicin, at the dose of 3 mg/kg significantly suppressed ketamine-induced stereotypic behavior (grooming p<0.05 and rearing p<0.05) without affecting locomotor activity (p<0.05).

Conclusion: TRPV1 agonism prevented ketamine-induced psychosis seen in schizophrenia mice model. TRPV1 channels are expressed in most of the sensory neurons in the central

nervous system, our results suggest that capsaicin-induced activation of these channels have regulatory role in ketamine-induced psychosis.

P-58

Relation of parkinsonian visual hallucinations with cognitive functions

Zeynep Yıldız[1], Tuğçe Kahraman Demir[2], Muzaffer Arıkan[3], Ali Behram Salar[4], Lütfü Hanoğlu[5], Süleyman Yıldırım[6]

[1]Department of Psychology, Fatih Sultan Mehmet Vakif University, Istanbul, Türkiye; [2]Programme of Electroneurophysiology, Vocational School, Biruni University, Istanbul, Türkiye; [3]Regenerative and Restorative Medicine Research Center (REMER), Research Institute for Health Sciences and Technologies (SABITA), Istanbul Medipol University, Istanbul, Türkiye; [4]Graduate Program in Neuroscience, Istanbul Medipol University, Istanbul, Türkiye; [5]Department of Neurology, Istanbul Medipol University Training Hospital, Istanbul, Türkiye; [6]Department of Medical Microbiology, International School of Medicine, Istanbul Medipol University, Istanbul, Türkiye

Objective: Although hallucinations and cognitive impairment are frequently reported neuropsychiatric findings in Parkinson's disease (PD), the relationship between parkinsonian hallucinations and cognitive functions has not been adequately explained. This study aimed to examine the cognitive functions of PD patients with visual hallucinations by means of neuropsychometric tests and to reveal the relationship between them. Patients diagnosed with PH were included in the study.

Methods: PH patients with visual hallucinations (n=46) were assigned to the hal(+)PH group, and PH patients without hallucinations (n=64) were assigned to the hal(-)PH group. Groups were matched for age, education level, Hoehn Yahr Scale (HYE), and Clinical Dementia Rating (CDR) stages. In the evaluation of cognitive functions of groups, Wechsler Memory Scale (WMS) personal and current knowledge subtest, WMS orientation subtest, verbal fluency tests, abstraction skills test, Clock Drawing Test, WMS visual reproduction subtest, WMS logical memory subtest, Öktem Verbal Memory Process Test, Boston Naming Test, Benton Face Recognition Test, Benton Judgment of Line Orientation Test, Yesavage Geriatric Depression Scale, Apathy Evaluation Scale, Neuropsychiatric Inventory and Mini-Mental State Examination were used. Unified Parkinson's Disease Rating Scale, HYE, University of Miami Parkinson's Disease Hallucination Questionnaire, and The REM Sleep Behavior Disorder Screening Questionnaire (RBDSQ) were used to evaluate Parkinson's disease.

Results: As a result of the statistical analyzes performed, the personal and current information of PH patients with hallucinations deteriorated [$t(105)=3.289$ $p<0.05$], orientation scores decreased [$t(105)=2.494$ $p<0.05$], their forward digit span is reduced [$t(105)=2.325$ $p<0.05$], phonemic fluency decreased [$t(98)=3.931$ $p<0.001$], abstraction skills deteriorated [$t(105)=2.035$ $p<0.05$], SBST immediate memory [$t(108)=2.405$ $p<0.01$], SBST learning score [$t(108)=3.154$ $p<0.01$] and SBST total score decreased [$t(107)=2.469$ $p<0.05$] and RBDSQ scores increased [$t(95)=-4.106$ $p<0.05$].

Conclusion: These findings show that the clinical and cognitive features of PD patients with hallucinations differ and support the attention hypothesis proposed to explain parkinsonian hallucinations.

Keywords: Cognitive functions, hallucinations, neuropsychometric assessment, Parkinson's disease

P-59

Investigation of the relationship between Parkinson's disease dementia and Akkermansia

Muzaffer Arıkan[1], Tuğçe Kahraman Demir[2], Zeynep Yıldız[3], Nesrin H. Yılmaz[4], Aysu Şen[5], Lütfü Hanoğlu[4], Süleyman Yıldırım[6]

[1]Department of Medical Biology, School of Medicine, Istanbul Medipol University, Istanbul, Türkiye; [2]Programme of Electroneurophysiology, Vocational School, Biruni University, Istanbul, Türkiye; [3]Graduate Program in Neuroscience, Istanbul Medipol University, Istanbul, Türkiye; [4]Department of Neurology, School of Medicine, Istanbul Medipol University, Istanbul, Türkiye; [5]Department of Neurology, Bakırköy Research and Training Hospital for Psychiatric and Neurological Diseases, Istanbul, Türkiye; [6]Department of Medical Microbiology, International School of Medicine, Istanbul Medipol University, Istanbul, Türkiye

Objective: Cognitive impairment, which is among the most common non-motor symptoms of Parkinson's disease (PD), has significant negative effects on patients' quality of life. Since the emergence and course of cognitive impairment in PD patients varies greatly from patient to patient, there is a need to develop better early detection and monitoring strategies. One of the members of the gut microbiota most frequently associated with PD is Akkermansia. While Akkermansia is a bacterium generally associated with health, the reason for its relative abundance in PD patients has not yet been resolved. Specific strains of Akkermansia may be present that may be associated with the development of dementia in PD. In this study, the relationship between the development of dementia in PD and strains of the genus Akkermansia was investigated using metagenomic and genus-specific amplicon-based analyses.

Methods: A reference database was created by combining previously reported Akkermansia genomes with Akkermansia genomes obtained from the gut microbiome of 4 new PD patients and healthy controls (HC). Using these genomes, genus-specific primer sequences were designed and 90 fecal samples (30 PD patients with dementia (PDD), 30 PD patients with mild cognitive impairment (PD-MCI) and 30 HC) were analyzed by NGS-based amplicon sequencing. The distribu-

tion of each Akkermansia strain was determined and those strains that showed significant differences between the sample groups were determined. By using the whole genome sequences of the detected Akkermansia strains, the gene sets were compared with across Akkermansia strains, and pathways and gene groups potentially associated with specific strains were determined.

Results: 7 Akkermansia strains were determined across study groups. Two of the detected strains were only present in HC and PD-MCI groups. In addition, the gene contents of the strains differentially distributed according to different cognitive status were determined through comparative analyses.

Conclusion: Thus, the results of this project will offer important opportunities for better understanding and prevention of cognitive impairment in PD.

Keywords: Akkermansia, Parkinson, metagenomics, microbiome

P-60

Do medical faculty students know migraine?

Yaren Nisa Genç[1], Ebru Nur Yavuz[2]

[1]Faculty of Medicine, Demiroğlu Bilim University, Istanbul, Türkiye; [2]Department of Neurology, Faculty of Medicine, Demiroğlu Bilim University, Istanbul, Türkiye

Objective: Migraine patients, who make up the majority of patients admitted to the neurology outpatient clinic, are frequently encountered in daily life. Since migraine is common and has negative effects on daily life activities, it is important to be recognized by medical students and to know the treatment approaches. To review whether medical school students who have completed or have not completed their neurology internship recognize migraine adequately, whether they are aware of treatment and new developments. In addition, it is aimed to draw attention to migraine awareness.

Methods: The detailed questionnaire approved by the ethics committee, was sent to the students via social media and whatsapp. Statistical comparison was made between group 1 (completed neurology internship) and group 2 (did not complete neurology internship).

Results: A total of 258 medical school students, 157 (60.9%) female and 101 (39.1%) male, participated in the study. Two hundred and fifteen (83.3%) of the participants were in Group 1 and 43 (16.6%) were in Group 2. When Group 1 and Group 2 were compared, 57.24% of group 1 and 37.16% of group 2 stated that the type of pain was throbbing (p=0.001). 37.24% of group1 and 24.77% of group 2 stated that the duration of pain was 4-72 hours (p=0.017). While 89.65% of group 1 reported photophobia/ phonophobia/ osmophobia during pain, 65.48% of group 2 reported (p=0.0001). While it was 75.86% in group 1 who heard the definition of aura, it was 63.71% in group 2 (p=0.021). While 46.89% said that the aura duration was 5-60 minutes in group 1, it was 29.20% in group 2 (p=0.002).

Conclusion: Our results show that students who have completed their neurology internship recognize migraine better in many aspects than students who have not completed their neurology internship, but new advanced specific treatments are not well known. In addition, our study is thought to be important because it increases the awareness of migraine in medical school students.

Keywords: Neurology, medical education, awareness, migraine

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