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FINAL DECLARATION OF THE "1ST WORKSHOP ON EMERGENCE OF ENGINEERED MODELS IN PERSONALIZING REGENERATIVE MEDICINE"

("KİŞİSELLEŞTİRİLMİŞ REJENERATİF TIP ALANINDA MÜHENDİSLİK ÜRÜNÜ MODELLERİN GELİŞİMİ" ÇALIŞTAYININ FİNAL DEKLARASYONU)

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ABSTRACT

This paper contains the final ideas of "1st Workshop on Emergence of Engineered Models in Personalizing Regenerative Medicine" organized within 7th Bioengineering Congress.

Keywords: Bioengineering, Regenerative medicine

ÖZ

Bu yazı, VII.Biyomühendislik Kongresi bünyesinde gerçekleşen "Kişiselleştirilmiş Rejeneratif Tıp Alanında Mühendislik Ürünü Modellerin Gelişimi" çalıştayının sonuçlarını kapsamaktadır.

Anahtar Kelimeler: *Biyomühendislik, Rejeneratif tıp*

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1. INTRODUCTION

This workshop was organized in conjunction with the 7th International Bioengineering Congress (BEC2015), on 21th November 2015 in Izmir Architecture Center to focus on engineered in vitro disease models on regenerative medicine. With the frame of this topic, it was aimed to remark on how tissue engineering can contribute to personalised medicine, help in the search for novel treatment strategies for various common diseases, and also help to decrease the use of animal models during preclinical trials.

Modeling of human diseases by certain toxic treatments, or in genetically manipulated animals has led to important advances in the understanding of pathogenic mechanisms of many disorders. While the continued importance of animals in translational research is undeniable, genetic and anatomical variation between these animals and human have led to discrepancies. The ultimate goal in developing experimental models mimicking pathologic hallmarks of the diseases is to either prevent these diseases in at-risk individuals before the onset of clinical symptoms or to develop effective therapies that slow down or halt disease progression in the earliest. Hence, there is an urgent need for developing new strategies for fast and reliable in vitro models based on human cells.

Although cell and tissue culture models of disease mechanisms have their experimental limitations, they have some significant advantages over animal models of disease, particularly in that they can be human genome-based and allow for the direct investigation of pathophysiological characteristics in a far less time and less labour intensive manner. Not only can experiments be more rapidly performed, but also techniques can be developed for high-throughput screening of therapeutic compounds.

The value of the *in vitro* tissue engineering approaches (Figure 1) for the study of disease pathways and for drug discovery has not been utilized to their fullest potential yet. Classical 2D cell culture techniques lack the complexity and physiological relevance required to model human tissues and their disorders. Cell differentiation, tissue development and homeostasis *in vivo* are strongly dependent on directional cues and spatial arrangement for correct trafficking and communication between different cell types; so extracellular microenvironment profoundly affects cell behaviour. Three dimensional (3D), tissue engineered *in vitro* systems can address this need and enhance clinical translation.

Speakers contributed the accumulation of knowledge of participants. Three dimensional (3D) scaffold production methods, use of stem cells, with an emphasis on stem cells derived from patients, the commercialisation of products were discussed. Possible further research opportunities using 3D bioprinters were discussed as a case study.

An interactive and creative platform was built by the group of 20 participants of different diciplines: Antonios G. Mikos, Gamze Torun Köse, Mustafa Özgür Güler, Aylin Şendemir-Ürkmez, Armağan Ergün, Yannis F. Missirlis, Bahattin Koç, S. İsmet Deliloğlu Gürhan, Şeyma Taşdemir, Cansu Görgün, Aslı Aybike Doğan, Ece Bayır, Ozan Karaman, Umut Doğu Seçkin, Atakan Tevlek, Zeynep İşlek, Pelin İlhan, Yaşar Cuma and Emine Erdoğan Özşeker. The workshop started with the presentation of Prof. Dr. Antonios G. Mikos from Rice University, USA. During the speech of Prof. Mikos, attention was drawned into the use of

biomaterials that are used in tissue engineering (Figure 5). Dr. Mikos shared his works upon stem cells that can be used together with biomaterials in innovative medical methods and presented examples about importance of the tissue engineering products that are used in current treatment methods.

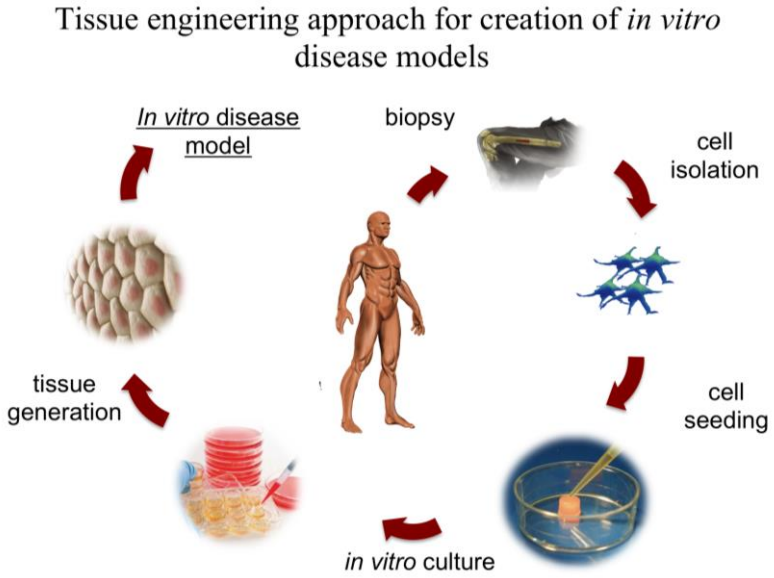

Figure 1. Tissue engineering approach for creation of *in vitro* disease models

Assist. Prof. Dr. Aylin Şendemir Ürkmez emphasized the advantages of using tissue engineering products on disease models and showed examples of the studies by Ege University Research Group of Animal Cell Culture and Tissue Engineering (EgeREACT). Especially when comparing two dimensional classical models with three dimensional models, emphasized on the limitations of creating replicates of true human tissues and informed participants about differences between 2D and 3D models (Figure 2).

Figure 2. Assist. Prof. Dr. Aylin Şendemir Ürkmez

Prof. Dr. Gamze Torun Köse, who is a member of Yeditepe University Genetic and Bioengineering Department has emphasized the use of 3D models at stem cell research. She has especially focused on the importance of stem cells used in personalized treatments and and given examples about recent milestones (Figure 3).

Figure 3. Prof. Dr. Gamze Torun Köse

Assoc. Prof. Dr. Mustafa Özgür Güler, who is a member of Materials Science and Nanotechnology Department of Bilkent University has showed recent examples of self-assembling peptides and mentioned the advantages of the the nanostructured self-assembled peptides in mimicking the extracellular matrices of various mammalian tissues (Figure 4).

Figure 4. Assoc. Prof. Dr. Mustafa Özgür Güler

The last session of the workshop was performed as a case study. This session, under the title of "*Is bioprinting the future? What are the advantages and pitfalls of bioprinting in tissue engineered disease models*?" created a brainstorming environment about the advantages and disadvantages of bioprinters. At this session Armağan Ergün, who is working with Tesla Teknik company made a small presentation about "Quantum Dot" 3D printers and informed participants about working principles of 3D printers. After this presentation there were discussions between participants about using 3D printers in tissue engineering and to create personalized treatments.

This workshop was organized by Ege University Biomedical Technologies Department as a pioneering workshop in the field in Turkey, and preparations to organize the second workshop has already begun. Products of tissue engineering and personalized innovative medicine will gain significant importance in our close future in the development of clinically relevant *in vitro* systems replicating disease physiologies accomplished through careful

engineering of the extracellular space, cellular components, and hierarchical 3D structure.

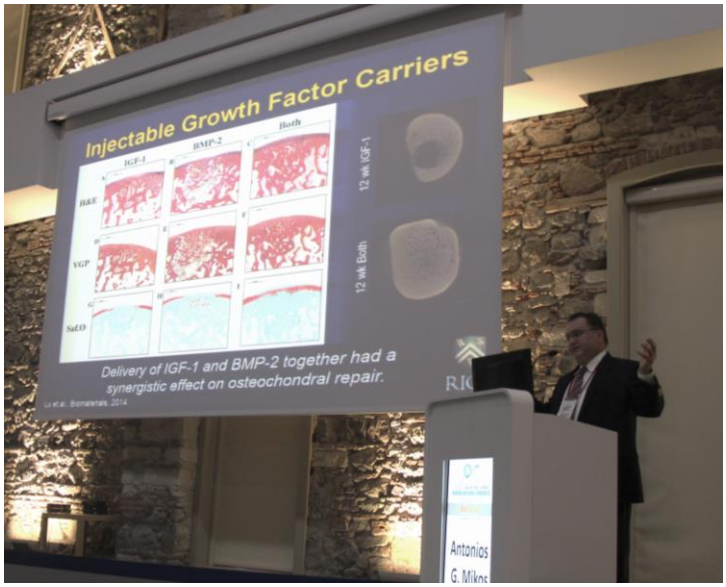

Figure 5. Prof. Dr. Antonios G. Mikos

ÖZGEÇMİŞ/CV

Cansu Görgün; Biochemist, Phd candidate(Biyokimyager, doktora öğrencisi)
She graduated as Biochemist from the Ege University (2012) and received her M.Sc degree from Department of Stem Cell, Ege University, 2015. Currently she is a PhD candidate at Biomedical Technologies Department, Ege University. During her bachelor, she completed her BSc. Thesis with the title of "RNA Isolation with nano polymers which are modified by Phenyl Boronic Acid" and she wrote her M.S theses about "The Hypoxia Effect on Cancer Stem Cells". Her strong interest in regenerative medicine has begun during her undergraduate education, as learning about the cellular metabolism and its further behaviors on the biomaterials made her curious about the alterations on different species, effects of these changes and discovers the cell structure. Two practical trainings at different laboratory groups broadened her interest in regenerative medicine, biomaterials and cell biology particularly in disease modeling.

Şeyma Taşdemir; Res.Asist. (Araştırma Görevlisi)
She graduated as Bioengineer from the Ege University (2010), received a M.Sc, (Ege University, 2013). Also she is a PhD candidate and research assistant at Ege University Bioengineering Department. She wrote her M.S theses about "Investigation of attachment and proliferation properties of rat bone marrow and adipose tissue derived mesenchymal stem cells on PCL nanofibrous surfaces" and her ongoing PhD theses about "Investigation of the neuroregenerative effects of ıron oxide (Fe_3O_4) nanoparticle and graphene reinforced tissue engineering products on *in vitro* and *in vivo* Parkinson's disease models". She qualified to master and doctora scholarship from The Scientific and Technological Research Council of Turkey. Her research interests are including animal cell culture, neural tissue engineering, production of scaffold, electrospinning, stem cells, interactions of cells and biomaterials, biocompatibility tests, *in vitro* Parkinson models, 3D micro tissue models.

Aylin Şendemir-Ürkmez; Assist. Prof. Dr. (Yrd.Doç.Dr.)
She has received her B.S. degree at Mechanical Engineering (1994), M.Sc. degree at Biomedical Engineering (1997) from Bogazici University, Turkey, and PhD. degree at Materials Science and Engineering (2006) from University of Illinois at Urbana-Champaign, USA. She has been working as an assistant professor at Ege University Faculty of Engineering, Bioengineering Department since January 2009 and currently the principal investigator at Ege Research Group of Animal Cell Culture and Tissue Engineering (EgeREACT). Her research interests include interactions of animal cells and biomaterials, tissue engineering, mechano-transduction, stem cells, cancer stem cells and biocompatibility testing. She is also interested in design and production of novel *in vitro* disease models in order to minimize animal testing. She has co-authored more than 20 scientific papers, 2 patents and 3 book chapters. Assist. Prof. Dr. Aylin Şendemir Ürkmez is a member of the Editorial Board of Challenges in Regenerative Medicine.

Lisans derecesini Boğaziçi Üniversitesi Makine Mühendisliği (1994), Yüksek Lisans derecesini ise, Boğaziçi Üniversitesi, Biyomedikal Mühendisliği (1997) bölümlerinden almış olup, doktorasını Illinois at Urbana-Champaign Üniversitesi, Malzeme Bilimi ve Mühendisliği (2006) bölümünde tamamlamıştır. 2009 yılının Ocak ayından itibaren, E.Ü., Mühendislik Fakültesi, Biyomühendislik Bölümü'nde Yrd. Doç. Dr. unvanıyla çalışmakta olup, Hayvan Hücre Kültürü ve Doku Mühendisliği Araştırma Grubu (EgeREACT)'ın yürütücülüğünü üstlenmektedir. İlgi alanları arasında, hayvan hücreleri ile biyomalzemelerin etkileşimleri, doku mühendisliği, mekano-transdüksiyon, kök hücreler, kanser kök hücreleri ve biyouyumluluk testleri yer almaktadır. Ayrıca, hayvan denemelerinin minimize edilmesi amacıyla, in vitro hastalık modellerinin dizayn ve üretimiyle ilgilenmektedir. 20'den fazla bilimsel makale, 2 patent ve 3 kitap bölümünün eş yazarlığına sahip olmakla birlikte, Yenileyici Tıp'taki Zorluklar (Challenges in Regenerative Medicine) adlı derginin editörlüğünü yapmaktadır.