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Research Article

Examining of trauma and post traumatic stress disorder in terms of neuroscience perspective

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Abstract

Trauma is an unexpected and terrifying event that has the potential to damage a person's bodily integrity or risk death. After this event, some negative emotional, cognitive and behavioral reactions are observed in people. If it has been one month or more after the event, and if the person shows avoidance behavior in addition to these negative reactions, or experiences the event over and over with flashbacks and has increased arousal, it can be mentioned that the person shows the symptoms of post-traumatic stress disorder (PTSD). Just as every behavior we do during the day has a neurobiological basis, the reactions shown during and after trauma also have a neurobiological basis. The stress at the time of trauma causes various activities in the brain and as a result of these activities, changes occur in the person's feelings, thoughts and behaviors. So we can talk about a two-way interaction. This interaction of different systems helps us understand PTSD.

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Introduction

Trauma, traumatic event is an event or situation that a person has directly experienced or witnessed, which negatively affects the person cognitively, emotionally and behaviorally. Although there is no single definition of trauma for everyone, events such as unexpected events with a high risk of loss of life, natural disasters, traffic accidents, exposure to sexual violence are events that can traumatize the person. These events do not have the same effect for everyone. Events that we can call trauma for some may not have the same effect and trauma for others.

In the acute period of a few weeks after trauma, people experience negative mood, various involuntary physiological reactions, and negative cognitive changes. Over time, these trauma effects lessen. However, it has been observed that these negative effects do not decrease after trauma, and that these effects continue for months or even years. In this case, we can talk about Post Traumatic Stress Disorder (PTSD). In this disorder, where the effects after trauma last longer than 1 month; Flashbacks of the event, sleep disorders, emotional insensitivity and memory registration disorders are frequently seen (Tanor, 2021). According to DSM-V (Diagnostic and Statistical Manual of Mental Disorders-V) there are the diagnostic criteria for PTSD for those over 6 years old. These are; directly experiencing the traumatic events or witnessing the event as it occurred to others or learning that traumatic event occurred to a close family member or friend, extreme exposure to aversive details of the traumatic events. After these; recurrent, involuntary distressing memories of traumatic event, dreams are related to traumatic event, dissociative reactions, intense and prolonged psychological

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distress, avoidance memories, thoughts or feelings associated traumatic event and external reminders such as people or places, negative alterations in cognitions and mood, irritable or self-destructive behavior (APA, 2013a, p.271-272).

Criteria of the PTSD are the results of a series of changes that occur in the brain after trauma. The events that take place in the brain during trauma stem from the person's survival instinct. Rather than processing and examining the information received during the event in a long and detailed way, the brain is alerted in faster ways to keep the person alive. This sometimes causes people to act irrationally. Like people jumping out of windows in earthquakes. After such traumatic events, the brain may not easily come out of the alarm state. Changes that occur during trauma may be permanent for a while. Here, we see PTSD symptoms for months or even years in people whose brain cannot fully come out of the alarm state.

Having the opportunity to reach social support after trauma is very important for recovery. The fact that the environment in which people are in the acute period is safe, that they can meet their urgent needs, and that they know that they can reach help whenever they want helps people to spend this period better. Still, the effects can last a long time and lead to PTSD. Today, there are proven methods in the treatment of PTSD. If people have not been able to get rid of these effects for a long time and these effects interfere with the daily work and life of the person, they should receive regular treatment. After the treatment, it was observed that the patients were involved in daily life again and did not show PTSD symptoms any more.

Although it was thought that trauma was experienced only after wars, people who started to show the same symptoms after different events showed that more research should be done about trauma and PTSD. As more research has been done, it has been discovered that trauma and post-traumatic stress disorder have many different aspects that need to be understood (Yehuda & LeDoux, 2007). One of these aspects was neurological activities. Looking at trauma and post-traumatic stress disorder from a neuroscience perspective has been helpful in developing treatment (Zoellner et al., 2003). As the neurological foundations were understood, there were developments in drug therapy (Albucher & Liberzon, 2002). In addition, it was discovered that physical activity is effective in the treatment of PTSD due to its effect on neurological activities, and interventions were made in this direction in the treatment process (Oppizzi & Umberger, 2018)

When PTSD and its treatment are the subject of study, it is necessary to know and understand the neurological effects in order to better understand both this psychopathology and the effects of its treatment. This psychopathology, which directly causes changes in neurological activities, cannot be understood without looking at it from the perspective of neuroscience (Ross et al., 2017). It is not possible to talk about the success of the treatment without making the necessary interventions in the neurological activities that have become unusual (Albucher and Liberzon, 2002). Therefore, in this study, trauma and PTSD will be discussed from the perspective of neuroscience. Thus, it is aimed to fully understand this psychopathology and to explain what the success of the treatment depends on.

The Effect of Trauma on the Brain

In order to understand what happens in our brain during and after trauma, we need to know the regions and functions that play a role in these moments. At the time of trauma, different activities occur in different parts of the brain. Since the risk of death or harm is high in trauma, the brain quickly goes into an alarm state and focuses on survival. For this reason, information does not come to the cortex and is not processed in detail here. In other words, upper cortical cognitive processes are disrupted. In such trauma situations, more thalamus, amygdala, hippocampus, that is, our lower brain, which allows us to react more quickly, is active. In this rapid information processing and reaction process, some information is processed incorrectly, distortedly and stored in the memory in that way. This can lead to many problems, especially long-term post-traumatic stress disorder. In some people, after a few weeks of acute phase, the brain's information processing system and overstimulated alarm state may return to normal, while in others, this may take much longer and recovery may not occur without assistance. In trauma situations, the systems that are mainly affected in the brain can be counted as cognitive, emotional and neurotransmitter systems (Tanör, 2021).

Cognitive System and PTSD from a Neuroscience Perspective

Cognitive systems, which are heavily affected during trauma and continue to be affected afterwards, play an important role in post-traumatic stress disorder. The first point to be mentioned in cognitive systems is the memory system. During trauma, the thalamus sends external information directly to the amygdala and hippocampus before the cortex. These structures are also part of the emotional system. It is known that both of these structures are related to memory and storing what has been learned in memory. In particular, the amygdala, the structure responsible for fear, causes fear with information from the thalamus and puts the body in "fight or flight" mode. This mode, which means that the sympathetic nervous system is active, causes many symptoms such as an increase in respiration, a decrease in blood pressure, and sweating. All of the information that comes during the trauma, such as sound, image, contact, is thus associated with fear and the "fight or flight" response. Since this associated information does not go to the cortex, it is recorded in the memory in this way. It is also known that the hippocampus has many tasks such as long-term memory and consolidation in memory. At the same time, all fear-inducing stimuli brought here by the thalamus are recorded in the long-term memory. For this reason, it is understandable for someone who has experienced a trauma at some point in their life to remember the trauma very clearly.

Another cognitive system affected is executive functions and the prefrontal cortex responsible for them. The prefrontal cortex is the region of our brain that is responsible for many executive functions such as reasoning, attention, problem-solving, planning, abstract thinking, and personality. Since the primary goal during trauma is to survive, it is important to ensure that the body responds quickly. Therefore, stimuli are not processed in this area of the brain because this area is located at the top and front of the brain and will not help the "fight or flight" situation. During and after trauma, the prefrontal cortex partially loses its function. It cannot process the information in detail and come to a logical conclusion, which prevents us from acting more rationally.

In post-traumatic stress disorder, the prefrontal cortex is not fully functional. The hyperarousal state of people with PTSD stems from this. The fact that there are patients who are as afraid of every loud sound as in the moment of trauma is because they cannot process the incoming stimulus in detail and enter the "fight or flight" mode again and again. In addition, distorted and incomplete information recorded in memory causes people to develop new beliefs. For example, a person now believes that being outside at the time of the traumatic event in daily life is dangerous and avoids being outside. Avoidances are already among the symptoms of PTSD and are caused by new beliefs formed by post-traumatic distorted information.

Emotional System and PTSD from a Neuroscience Perspective

The name of the emotional system responsible for emotions in our brain is the limbic system. The hippocampus, amygdala, cingulate gyrus, corpus mamillare, some higher cortical centers, such as anterior parts of the thalamus, and right superior temporal and insula, are parts of the limbic system. This system, which is responsible for the control of emotions and emotional response, is one of the systems affected during trauma. Information coming to the limbic system through the thalamus during trauma usually causes negative emotions such as fear, anxiety, sadness, and shame. Living with these feelings for a long time means that the amygdala and insula are working for too long. Studies have shown that overworking the amygdala and insula causes the hippocampus to shrink (Tanor, 2021). This can lead to difficulties with memory and emotions. All these interacting structures play a major role during and after trauma. The fact that the person is constantly in a state of fear and anxiety in post-traumatic stress disorder indicates that the limbic system is still operating under the influence of the trauma moment and cannot return to its normal order due to the distorted information in the memory. Conversely, people may experience numbing during or after trauma. Numbing is a biological process whereby emotions are detached from thoughts, behaviors, and memories. (Substance Abuse and Mental Health Services Administration, 2014). It is the state of not feeling anything about the event at the time of or after the trauma. In this case, people say that they are not emotionally affected and that they cannot feel anything.

Neurotransmitter System and PTSD from a Neuroscience Perspective

Another system affected by frightening and unexpected trauma is the neurotransmitter system. Neurotransmitters are chemical carriers that provide communication between neurons in our body. Thanks to neurotransmitters, the incoming information is transmitted to the necessary structures throughout the entire nervous system. There are two groups of neurotransmitters that act as inhibitors or excitators. Neurotransmitters have specific receptors and become functional by binding to them. Various neurotransmitters such as dopamine, noradrenaline, serotonin, histamine, acetylcholine, glutamate, GABA, glycine have various effects on the human body.

During and after trauma, stress-induced deterioration occurs in the balance of neurotransmitter system, as in many systems. At the same time, cortisol secretion in the body increases due to the stress signals sent by the hypothalamus to the pituitary gland. This causes an increase in blood pressure and sugar. It also plays a role in triggering the noradrenergic system. In trauma situations, hypothalamic-pituitary-adrenal axis activity changes with unstable and variable cortisol level. In addition, low cortisol level has been found to be associated with post-traumatic stress disorder. (Substance Abuse and Mental Health Services Administration, 2014).

During trauma, the noradrenergic system is highly active. This plays an important role in trauma and post-traumatic stress disorder. Noradrenergic neurons release transmitter throughout the brain; this is associated with an increase in alerting and vigilance behaviors, critical for coping with acute threat. (Substance Abuse and Mental Health Services Administration, 2014). Noradrenaline release is the body's response to physiological and psychological stress. It causes a state of arousal. The brain, which is in a "fight or flight" mode during trauma, commands the release of noradrenaline. Thus, behaviors that increase the chances of survival are facilitated. However, long-term activation of the noradrenergic system causes negative effects. Hyperarousal, which is a symptom of post-traumatic stress disorder, is due to the imbalance of this system. This imbalance can also bring flashbacks and inappropriate thinking styles.

Contrary to the noradrenergic system, the activation of the serotonergic system decreases during and after trauma. The serotonin neurotransmitter is associated with our mood. It also plays a role in the formation and symptom manifestation of many mental illnesses. It also plays a role in various conditions such as blood pressure, heart rate, respiration, appetite, and sexual behavior. The fact that SSRIs (Selective Serotonin Reuptake Inhibitors) work in the treatment of PTSD shows that this neurotransmitter has a role in PTSD (Eryilmaz and Gogcegoz, 2015). Serotonin levels, which decrease during the trauma and remain low afterward, are effective in the depressed mood of people.

Prevalence of PTSD

It is known that not every event will have the same effect on every person. Individuals have different genetic characteristics, psychological backgrounds and coping mechanisms with stress. Therefore, not everyone feels and thinks the same for the same event. In the emergence of PTSD, the nature of the trauma, its severity, previous traumatic events and post-traumatic conditions will be the determining factors (Aydin and Ozgen, 1999). The prevalence of PTSD also differs accordingly.

PTSD entered the literature because of the disorders seen in humans after World War II. In other words, the prevalence of PTSD is much higher in people who are under risk factors such as war, conflict, murder, natural disaster. The prevalence in this group can reach up to 58% (Aydin and Ozgen, 1999). It is known that the prevalence of PTSD in the general population is between 1% and 14%, and the prevalence of PTSD is higher in women, people with low socioeconomic status, and people with limited access to social support. In addition, the rate of developing PTSD after rape increases to 48% in women and to 10% after unexpected death or serious injury in men (Kessler et al. 1995).

Comorbidity of PTSD

PTSD symptoms cover a wide spectrum. We can think of it as an intersection of different mental disorders, especially panic disorder and depression. Therefore, differential diagnosis becomes difficult. In PTSD, which is often seen together with other mental disorders, the lifetime risk of developing comorbid mental disorders is around 70% (Aydin and Ozgen, 1999). Studies have found that depression, phobic disorder, obsessive-compulsive disorder, panic disorder and alcohol

addiction are the most common with PTSD. Many of these diseases experience similar changes in the brain. These changes also cause certain symptoms. Therefore, there are many common symptoms in these diseases.

Treatment of PTSD In the Light of Neuroscience

Understanding trauma and PTSD from a neuroscience perspective has led to increased success in treatment. Differences in neurological activities have been understood, and different treatment methods have been developed to return these activities to their normal state. It has been researched which neurologic activities are corrected by different drugs and the most appropriate treatment for PTSD has been tried to be established. In addition, PTSD has been started to be studied with different therapy methods and the healing power of the therapy has been tried to be increased.

Organizing the physical environment of the people after the trauma and providing social support to the traumatized people provide healing effects in the acute period. However, these are not enough in post-traumatic stress disorder. People need regular and effective treatment. Treatments for post-traumatic stress disorder are quite effective. The aim of the treatment is to enable the person to continue his/her social and daily life and to cope with the intense feelings and thoughts about the traumatic event. At the end of the treatment, this goal is achieved.

One of the methods used in the treatment of post-traumatic stress disorder is psychotherapy. In general, trauma-focused cognitive behavioral therapies have been found to be quite effective. Cognitive behavioral therapy (CBT) is a structured treatment method that includes methods such as cognitive reconstruction, prolonged exposure, cognitive processing therapy (Unveren and Izci, 2017). CBT is also a treatment that includes techniques for coping with anxiety such as relaxation. With CBT, the person's non-adaptive cognitive processes are detected and efforts are made to replace them with more adaptive processes. With a healthy exposure, the person gradually confronts their fears and learns how to deal with negative emotions. In addition, cognitive distortions are often seen in people after trauma. The person may not always remember the event as it is, so the person may have unrealistic feelings and thoughts. These distortions can be corrected with cognitive restructuring.

In addition to cognitive behavioral therapy, another method with proven effectiveness in the treatment of PTSD is EMDR (Eye Movement Desensitization and Reprocessing). EMDR is a psychotherapy method that combines elements of cognitive, behavioral and client-centered approaches, which are used in the treatment of many different problems such as phobia, performance anxiety, panic disorder, body image disorder, trauma symptoms in children, grief, as well as emotional problems caused by traumatic experiences (Shapiro, 2001). This 8-phase method is thought to stimulate information processing through eye movements and other two-way sound and tactile stimuli. Information cannot be fully processed when a traumatic event occurs. Perceptions remaining in memory, distorted thoughts will lead to PTSD symptoms. With EMDR, eye movements will enable to process the unprocessed information and depersonalize the frozen information remaining in the memory. This will neutralize the negative impact and allow positive thoughts to be re-established (Unveren and Izci, 2017).

Another method used in the treatment of PTSD is pharmacological treatment. After the neurological effects of post-traumatic stress disorder are understood, drug therapy, which becomes more effective, yields results in patients (Albucher, Liberzon, 2002). In pharmacological treatment with proven efficacy, Selective Serotonin Reuptake Inhibitors (SSRIs) are first given to patients. First, we can talk about SSRIs such as sertraline and fluoxetine. Van der Kolk et al. (1994) found in their study that fluoxetine was particularly effective on startle, emotional blunting, and depressive symptoms. Sertraline studies have also shown that it is effective in reducing intrusive thoughts and avoidance levels (Gokalp, 2000). In addition to SSRIs, the effectiveness of antidepressants and mood stabilizers has been shown in various studies. An important point to be considered in pharmacological treatment is comorbidity. If there are disorders seen together with PTSD, the drugs to be given should be selected from drugs that will also be effective on comorbid diseases.

PTSD treatments are treatments that give very positive results. But the point to be considered is to remember that each person is unique and to choose the most appropriate treatment method for the person's condition. If every event

does not have the same effect on every person or if not everybody experiences their trauma in the same way, not every treatment is suitable for everybody. For some, only psychotherapy is sufficient, while for others, pharmacological treatment may be necessary in addition to psychotherapy. For this reason, the specialists who will give the treatment should determine the symptoms and needs of the person well and decide which method can best meet these needs. After the right road map is drawn, the end of the road leads to recovery.

Conclusion

Working as a whole, the brain responds to external stimuli. When stimuli are transmitted to the brain, different parts of the brain show different functions, leading to the behavior, feelings and thoughts of the person against the stimulus. In the event of trauma, stimuli comes to the brain are perceived as dangerous and the body enters "fight or flight" mode to survive in dangerous situations. At the same time, this process, which affects many different systems in the body, shapes not only our behaviors but also our feelings and thoughts.

In case of trauma, the affected brain may have difficulty returning to normal for a while after the trauma. Distorted cognitions, incomplete or incorrect memory are the factors that have emerged due to trauma and may negatively affect the mood of the person after the trauma. Due to these factors, the person's hyper-arousal and anxiety may continue for a while. Post-traumatic social support can help this negative process pass more easily and quickly. However, as this negative process continues, the risk of being diagnosed with post-traumatic stress disorder increases. Post-traumatic stress disorder is the continuation of the effects of the traumatic event after 1 month or more after the traumatic event. Symptoms manifest themselves in many specific ways such as reminiscing and experiencing the event over and over during the day, that is, flashbacks, avoiding things related to the event or things that will remind of the event, emotional insensitivity, sleep disorder, memory recording disorder, and hyperarousal state. All of these symptoms are caused by the many changes that occur in the brain during trauma and their persistence.

In other words, the brain, which is affected by various aspects during trauma, may cause a mental disorder in the post-traumatic period as a result of these effects. Cognitive system affected by trauma creates new beliefs and thoughts, memory records the event moment incompletely or incorrectly. These become permanent and shape one's behavior. Again, the limbic system affected during trauma is related to our emotions. The high activation of the amygdala associated with the feeling of fear, as well as the affected neurotransmitter system, the increase in adrenaline and the decrease in serotonin direct the mood of the person. Hyper-arousal and depressed mood are caused by them. These effects, which can be permanent in the post-traumatic process, play a role in post-traumatic stress disorder.

As a result, we can talk about a multi-faceted interaction here. External stimuli affect the brain, and these effects in the brain affect the emotions, thoughts and behaviors of the person. We can understand the symptoms and causes of many mental disorders by looking at brain activity, and we can understand post-traumatic stress disorder in the same way. The brain, which shapes a person from his/her character to his/her emotions, has given us information about many disorders and has shown the way for treatment processes. This was also the case for trauma and post-traumatic stress disorder.

Recommendations

This study is a review study on post-traumatic stress disorder, which is one of the disorders that seriously impair the quality of life and functionality of individuals, from a neuroscience perspective. The aim of the study is to provide a better understanding of the neurological infrastructure of post-traumatic stress disorder. It is recommended that more quantitative and qualitative studies be conducted in this area in the future. It is recommended to researchers in the field to investigate neurological activities in patients diagnosed with post-traumatic stress disorder and in the treatment process. In addition, studies can be conducted on what neurological differences are observed before and after trauma.

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