Advances in Treating Posttraumatic Stress Disorder: Diagnostic Criteria, Molecular Mechanisms, and Therapeutic Approaches

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Abstract

Background: Posttraumatic Stress Disorder (PTSD) is a debilitating condition that affects individuals exposed to traumatic events, with higher prevalence rates among military personnel. The disorder's complexity, including the distinction between PTSD and complex PTSD (CPTSD), has led to evolving diagnostic criteria in both the DSM-5 and ICD-11. Advances in understanding PTSD have led to improved treatment strategies, but further research is needed to explore its underlying molecular, genetic, and neurobiological mechanisms. Methods: This review synthesizes current literature on PTSD, focusing on its diagnostic evolution, treatment options, and emerging research on its genetic and neurobiological foundations. Studies on PTSD in military populations were highlighted, emphasizing diagnostic frameworks, treatment modalities, and the role of healthcare providers, particularly nurses, in managing PTSD. A systematic analysis of genetic studies and neuroimaging findings was also included to understand the molecular underpinnings of PTSD. Results: The review found that PTSD's diagnostic criteria have evolved to include more detailed distinctions between standard PTSD and CPTSD. Pharmacological treatments such as SSRIs and SNRIs, alongside psychological therapies like Cognitive Behavioral Therapy (CBT) and Eye Movement Desensitization and Reprocessing (EMDR), were identified as effective in alleviating symptoms. Emerging evidence points to genetic predispositions, immune system dysfunction, and neuroimaging findings, such as reduced hippocampal volume, as key factors in the development and persistence of PTSD. Conclusion: Despite substantial progress in the understanding and management of PTSD, further research is needed to explore the genetic, neurobiological, and molecular factors contributing to the disorder. Healthcare providers, especially nurses, play a crucial role in early detection, treatment facilitation, and advocacy, ensuring better outcomes for those affected by PTSD.

Keywords: PTSD, diagnostic criteria, molecular mechanisms, treatment approaches, therapeutic interventions

Significance |This review analysis the PTSD's complex nature, diagnostic advancements, and treatment strategies, offering insights for improved care and outcomes.

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1. Introduction

Posttraumatic Stress Disorder (PTSD) is a complex psychiatric condition that often emerges after an individual is exposed to significant stressors, such as combat, natural disasters, or other

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traumatic events. Initially defined in the *Diagnostic and Statistical Manual of Mental Disorders, Third Edition* (DSM-III) in 1980, PTSD was recognized as a distinct clinical entity characterized by intrusive memories, avoidance behaviors, and heightened arousal (Kendell, 1980). Over the decades, extensive research has illuminated the complexities of this disorder, but challenges remain in understanding its full pathophysiology and identifying definitive treatment approaches. In particular, PTSD's significance has increased in the context of military personnel, as exposure to combat-related stressors has been strongly linked to the development of PTSD (White et al., 2015).

The diagnosis of PTSD has evolved over time. The most recent edition, DSM-5, includes 20 symptoms, divided into four categories: intrusion, avoidance, negative alterations in cognition and mood, and marked changes in arousal and reactivity (American Psychiatric Association, 2013). These symptoms must persist for at least a month and lead to functional impairment. An important revision in DSM-5 reclassified PTSD from an anxiety disorder to a trauma- and stressor-related disorder, reflecting a more nuanced understanding of the condition (Brewin et al., 2017). This shift is significant, as it acknowledges that PTSD's roots lie more directly in trauma exposure than in traditional anxiety pathways. In comparison, the World Health Organization's International Classification of Diseases, 11th Edition (ICD-11), offers a different perspective by grouping PTSD symptoms into three core clusters: persistent re-experiencing of trauma, avoidance of trauma reminders, and a pervasive sense of threat (Maercker et al., 2013). This differentiation between diagnostic systems highlights the ongoing challenges of accurately capturing the full spectrum of PTSD.

The prevalence of PTSD is notably high among military personnel, where combat-related experiences increase the risk of developing this debilitating disorder. Studies show that the prevalence of PTSD in military personnel ranges from 5.4% to 16.8%, significantly higher than in the general population (Jonas et al., 2017). PTSD is often accompanied by comorbidities such as depression, substance use disorders, and cognitive impairments, particularly following mild traumatic brain injuries (MDD) (Jonas et al., 2017). The impact of PTSD extends beyond the individual, with military families often bearing the brunt of the disorder's emotional toll, which can contribute to family dysfunction, relationship breakdowns, and, in extreme cases, domestic violence (Evans et al., 2017). Moreover, the effects of PTSD are not confined to veterans; children of veterans have also been found to exhibit emotional and behavioral difficulties linked to parental PTSD (Brewin et al., 2017).

Molecular research into PTSD's mechanisms has identified the role of the hypothalamic–pituitary–adrenal (HPA) axis, catecholamines, and immune system dysregulation as crucial factors in the disorder's development (Zhang et al., 2017). Elevated proinflammatory cytokines and altered gene expression may contribute to PTSD's onset and persistence, suggesting that neurobiological alterations could predispose individuals to develop the disorder after exposure to trauma (Brewin et al., 2017). These biological findings align with studies showing that genetic factors, such as polymorphisms in the FKBP5 gene, are associated with PTSD susceptibility (Zhang et al., 2017).

Despite these advances in understanding PTSD's underlying biology, treatment options remain a critical area of focus. Psychological interventions, including Cognitive Behavioral Therapy (CBT) and Eye Movement Desensitization and Reprocessing (EMDR), have shown efficacy in managing PTSD symptoms (Jonas et al., 2017). Pharmacological approaches, such as selective serotonin reuptake inhibitors (SSRIs), are commonly used to alleviate symptoms, although they have varying levels of effectiveness (Jonas et al., 2017). Comprehensive treatment strategies, which may involve a combination of psychological and pharmacological interventions, are recommended for better outcomes in individuals with PTSD (American Psychiatric Association, 2013).

PTSD remains a multifaceted disorder with profound implications for both individuals and society, particularly within military populations (Table 1). Ongoing research into its molecular mechanisms, alongside the development of targeted therapeutic strategies, will be essential in reducing the burden of this disorder and improving outcomes for affected individuals. The objective of this review is to provide an updated understanding of PTSD, particularly in military contexts, facilitating further interdisciplinary dialogue and research to improve care and intervention strategies for individuals suffering from PTSD.

2. Posttraumatic Stress Disorder: Diagnostic Criteria, and Differential Diagnosis

Posttraumatic stress disorder (PTSD) is a prevalent and often debilitating psychiatric disorder that affects individuals exposed to traumatic events. It leads to significant impairment in various aspects of functioning, including social, occupational, and personal domains. The complexity of PTSD, in terms of both its manifestations and etiology, makes its diagnosis challenging. Over time, research advancements have led to a refined understanding of PTSD, and diagnostic criteria have evolved to reflect this increasing knowledge. This article explores the definitions and diagnostic frameworks of PTSD as outlined in the DSM-5 and ICD-11, compares the differential diagnosis of PTSD with other psychiatric disorders, and highlights recent insights into the factors contributing to PTSD development.

3. Evolution of PTSD Criteria: DSM-5 vs. ICD-11

The initial definition of PTSD was presented in the third edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-III, 1980), which categorized PTSD symptoms into three clusters, consisting of a total of 17 symptoms. The DSM-III emphasized the occurrence of symptoms following exposure to a traumatic event but did not offer a comprehensive understanding of the disorder's full range of manifestations. Subsequent revisions in the DSM series, including the DSM-IV and the DSM-5, have significantly expanded and refined these diagnostic criteria.

The DSM-5, published by the American Psychiatric Association (APA) in 2013, recognizes PTSD as a trauma- and stressor-related disorder, distinct from anxiety disorders. The DSM-5's diagnostic criteria include 20 symptoms organized into four clusters: intrusion, avoidance, negative alterations in cognitions and mood, and marked alterations in arousal and reactivity. A diagnosis requires that the individual has experienced a traumatic stressor and exhibits at least one intrusion symptom, one avoidance symptom, two negative alterations in cognitions and mood, and two symptoms related to arousal and reactivity. These symptoms must persist for a minimum of one month and result in functional impairment (APA, 2013).

In contrast to the DSM-5, the World Health Organization (WHO) adopted a different approach to diagnosing PTSD in the 11th edition of the International Classification of Diseases (ICD-11). The ICD-11 consolidates PTSD symptoms into three primary clusters: persistent re-experiencing of the trauma, avoidance of reminders of the trauma, and a pervasive sense of threat. Unlike the DSM-5, the ICD-11 does not require specific symptom counts but mandates that at least one symptom from each cluster must be present for a diagnosis. Additionally, symptoms must persist for several weeks after exposure to a severe stressor (Maercker et al., 2013).

4. Differential Diagnosis of PTSD

While the diagnostic criteria for PTSD are well-established in both the DSM-5 and ICD-11, differential diagnosis can be challenging due to overlapping symptoms with other psychiatric disorders. PTSD shares common features with conditions such as adjustment disorder, anxiety disorders, obsessive-compulsive disorder (OCD), and personality disorders. One distinguishing feature of PTSD is the trauma exposure requirement, which is not present in disorders like major depressive disorder (MDD). Individuals with MDD may or may not have experienced traumatic events and typically do not exhibit the intrusive re-experiencing symptoms characteristic of PTSD (Brewin et al., 2017).

Furthermore, traumatic brain injury (TBI) can produce neurocognitive symptoms like persistent disorientation, which may overlap with PTSD symptoms. However, neurocognitive issues associated with TBI are more focused on cognitive impairment rather than the emotional and behavioral symptoms central to PTSD (White et al., 2015).

Another significant distinction within the context of PTSD is the recognition of complex PTSD (CPTSD) in the ICD-11. Complex PTSD includes the core PTSD symptoms along with disturbances in self-organization (DSO), which involve negative self-concept and difficulties in interpersonal relationships. These additional symptoms differentiate CPTSD from classical PTSD, highlighting the severity and chronicity of trauma in individuals diagnosed with this condition (Brewin et al., 2017).

5. Factors Contributing to PTSD: Stressor Type and Comorbidity

Research has established that PTSD can develop following exposure to a variety of traumatic stressors, with military-related trauma being particularly significant. Combat-related stressors, including direct exposure to violence, have been strongly linked to the development of PTSD symptoms. However, research also suggests that non-combat stressors, such as moral injury, can be critical in PTSD development, especially in military personnel. Moral injury refers to a profound sense of shame or guilt arising from violating deeply held moral beliefs during combat. This type of injury is a significant independent risk factor for PTSD and major depressive disorder (MDD) (Nash & Litz, 2013; Nazarov et al., 2018).

Recent studies have highlighted the prevalence of moral injury in military families and its contribution to PTSD development. For example, a study of Canadian Armed Forces personnel found that exposure to moral injury during deployments was associated with higher rates of PTSD and MDD, suggesting that PTSD is not limited to the direct victims of trauma but extends to their families as well (Nazarov et al., 2018).

Posttraumatic stress disorder remains a complex and evolving diagnosis, with criteria that have undergone significant revisions over time. The latest frameworks in the DSM-5 and ICD-11 reflect the growing understanding of PTSD's nature and its distinct symptom clusters. While PTSD shares overlapping symptoms with other psychiatric conditions, its specific diagnostic criteria help differentiate it from disorders like major depressive disorder and anxiety disorders. Ongoing research into the nature of stressors, such as moral injury, and the recognition of complex PTSD underscore the multifaceted nature of the disorder and the importance of comprehensive diagnostic approaches. The continued refinement of PTSD diagnostic criteria and differentiation from other conditions remains crucial for ensuring accurate diagnosis and effective treatment for affected individuals.

6. Prevalence and Significance of Posttraumatic Stress Disorder (PTSD)

Posttraumatic stress disorder (PTSD) is a debilitating mental health condition commonly associated with a variety of negative individual outcomes (Figure 1). These include co-occurring disorders such as depression, substance abuse, and numerous physical health issues. A significant proportion of individuals with PTSD also experience cognitive impairments, particularly in memory and attention, which further hinder daily functioning. According to DSM-5 guidelines, more than 80% of PTSD patients present with at least one comorbidity, with conditions such as mild traumatic brain injury (TBI) affecting approximately 48% of PTSD patients (Foa et al., 1997). The prevalence of PTSD varies considerably across different populations, with military personnel and veterans being notably more affected.

The prevalence of PTSD among military personnel and veterans is notably higher than in the general population. Studies indicate that PTSD affects between 5.4% and 16.8% of military personnel, which is roughly double the rate observed in the civilian population (Reijnen et al., 2015; Sundin et al., 2014). This increased prevalence is particularly concerning in the context of global conflicts and terrorism, which exacerbate the mental health burden on affected individuals. Though PTSD can impact individuals of any age and background, research has predominantly focused on military veterans, with far less attention given to its impact on children.

Gender differences in PTSD prevalence within the military are still debated. A large-scale study of Operation Enduring Freedom and Operation Iraqi Freedom (OEF/OIF) veterans found PTSD rates to be similar for men and women, with men exhibiting a slightly higher prevalence (13% vs. 11%) (Seal et al., 2008). However, other research suggests that women may experience higher PTSD rates due to a greater incidence of military sexual trauma, a strong risk factor for PTSD development (Street et al., 2016). Additionally, despite combat exposure being a well-established risk factor, women in the military tend to have less combat exposure, yet experience higher rates of trauma-related mental health issues, which highlights the complex factors influencing PTSD development.

Another significant issue for military veterans with PTSD is the emotional regulation difficulties they often experience. PTSD symptoms, such as anger, avoidance, and hyperarousal, are closely linked to impaired emotional regulation, contributing to family dysfunction and, in some cases, domestic violence. A meta-analysis of 34 studies found a significant correlation between PTSD severity and heightened anger, particularly in military populations (Olatunji et al., 2010). In addition to emotional distress, PTSD symptoms can interfere with social relationships, making reintegration into civilian life challenging for many veterans. Research has shown that between 44% and 72% of veterans report high levels of stress following their return to civilian life, with PTSD symptoms exacerbating these challenges (Macera et al., 2014).

The impact of PTSD extends beyond the affected individual, with significant consequences for family dynamics. A study by Evans et al. (2009) found that PTSD symptoms in veterans often disrupt family functioning, with avoidance behaviors negatively impacting family relationships, and hyperarousal symptoms contributing to indirect emotional strain. Furthermore, recent studies from the Veterans Health Administration (VHA) indicate a link between PTSD and suicidal ideation, with depression and mood disorders serving as mediating factors (McKinney et al., 2017).

The effects of PTSD on children, particularly those exposed to parental PTSD, have received increased attention in recent years. Children whose parents suffer from PTSD often experience emotional and behavioral disruptions, including confusion, frustration, withdrawal, and mimicking of their parents' behaviors (Enlow et al., 2013). Children exposed to trauma in early life, such as intimate partner violence (IPV) or maltreatment, are at greater risk for developing PTSD and other psychological issues (Briggsgowan et al., 2012). The development of PTSD in young children is particularly concerning due to the critical role caregivers play in early childhood development. However, research on the long-term developmental impacts of PTSD in children remains limited, with few studies investigating the relationship between early exposure to trauma and later developmental outcomes.

The prevalence of PTSD, particularly among military personnel and veterans, is a significant public health concern. The comorbidity of PTSD with other mental health and physical conditions further complicates diagnosis and treatment. As research continues to explore the varying prevalence and significance of PTSD across different demographics, it remains essential to consider the broader implications of PTSD on both individuals and their families. Future research should focus on refining diagnostic criteria and understanding the long-term effects of early trauma exposure, particularly in children.

7. Molecular Mechanism and Predictive Factors of PTSD

Posttraumatic stress disorder (PTSD) is a complex condition influenced by multiple biological systems, including neuroendocrine, immune, and genetic factors (Figure 1). While the precise molecular mechanisms underlying PTSD remain incompletely understood, emerging evidence suggests that both the neuroendocrine and immune systems play critical roles in its onset and progression (Newport & Nemeroff, 2009; Neigh & Ali, 2016).

Following exposure to trauma, stress response systems such as the hypothalamic-pituitary-adrenal (HPA) axis and the sympathetic nervous system are activated, leading to the dysregulated release of glucocorticoids (GCs) and catecholamines. GCs, in particular, induce a range of effects, including immunosuppression, enhanced metabolism, and negative feedback inhibition on the HPA axis via binding to the glucocorticoid receptor (GR) (Newport & Nemeroff,

2009). This dysregulation links alterations in neuroendocrine function with immune dysfunction and inflammation, which may be a key factor in the development of PTSD. A meta-analysis of 20 studies found elevated plasma levels of proinflammatory cytokines—such as tumor necrosis factor-alpha (TNF-α), interleukin-1beta (IL-1β), and interleukin-6 (IL-6)—in individuals with PTSD, suggesting an ongoing inflammatory state (Passos et al., 2015). Additionally, C-reactive protein (CRP), a biomarker of inflammation, has been implicated in PTSD risk, with some studies suggesting that its levels may correlate with traumatic exposure (Eraly et al., 2014). These findings support the idea that neuroendocrine dysregulation and inflammation not only reflect the effects of PTSD but may also serve as biological precursors to the disorder.

Further, genetic factors contribute significantly to PTSD susceptibility. Research indicates that genetic and epigenetic mechanisms account for a substantial proportion of individual variability in PTSD risk, with heritability estimates as high as 30% (Lebois, Wolff, & Ressler, 2016). A review of genetic studies by Zhang et al. (2017) highlighted several candidate genes involved in the modulation of HPA-axis reactivity and catecholamine processing, such as FKBP5 and catechol-O-methyltransferase (COMT). Additionally, genes involved in neuronal survival, such as AKT, have been linked to PTSD risk (Zhang et al., 2017). Epigenetic mechanisms, including DNA methylation, have also been shown to influence gene expression in response to trauma exposure, with some studies suggesting that these changes may be passed down to offspring, thereby increasing long-term PTSD risk (Zhang et al., 2017). However, there are significant challenges in this area of research, including inconsistent replication across studies and the complexity of trauma exposure and its diverse impacts on individuals. Furthermore, the overlap of PTSD-related genes with those implicated in other psychiatric disorders, such as depression and schizophrenia, complicates the interpretation of these findings (Lebois et al., 2016).

In addition to genetic factors, neuroimaging studies have explored the relationship between brain structure and PTSD (Figure 1). Individuals with PTSD frequently exhibit structural changes in subcortical regions of the brain, including reductions in the volume of the hippocampus, amygdala, and prefrontal cortex (Bolzenius et al., 2018). Logue et al. (2018) found that smaller hippocampal volumes were particularly associated with PTSD, although reductions in amygdala volume were not consistently observed. Moreover, studies using advanced imaging techniques, such as functional magnetic resonance imaging (fMRI), have demonstrated alterations in brain activity associated with PTSD, providing further insight into the neural mechanisms underlying the disorder. Reduced white matter integrity has also been observed in PTSD patients, suggesting disruptions in brain connectivity that may contribute to the emotional and cognitive dysfunctions characteristic of the disorder (Bolzenius et al., 2018).

Overall, while substantial progress has been made in understanding the molecular and genetic factors that contribute to PTSD, much remains to be explored. Future research employing large-scale genome-wide studies and advanced neuroimaging techniques is necessary to clarify the complex interactions between genetic, neurobiological, and environmental factors in the development of PTSD. Such studies hold promise for identifying biomarkers of PTSD risk and developing more targeted, effective interventions for those affected by the disorder.

8. Psychological and Pharmacological Strategies for Prevention and Treatment of PTSD

8.1 Prevention

PTSD prevention strategies are generally divided into primary, secondary, and tertiary categories, each with distinct aims and approaches. Primary prevention aims to prevent PTSD before trauma exposure, secondary prevention focuses on intervening between trauma exposure and the onset of PTSD symptoms, and tertiary prevention targets individuals already exhibiting PTSD symptoms. While secondary and tertiary interventions are well-established, primary prevention is still in its early stages and faces several challenges.

Research on primary prevention strategies for PTSD suggests that psychological and pharmacological interventions targeting high-risk individuals—such as military personnel, police officers, and firefighters—can be effective. Psychological strategies commonly involve psychoeducation and skill-building in areas such as stress response management, anxiety reduction, emotional regulation, and coping strategies (Sijaric-Voloder & Capin, 2008; Deahl et al., 2000). However, the effectiveness of these approaches is still debated due to inconsistent results across studies. Despite these challenges, there is evidence that early psychological interventions can help mitigate PTSD symptoms by enhancing individuals' resilience to trauma (Wolmer, Hamiel, & Laor, 2011).

Pharmacological prevention strategies, in contrast, focus on reducing the physiological impact of stress on memory and emotional processing. These strategies often target pathways linked to the HPA axis, autonomic nervous system, and opioid systems. Sympatholytic drugs, including alpha- and beta-blockers, have shown the greatest potential in preventing PTSD when administered early, ideally before or shortly after traumatic exposure (Skeffington, Rees, & Kane, 2013). However, ethical concerns regarding the use of preemptive medications, particularly in vulnerable populations, limit the widespread adoption of these approaches. Additionally, pharmacological interventions may carry potential side effects that need careful consideration in high-risk situations.

8.2 Treatment

Once PTSD has developed, treatment strategies fall into two broad categories: psychological interventions and pharmacological treatments. Several organizations, including the American Psychiatric Association (APA), the National Institute for Health and Clinical Excellence (NICE), and the U.S. Department of Veterans Affairs (VA), have published treatment guidelines (Jaques, 2012; Bulger, 1992). These guidelines emphasize the importance of evidence-based therapies for managing PTSD.

Psychological treatments, particularly cognitive-behavioral therapy (CBT), have demonstrated effectiveness in alleviating PTSD symptoms. CBT, including trauma-focused CBT, aims to help individuals reframe their thoughts and beliefs related to the traumatic event, thereby reducing distress and promoting recovery. Studies have shown that CBT can lead to symptom reduction, improved quality of life, and functional recovery, including a return to work or active duty (Sripada, Rauch, & Liberzon, 2016). Additionally, eye movement desensitization and reprocessing (EMDR) therapy has shown promise in treating trauma-related symptoms (Jonas et al., 2013).

Pharmacological treatments, including selective serotonin reuptake inhibitors (SSRIs), are also widely used to manage PTSD. SSRIs, such as sertraline and paroxetine, are considered first-line pharmacological options due to their ability to reduce symptoms such as anxiety, depression, and hyperarousal (Jonas et al., 2013). Other pharmacological approaches, such as the use of atypical antipsychotics or mood stabilizers, may be considered for individuals with treatment-resistant PTSD or co-occurring psychiatric conditions.

While psychological and pharmacological interventions for PTSD have demonstrated varying degrees of success, ongoing research and refined treatment approaches are needed to optimize care. By integrating both prevention and treatment strategies, a more comprehensive approach to managing PTSD can be developed, leading to improved outcomes for individuals affected by trauma.

9. Trauma-Focused Psychological and Pharmacological Treatments for PTSD

9.1 Psychological Treatments for PTSD

Trauma-focused psychological interventions are considered the primary treatment for post-traumatic stress disorder (PTSD) according to most clinical guidelines (Jonas et al., 2013). These interventions encompass a variety of therapies, including cognitive behavioral therapy (CBT), cognitive processing therapy (CPT), cognitive therapy (CT), cognitive restructuring (CR), stress inoculation therapy, exposure-based therapies, eye movement desensitization and reprocessing (EMDR), hypnosis, and brief eclectic psychotherapy. Although these therapies are primarily delivered in individual sessions, certain interventions can also be adapted for family or group settings. Despite the widespread recommendation of these therapies, comparative research evaluating the effectiveness of these various modalities remains limited. This lack of rigorous comparative studies has made it difficult to determine definitively which interventions provide the most significant benefits for patients suffering from PTSD.

Jonas et al. (2013) conducted a systematic review and network meta-analysis of PTSD treatments, which included both psychological and pharmacological interventions. Their study demonstrated that all psychological interventions reviewed were effective in improving PTSD symptoms, with exposure-based therapies showing the strongest evidence of efficacy. These therapies include methods such as prolonged exposure therapy and cognitive-behavioral therapy, both of which have demonstrated significant efficacy in reducing PTSD symptoms and achieving remission in the acute phase of the disorder. Further research conducted by Kline et al. (2016) confirmed these findings, showing that all psychological treatments examined led to sustained improvements in symptoms, with exposure therapies demonstrating larger effect sizes than other treatments.

One of the key findings from the studies is the consistent positive impact of exposure-based therapies. Exposure therapies, which encourage patients to confront trauma-related memories and situations in a controlled and safe environment, have become a cornerstone in PTSD treatment. The effectiveness of these therapies has been consistently supported in long-term studies, particularly in in-person psychotherapy settings, where patients exhibit significant reductions in PTSD symptoms. The benefits of these treatments include not only symptom reduction but also functional improvements, such as a return to daily activities, work, and social interactions.

9.2 Pharmacological Treatments for PTSD

Pharmacological treatments are often used as adjuncts to psychological therapies or as standalone treatments for PTSD. Medications commonly prescribed for PTSD include antidepressants, such as selective serotonin reuptake inhibitors (SSRIs), serotonin and norepinephrine reuptake inhibitors (SNRIs), monoamine oxidase inhibitors (MAOIs), and sympatholytic drugs (e.g., alpha-blockers). Additionally, antipsychotics, anticonvulsants, and benzodiazepines are sometimes prescribed. Some medications, including fluoxetine, paroxetine, sertraline, topiramate, risperidone, and venlafaxine, have demonstrated effectiveness in alleviating PTSD symptoms (Jonas et al., 2013).

The systematic review by Jonas et al. (2013) involving 28 trials and 4817 participants revealed that paroxetine and topiramate were among the most effective medications for reducing PTSD symptoms. Paroxetine, an SSRI, is widely recognized for its ability to alleviate the emotional dysregulation and hyperarousal

Table 1. The interplay between biological, psychological, and environmental mechanisms, offering insights into PTSD's multifaceted nature.

Mechanism	Description	Key Findings
Neurobiological Changes	Dysregulation of the hypothalamic-pituitary-adrenal (HPA) axis and alterations in brain regions like the hippocampus and amygdala.	Smaller hippocampal volumes in PTSD patients; neuroimaging studies link stress-response pathways to PTSD susceptibility.
Immune System Dysfunction	Immune alterations and inflammation associated with PTSD, including elevated proinflammatory cytokines.	Increased C-reactive protein levels as a biomarker; systemic inflammation contributes to symptom severity.
Genetic Predisposition	Genetic variations influence vulnerability to PTSD, particularly genes involved in stress response systems, such as FKBP5.	Studies indicate that genetic markers like FKBP5 and inflammatory pathways increase PTSD risk and influence individual differences in resilience and recovery.
Neurotransmitter Dysregulation	Imbalances in serotonin, dopamine, and norepinephrine systems affecting mood and emotional regulation.	Pharmacological treatments (e.g., SSRIs, SNRIs) target these pathways to alleviate emotional symptoms.
Cognitive and Psychological Factors	Cognitive distortions, memory fragmentation, and emotional dysregulation exacerbated by trauma exposure.	Effective therapies like CBT and EMDR focus on reframing negative beliefs and integrating traumatic memories.
Environmental and Sociodemographic Factors	Early-life trauma, sociodemographic risks, and interpersonal stressors interact with biological mechanisms to influence PTSD development.	Studies highlight the role of socioeconomic disadvantages and early trauma exposure in increasing susceptibility to PTSD.

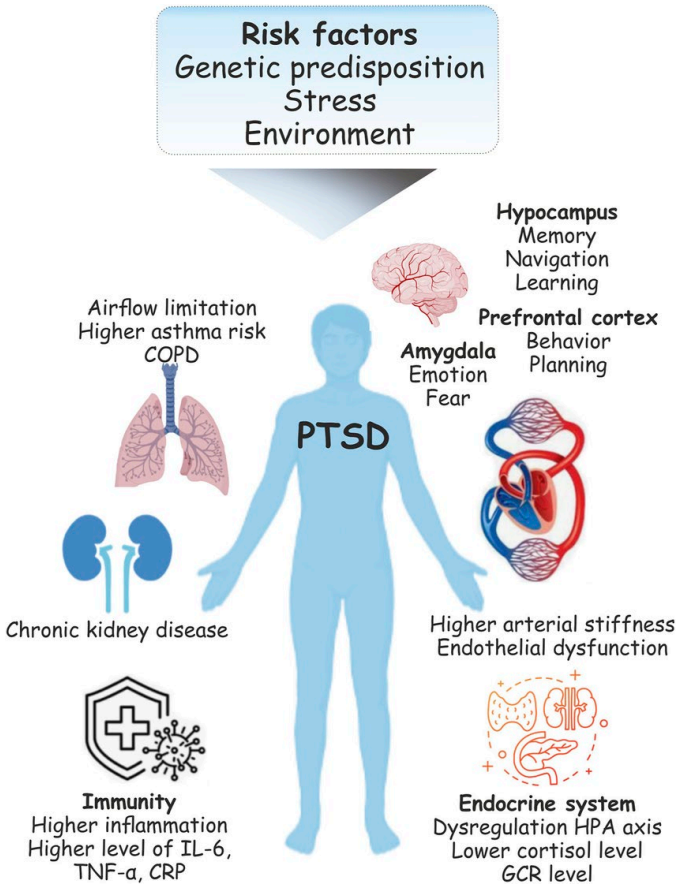

Figure 1. Post-traumatic stress disorder (PTSD) often follows trauma and is linked to lasting brain changes in the amygdala, hippocampus, and prefrontal cortex. PTSD may co-occur with functional impairments, respiratory issues, and heightened cardiovascular disease (CVD) risk. Its pathophysiology involves altered immune function and increased inflammatory activity.

commonly seen in PTSD, while topiramate, an anticonvulsant, has shown efficacy in reducing intrusive memories and improving overall symptomatology. However, the evidence for other medications is less clear due to limited and sometimes inconsistent research.

Pharmacological treatments for PTSD primarily focus on symptom remission, particularly the reduction of symptoms like anxiety, depression, and hyperarousal. Although medications can help alleviate these symptoms, complete resolution of PTSD is less commonly reported. It is also important to note that the comparative efficacy of psychological treatments versus pharmacological interventions—and particularly their combination—remains underexplored. Research has shown that while pharmacological treatments can be beneficial, they are often not sufficient on their own to resolve PTSD completely (Jonas et al., 2013). Furthermore, the reporting of adverse events, such as suicidal behaviors, self-harm, and withdrawal from treatment, is often sparse, complicating the interpretation of these studies.

9.3 Overview of PTSD and Its Complexities

Post-traumatic stress disorder is a multifaceted and debilitating disorder characterized by both psychological and physical symptoms (Table 1). PTSD can be triggered by exposure to traumatic events, such as combat, abuse, or natural disasters, and is influenced by various factors, including the severity and nature of the trauma, gender, genetic predispositions, and epigenetic factors (Sripada et al., 2016). The disorder leads to significant psychological and physical impairment, causing emotional distress, disrupting family and social functioning, and reducing the quality of life for affected individuals.

PTSD is unique in that it often involves both an alteration in psychological processes—such as intrusive thoughts, avoidance behaviors, and emotional numbness—and physical changes, including dysregulation of the stress response system. Research into the underlying mechanisms of PTSD has revealed that it is not just a psychological condition but also a neurobiological disorder. This complex interaction of psychological, genetic, and physiological factors necessitates comprehensive treatment strategies that address both the mind and body.

Despite the advancements in PTSD research, the mechanisms underlying the disorder remain poorly understood. Many aspects of PTSD are still not well-defined, and there is a lack of standardized diagnostic tools and biomarkers that can help predict who will develop PTSD and how best to treat them. This gap in knowledge underscores the need for further research, particularly into the neurobiological underpinnings of PTSD, which could lead to the development of more effective, symptom-specific therapeutic interventions (Sripada et al., 2016).

9.4 Nursing Interventions in PTSD Management

Nursing interventions are crucial in the comprehensive management of PTSD. Nurses play a significant role in the treatment and care of PTSD patients by addressing the psychological, emotional, and physiological aspects of the disorder. The following interventions are commonly used by nurses to manage PTSD symptoms:

Assessment and Monitoring: Nurses must conduct thorough assessments to identify the symptoms of PTSD, such as re-experiencing trauma, hyperarousal, and avoidance behaviors. Continuous monitoring of the patient's mental health, including signs of depression, anxiety, or substance abuse, is essential for providing comprehensive care.

Cognitive Behavioral Therapy (CBT): Nurses can support the delivery of CBT by encouraging patients to participate in therapy sessions and offering emotional support throughout the process. CBT helps patients identify and modify maladaptive thought patterns, which is a crucial component of PTSD treatment.

Psychoeducation: Nurses play an important role in educating patients and their families about PTSD, its symptoms, and the expected course of treatment. Providing psychoeducation helps reduce stigma and promotes better understanding of the condition.

Relaxation Techniques: Nurses can teach patients relaxation strategies, such as deep breathing, guided imagery, and mindfulness meditation. These techniques are particularly useful in managing hyperarousal symptoms and reducing anxiety.

Medication Management: Nurses collaborate with healthcare providers to ensure the appropriate administration of pharmacological treatments, including SSRIs and other medications for PTSD. They also educate patients about potential side effects and the importance of medication adherence.

Crisis Intervention: In cases of severe distress, nurses can provide immediate crisis intervention to ensure the safety of the patient and connect them with appropriate mental health services for further support.

9.5 Perspective

Posttraumatic Stress Disorder (PTSD) is a complex and debilitating condition that significantly impacts individuals, particularly those exposed to traumatic events such as military combat. The prevalence of PTSD is notably higher in military populations, underscoring the psychological burden of combat exposure. Diagnostic criteria for PTSD have evolved significantly, with the DSM-5 and ICD-11 offering distinct but overlapping frameworks. Recent updates reflect a better understanding of PTSD's complexity, including the distinction between PTSD and Complex PTSD (CPTSD), which incorporates additional symptoms like disturbances in self-organization. Treatment approaches have advanced substantially, with pharmacological options, such as antidepressants (SSRIs and SNRIs), and psychological therapies,

including Cognitive Behavioral Therapy (CBT) and Eye Movement Desensitization and Reprocessing (EMDR), demonstrating efficacy in symptom alleviation.

Nurses are essential in the management of PTSD, providing support through early symptom identification, emotional regulation techniques, and helping patients access necessary treatments. They also play a key role in creating safe environments for patients to address their trauma and engage in treatment planning. Emerging research has revealed that the molecular and genetic underpinnings of PTSD are more intricate than previously understood. Dysregulation of the hypothalamic-pituitary-adrenal (HPA) axis, immune system alterations, and genetic predispositions contribute to individual vulnerability to PTSD. Studies have identified variations in genes such as FKBP5 and proinflammatory cytokines, which may provide insights into PTSD's development. However, the exact mechanisms linking trauma exposure to PTSD remain unclear, necessitating further large-scale research to deepen our understanding.

10. Conclusion

In conclusion, PTSD is a devastating disorder with profound effects on individuals and families, particularly within military populations. Despite advancements in its diagnosis and treatment, further research into its genetic and neurobiological mechanisms is essential. Improved diagnostic tools, individualized therapies, and widespread PTSD education are necessary to enhance outcomes for affected individuals. Nurses and healthcare providers are vital in this effort, offering both direct care and advocacy to improve the quality of life for those suffering from PTSD.

Author contributions

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Competing financial interests

The authors have no conflict of interest.

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