

Virtual Reality and Other Experiential Therapies for Combat-Related Posttraumatic Stress Disorder

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ABSTRACT

Numerous experiences can lead to acute stress disorder or posttraumatic stress disorder (PTSD) in military personnel. Unfortunately, PTSD is a relatively common outcome of combat exposure. The primary focus of this article is the role of experiential psychotherapy treatments which teach skill development to better cope with combat-related PTSD. The article pays particular focus on virtual reality-assisted exposure therapies.

INTRODUCTION

Numerous experiences can lead to acute stress disorder or posttraumatic stress disorder (PTSD) in military personnel. Combat-related experiences that can lead to PTSD include witnessing another service member being killed or wounded, feeling responsible for the death of a military member, being ambushed, a near death experience, and witnessing the death or wounding of civilians, including children. Each of these experiences is outside the range of what is considered normal human experience. In addition, PTSD appears to be more severe and longer lasting when the event is caused by human means and design, such as warfare.¹

Combat-related PTSD may be a condition that existed from the start of humankind. The written history of PTSD dates back to the account of Achilles in *The Iliad* by Homer (800 BC). More recently in the United States, symptoms of PTSD have been described as “soldier’s heart” during the Civil War, “shell shock” during WWI, “combat fatigue” or “war neurosis” during World War II, and PTSD

Needs Assessment: Posttraumatic stress disorder (PTSD) is a common mental health problem among combat veterans. Given the current conflicts in Iraq and Afghanistan, the prevalence of combat-related PTSD is expected to increase. Various psychotherapies have been used to treat PTSD. The most effective psychotherapies appear to be cognitive behavioral and exposure therapies. Virtual reality-assisted exposure therapy for combat-related PTSD is a new method for delivering exposure therapy and is currently being tested by the Department of Defense.

Learning Objectives:

- List the three core symptom clusters of PTSD.
- Identify the most effective psychotherapies for PTSD treatment.
- Describe the use of virtual reality as an exposure therapy for PTSD.

Target Audience: Primary care physicians and psychiatrists.

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after the Vietnam War. The *Diagnostic and Statistical Manual of Mental Disorders*, Third Edition (*DSM-III*),² published the first diagnostic criteria for PTSD.

In a study of Vietnam veterans, 31% of men and 27% of women suffered from PTSD at some point since their return from the war.³ A few months after returning from Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF), 12.2% to 19.9% of Marine Corps personnel and 6.2% to 11.5% of Army personnel met diagnostic criteria for PTSD.⁴ The numbers of OIF/OEF service members with PTSD is expected to increase over time because the delayed PTSD symptom onset has been shown in connection with other recent military conflict.⁵ This heightened rate of PTSD is also due to the duration of conflict, the repeated and longer deployments, the unknown duration of deployment, the unconventional type of warfare, the increased use of reservists, and the increased risks for all military occupations.

According to the Veterans Healthcare Administration, the British National Health Service National Institute for Clinical Excellence, the American Psychiatric Association (APA), and recent expert panels,⁶⁻⁹ the current treatment recommendations for PTSD include the use of medication and psychotherapy. Each of these sources recommends selective serotonin reuptake inhibitors (SSRIs) as the first-line medication treatment for PTSD. However, the remission rates for combat-related PTSD remain low (20%–30%) using SSRIs.¹⁰ Despite the commonality of combination therapy in clinical practice, there are no published controlled trials comparing the efficacy of combination medication and psychotherapy to medication or psychotherapy alone.

This article briefly reviews the PTSD symptom clusters and medication treatments for PTSD. The primary focus is a review of psychotherapies for PTSD. The use of virtual reality (VR)-assisted exposure therapy for the treatment of combat-related PTSD will also be discussed.

PTSD SYMPTOM CLUSTERS

After experiencing a traumatic event, the three core PTSD symptom clusters include re-experiencing, avoidance/numbing, and hyperarousal. The re-experiencing symptoms include recurrent and intrusive distressing recollections of the event, recurrent distressing dreams of the event, flashbacks, intense psychologic distress when reminded of the event, and physiologic reactivity when reminded of the event. The avoidance/numbing symptoms include efforts to avoid thoughts, feelings, or conversations associated with the event; efforts to avoid activities, places, or people that are

reminders of the event; inability to recall important aspects of the event; decreased interest in significant activities; feeling detachment from others; decreased range of affect; and sense of foreshortened future. The hyperarousal symptoms include problems sleeping, increased irritability, difficulty concentrating, hypervigilance, and exaggerated startle response.

MEDICATION TREATMENTS FOR PTSD BY SYMPTOM CLUSTER

The APA recommends SSRIs as the first-line medication treatment for all three PTSD symptom clusters.⁹ The evidence supporting the use of other classes of medications by PTSD symptom cluster was also summarized in a recent article.¹¹ For example, tricyclic antidepressants were found generally effective except in relieving symptoms in the avoidance/numbing cluster. While monoamine oxidase inhibitors (MAOIs) were found generally effective, there is limited evidence about the effectiveness of the more tolerable reversible MAOIs. Benzodiazepines were generally ineffective for core PTSD symptom clusters, but may improve sleep. Anticonvulsants appeared more helpful for re-experiencing symptoms. Second-generation antipsychotics appeared helpful for all core PTSD symptom clusters. Adrenergic inhibitors may be useful as an early intervention to prevent the development of PTSD following a traumatic event, to decrease re-experiencing symptoms, or as an adjunctive treatment. However, in a recent meta-analysis, the overall effectiveness of medication management was found to be half as effective as psychotherapy and had twice the drop-out rate.¹²

PSYCHOTHERAPY TREATMENTS FOR PTSD

The psychotherapy options include preventive and treatment strategies. The psychotherapeutic preventive strategies following traumatic exposure include one-session critical incident stress debriefing (CISD) and cognitive-behavioral therapy (CBT). Two recent meta-analyses found no evidence to support the use of CISD to decrease psychologic distress or prevent the onset of PTSD.^{13,14} A limited number of well-designed studies demonstrate some success in preventing PTSD using a few sessions of CBT starting 2–3 weeks after the traumatic event.^{15,16}

Psychotherapeutic treatment strategies extend along the continuum from therapies where the focus is more reflective, to therapies where the focus is more experiential and skill-based. Each of the therapies outlined below include reflective

and experiential elements. This continuum simplifies the organization of this article. More reflective therapies include interpersonal and psychodynamic therapies. Combination reflective and experiential therapies include CBT and dialectical behavioral therapy. More experiential and skill-based therapies include somatic (relaxation training and biofeedback), attentional (meditation), and exposure (flooding, graded exposure, eye movement desensitization reprocessing [EMDR], and hypnosis) therapies.

REFLECTIVE PSYCHOTHERAPIES

The well-structured interpersonal psychotherapy (IPT) was developed to address the interpersonal and social problems stemming from the development of a patient's personality and is influenced by social interactions.¹⁷ Interpersonal and social problems often lead a patient with PTSD to seek treatment, and they often influence the symptom course. A pilot study of group-based IPT demonstrated improvement in social functioning but had limited effect on more PTSD-specific symptoms.¹⁸ Therefore, there is minimal evidence to support the use of IPT for the treatment of PTSD.¹⁹

Psychodynamic psychotherapy is less structured and has a long tradition in mental health treatment. A broad exploration of a patient's underlying personality structure offers clarity to his or her response to life events, particularly to traumatic events. Psychodynamic formulations enhance understanding of the traumatic stress associated with PTSD, and are often incorporated into other treatment strategies used for the treatment of PTSD. In one controlled trial comparing brief psychodynamic psychotherapy, hypnotherapy, desensitization, and a wait-list control, all active treatment groups resulted in significant symptom improvement.²⁰ Therefore, minimal evidence supports the use of psychodynamic psychotherapy in the treatment of PTSD.¹⁹

COMBINATION REFLECTIVE AND EXPERIENTIAL PSYCHOTHERAPIES

CBT targets the patient's distorted threat appraisal assumptions in order to reverse dysfunctional thinking patterns that are associated with and perpetuate the PTSD symptom clusters. Through reflective dialogue, therapists help patients identify distorted automatic cognitive, affective, physiologic, and behavioral responses to current events, and focus instead on more rational responses appropriate to a given situation. Experiential homework is given to assist the patient in impli-

menting what was discussed in therapy sessions. Proponents of CBT sometimes incorporate other therapeutic modalities, including aspects of the more experientially oriented therapies discussed below. Similar to psychodynamic and interpersonal approaches, therapists using a CBT approach often examine underlying factors that may influence current responses to traumatic events, such as core beliefs about oneself or the world. In the case of PTSD, many CBT therapists also have the patient describe the traumatizing event while utilizing relaxation techniques; this can be considered a mild form of exposure therapy. CBT can be conducted in group or individual formats. However, there are fewer group CBT studies than individual ones, and no studies comparing group and individual CBT.²¹ The evidence base for PTSD CBT is supported by a number of controlled studies.¹⁹

Dialectical behavioral therapy (DBT) is a structured psychotherapy specifically developed for the treatment of borderline personality disorder. The combination of borderline personality disorder and PTSD is referred to as complex PTSD. Borderline personality disorder often develops within the context of childhood abuse or neglect and is a known risk factor for developing PTSD related to a traumatizing event later in life. DBT combines reflective cognitive and experientially-based skill development by focusing on affect regulation, distress tolerance, and principles of mindfulness meditation to address distressing symptoms and behavior. While DBT has been used clinically with PTSD patients, the evidence base is limited to only case reports at this time.¹⁹

EXPERIENTIAL PSYCHOTHERAPIES

Experiential psychotherapies use non-reflective methods within a reflective psychotherapeutic context (usually CBT-based). These therapies focus on developing attentional control and autonomic regulation, in an attempt to gain mastery over troublesome symptoms. The more experiential therapies can be divided into somatic (eg, autonomic regulation through relaxation training and biofeedback), attentional (eg, meditation, developing control over cognitive processing), and exposure (eg, flooding, graded exposure, eye movement desensitization reprocessing EMDR, hypnosis). As is true of all the psychotherapies, there is considerable overlap across the reflective-to-experiential continuum, and there is also considerable overlap among the components of the more experientially oriented therapies.

Many popular treatments for PTSD include a skill-based somatic component. Relaxation exercises have a physical (autonomic) emphasis. Typically, patients are trained

to reduce the sympathetic arousal associated with PTSD symptoms and enhance parasympathetic recuperation using progressive muscle relaxation and slow abdominal breathing with or without biofeedback. There is no evidence to support relaxation training as an independent intervention, but it is often incorporated as an aspect of CBT, exposure therapy, or attentional interventions.

Biofeedback can be useful as a method of self-regulation. Practiced for more than 40 years, there are a variety of approaches to biofeedback. Using the oldest forms, the patient watches a monitor or listens to a tone that reflects autonomic arousal as measured by skin temperature, skin conductance, muscle tension, respiratory rate, and/or heart rate. Patients are told to manipulate the monitor (sound or graphic) by any means they can (eg, recall or imagining a pleasant scene or slow abdominal breathing). Rather than simply instructing the patient to “make the tone go up” any way possible, modern-day biofeedback practitioners continually monitor the physiologic data and suggest attentional and somatic exercises for the patient’s use. In this way, the relaxation approach is tailored to each patient. Such physiologic monitoring and feedback is a useful tool in conjunction with other interventions (including VR-graded exposure therapy, described below) to continually monitor objective arousal in patients with PTSD and assist patients in regaining a sense of mastery over their symptoms.²² No evidence supports the use of biofeedback interventions alone in the treatment of PTSD.

Attentional therapies employ various meditative traditions, which emphasize different aspects of attention. For example, Zen meditation emphasizes signal enhancement, ie, attending to and becoming absorbed in what one sees, hears, feels, and smells at each moment. When thoughts arise, practitioners note that “noise,” let it go, and returns to the sensations (“signal”) at hand. Vipassana (Mindfulness) meditation emphasizes noise reduction. In other words, a person should notice what thoughts and feelings arise, but should not react to it or judge it. A person should simply notice what arises, passively attend to it until it dissipates, and then return to the moment at hand (such as feeling the breath flow in and out, or continuing with one’s work activity). These practices are complementary, merely emphasizing different aspects of the same principle.

Meditative traditions share with CBT the belief that cognitive processes drive affective, physiologic, and behavioral reactivity. However, while CBT focuses on underlying belief systems as the cause of current dysfunction, meditative traditions emphasize mastery over fundamental cogni-

tive processes or attentional retraining (eg, whatever one attends to, one enhances). Indeed, when patients attend to a distressing thought or feeling, their sympathetic arousal is significantly increased. By contrast, when engaged in Zen meditation (attending to what they see, hear and feel), patients significantly reduce their sympathetic arousal, even without controlling their breathing or otherwise consciously manipulating their physiology.^{23,24} While research on the effectiveness of meditation alone for PTSD is lacking, clinically it appears to be helpful when used in combination with other approaches.

Exposure-based therapy helps patients decrease fear response to internal and external cues that would otherwise cause symptom intensification. Exposure therapy is based on emotional processing theory (EMT). Applying EMT to PTSD, fear memories are stored as a “fear structure” and include psychologic and physiologic information about stimuli, meaning, and responses.²⁵ Once accessed and emotionally engaged, the fear structure is then open to modification and, if treated appropriately, over time will result in habituation and extinction of the fear response. Common approaches to exposure therapy include flooding, graded exposure, EMDR, tolerating narrative report of the traumatic event, and hypnosis.

Flooding exposure therapies present the patient with as much stimulation as possible, and have the patient sustain attention to that stimulation until it begins to extinguish, (usually in approximately 20 minutes). Several theories support the use of flooding-type exposure. Classical conditioning is the original theoretical basis of this approach, where the conditioned stimulus (loud sound, internal memory) is no longer paired with a conditioned response (fear arousal), and therefore the conditioned response extinguishes over time. Case studies using flooding exposure therapy have reported mixed results.²⁶⁻²⁸ Therefore, the evidence base for flooding therapy lacks strength at this time.

Graded exposure therapy attempts to elicit arousal at the level the patient can tolerate and then increase exposure gradually over time as the patient learns skills to modulate arousal. This approach is most often coupled with a skill-based de-arousal method, such as relaxation training (progressive muscle relaxation, biofeedback), distancing (hypnosis, visual imagery), and/or attentional retraining (Zen or Vipassana meditation). Graded exposure can include imaginal, in vivo, or VR exposure techniques. To date, the most commonly used graded exposure technique used for PTSD treatment is imaginal exposure. VR-graded exposure is discussed in more detail below.

EMDR most typically involves the patient focusing on

a disturbing memory while the therapist initiates saccadic eye movements by asking the patient to track the horizontal motion of the therapist's rapidly moving finger. Following the therapist's finger movement is thought to disassociate memories from associated emotions. In studies with and without the saccadic eye movements, it is unclear that the eye movements are necessary for treatment efficacy.²⁹ A meta-analysis of EMDR and other exposure techniques found no significant differences in outcomes.³⁰ At this time, the evidence base for EMDR treatment of PTSD shows it to be at least equivalent to CBT and in some cases to other exposure therapies.¹⁹

Hypnotherapy using light or deep trance techniques has been used clinically for decades to treat combat-related stress disorders.³¹ Typically, the patient is induced into a comfortable, relaxed mental and physical state while simultaneously reviewing and distancing from the traumatic episode. Thus, the patient learns to dissociate the traumatic event from arousing sequelae. However, results from controlled studies are unavailable at this time.³² Therefore, there is minimal evidence to support the use of hypnotherapy for the treatment of PTSD.

In summary, exposure-based therapies (including CBT with exposure) have been found to be the most effective form of treating PTSD.³³ Van Etten and Taylor¹² analyzed 61 treatment trials that included pharmacotherapy and modalities such as behavior therapy (particularly exposure therapy), EMDR, relaxation training, hypnotherapy, and dynamic psychotherapy. Specifically, the effect size for all types of psychotherapy interventions was 1.17 compared with 0.69 for medication, and the mean dropout rate in medication trials was 32% compared with 14% in psychotherapy trials. Additionally, this meta-analysis found that exposure therapy was more efficacious than any other type of treatment for PTSD according to clinician-rated measures.

VIRTUAL REALITY-ASSISTED EXPOSURE THERAPY

VR can be used to deliver graded exposure or flooding exposure therapies. Graded exposure therapy has been used clinically for a variety of anxiety disorders.^{34,35} There are advantages of VR exposure over imaginal exposure. Therapist control over the exposure presented and VR exposure does not rely upon individual imagery ability or even the ability of the patient to verbalize his or her experiences (although the ability to talk about the traumatic event(s) can be utilized within a VR environment to increase personal relevancy and increase arousal). Many patients are unwilling or unable to

effectively visualize the traumatic event. In fact, avoidance of reminders of the trauma is inherent in PTSD and is one of the defining symptoms of the disorder.³⁶ One disadvantage of the use of VR exposure for PTSD is that the VR environment is content specific and must be developed for a particular context. The evidence base for use in combat-related PTSD treatment at this time is limited to case studies,^{37,38} but will be expanding with treatment trials described below that are currently underway and supported by the Department of Defense.

A VR environment can be used to present both general and specific stimuli to patients in order to assist them in reducing reactivity to the traumatic event. A general VR environment (eg, Iraqi village) is often sufficient to elicit a general reminder of the arousal experienced during deployment. Additionally, if the VR environment allows for operator control over a repertoire of various optional stimuli, then a graded exposure of relevant arousing stimuli can be individually tailored to allow for an arousal hierarchy to be developed and presented to each patient. For example, a Marine who conducted night operations may not get sufficiently aroused in a daytime environment. Similarly, a Navy Construction Battalion (Sea Bee) driver may require a convoy scenario to elicit arousal. Since the goal is to teach mastery over cognitive, affective, and physiologic arousal, the ability to generate arousal is critical for successful treatment. An optimal VR environment would therefore contain a general reminder of the deployment and have a range of options that the therapist can employ to bring out an arousal more specific to each patient's unique experience.

Other aspects of VR environments important to treatment include realism, immersion, and interaction. Although technology has been steadily improving with regard to video graphics and VR in particular, it is unnecessary that the environment be completely "realistic." Various VR studies have shown that exact reproductions are unnecessary to elicit anxiety.³⁹ If the VR environments are similar enough to the index traumatic events, then it should be possible to trigger emotional responses similar to those which may have occurred originally, thereby providing access to the memories of the trauma. In the future, degree of realism (eg, the addition of vibration, scent, and other stimuli to the VR) will likely enhance the options available to clinicians and provide greater coverage of traumatic situations.

Immersion appears to be related to the degree of arousal that can be achieved with a given exposure. Using a head mount with the greatest clarity, viewing range, and comfort, along with the patient's ability to see the environment move

along with head or body movements, allows the patient greater immersion and perhaps greater arousal. Sounds presented through headphones are also a critical element for improved immersion. It is also possible to enhance immersion by placing a vibration platform underneath the patient (eg, to vibrate with helicopters going overhead, rockets exploding), matching climate (eg, dry heat blowing on the patient), or even using a machine to present smells to the patient (eg, burning rubber, gun powder). In theory, the more sensory modalities stimulated, the greater the immersion.

Another factor that effects immersion is the degree to which a patient can interact with the VR environment. Usually, the patient will use a joystick or computer mouse to navigate through the environment and move his or her head to change the visual field. The level of patient interaction with the VR environment is another aspect of exposure that the therapist can utilize to influence arousal.

Two Department of Defense-funded studies are underway to examine the use of VR therapies for combat-related PTSD. One study will utilize a graded exposure approach in a randomized controlled design, and the other will utilize a flooding approach in a case series design. In both studies (as described below), the primary outcomes will be symptom severity, physiologic reactivity to a test VR environment, and health-related quality of life.

Eighteen marine and navy personnel recently diagnosed with combat-related PTSD and receiving outpatient mental health treatment were interviewed by the authors of this article in order to develop the general and specific content for the VR environments. Specifically, patients were asked about the precise sights, sounds, smells, and feelings associated with the recurring intrusive thoughts they experienced upon returning from their combat tours. This information was then used to create VR environments for use with medical and Marine Corps personnel. Some relevant specific stimuli that can be turned on or off as needed include voices of Iraqi civilians, Arabic prayer, sounds of gunfire, rocket's fired and exploding, helicopters flying overhead or landing, terrorists running and firing guns, comrades being wounded by gunfire, buildings and vehicles burning, and driving through dangerous areas.

In the flooding VR exposure study, the therapist will ask the patient to relate his or her narrative of the sentinel traumatic event or sequence of events and then presents the patient with VR stimuli sufficient to maintain a high level of arousal for at least 20 minutes. All patients will also be treated with an SSRI prescribed by their mental health provider. It is critical to not over-arouse the patient to the extent of cognitive dissociation, emotional shutdown, or being overwhelmed during

or after the session. The therapist will also record the patient narrative and the sounds of the VR environment during the VR session so that the patient can continue to listen to the recording daily in between sessions, in order to facilitate the extinguishing of arousal. In a small, single-group design study of Vietnam veterans with chronic combat-related PTSD, the use of a similar protocol twice a week for 6 weeks proved beneficial in reducing PTSD symptoms.³⁸

In the graded exposure VR study, the authors of this article will determine the relative value of 10 weekly sessions of VR graded exposure plus SSRI treatment compared to 10 weekly group CBT sessions plus SSRI treatment. The VR graded exposure therapy will incorporate Zen absorption techniques to focus comfortably into the moment (attentional retraining) and Vipassana internal noise reduction techniques to distance arousing thoughts and feelings. The graded exposure VR intervention will also incorporate biofeedback to monitor physiologic response so that the therapist can both better determine when a patient is becoming aroused, and train the patient to modulate these responses. Over the past 5 years, heart rate variability (HRV) has become the indicator of choice for many biofeedback therapists and those who wish to monitor physiologic reactivity in their patients or research subjects.²⁴ In particular, the very low frequency (VLF)/low frequency (LF) ratio (part of the HRV spectral analysis) is the best single indicator of when a patient is focused comfortably in the moment without significant cognitive/affective/physiologic arousal. Simply, when VLF is >50% the LF, the therapist should instruct the patient to relax and focus in the moment. If this is impossible for the patient, the therapist should reduce the intensity of the VR stimulus. When the VLF is <50% the LF, the patient is calmer and more relaxed, and the VR stimuli can be increased so that the patient has more opportunity to practice experiential methods of self-regulation. As the patient becomes more skilled at modulating physiologic response to the VR environment, the patient will gain a sense of mastery over arousal, develop confidence to be able to handle even more arousal, and re-establish the calm and relaxed state as his or her natural baseline. As with other exposure therapies, the goal is to generalize these skills into everyday activities. At this time, it is unknown which patients will be more likely to benefit from VR-assisted exposure therapies or how best to integrate VR therapies with other existing treatments for PTSD.

CONCLUSION

Existing medications and psychotherapies are helpful for

in the treatment of PTSD. However, there is still need to improve the outcomes for patients with PTSD, including combat-related PTSD. Experiential psychotherapies utilized within a therapeutic framework are promising additions to existing approaches. Ongoing studies testing VR-assisted interventions will help define the role of novel VR interventions in the treatment of combat-related PTSD.

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