BRIEF REPORT

Effectiveness of Virtual Reality Exposure Therapy for Active Duty Soldiers in a Military Mental Health Clinic

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Exposure therapy is an evidence-based treatment for posttraumatic stress disorder (PTSD), but research evaluating its effectiveness with active duty service members is limited. This report examines the effectiveness of virtual reality exposure therapy (VRE) for active duty soldiers ($N = 24$) seeking treatment following a deployment to Iraq or Afghanistan. Relative to their pretreatment self-reported symptoms on the PTSD Checklist, Military Version ($M = 60.92; SD = 11.03$), patients reported a significant reduction at posttreatment ($M = 47.08; SD = 12.70; p < .001$). Sixty-two percent of patients ($n = 15$) reported a reliable change of 11 points or more. This study supports the effectiveness of exposure therapy for active duty soldiers and extends previous research on VRE to this population.

Combat deployments to Iraq and Afghanistan increase the risk of posttraumatic stress disorder (PTSD) in military service members (Milliken, Auchterlonie, & Hoge, 2007; Smith et al., 2008). Although exposure therapy has been found to be an effective treatment for diverse trauma types (Cahill, Rothbaum, Resick, & Follette, 2009), including combat-related trauma (Keane, Fairbank, Caddell, & Zimering, 1989), there is limited research of exposure therapy with active duty populations. One case report of three patients treated with four sessions of exposure therapy in Iraq reported positive outcomes (Cigrang, Peterson, & Schobitz, 2005) and a large sample of female veterans treated for PTSD included seven active duty participants (Schnurr et al., 2007), but without separate analyses of efficacy.

Despite its effectiveness, Prolonged Exposure (PE) has smaller pre- and posteffect sizes for combat trauma relative to other trauma types (Bradley, Greene, Russ, Dutra, & Westen, 2005; Schnurr et al., 2007). It is possible that combat deployments result in
adaptive, deployment-related emotional detachment, which later interferes with activation of the trauma memory during exposure therapy (Reger & Gahm, 2008), which is theoretically important to treatment outcome (Foa, Huppert, & Cahill, 2006; Jaycox, Foa, & Morrall, 1998).

Virtual reality (VR) is an effective tool for delivering exposure therapy for a range of phobias and anxiety disorders (Parsons & Rizzo, 2008). Virtual reality exposure therapy (VRE) for PTSD has demonstrated effectiveness in a multiple case report of motor vehicle accident-related PTSD (Beck, Palyo, Winer, Schwagler, & Ang, 2007), in a small, open clinical trial of Vietnam veterans with PTSD (Rothbaum, Hodges, Ready, Graap, & Alarcon, 2001), and in a quasi-experimental, waitlist controlled study of survivors of the 9/11 World Trade Center attack (Difede et al., 2007). Case studies have reported positive clinical outcomes for VRE with individual veterans (Gerardi, Rothbaum, Ressler, & Heekin, 2008) and active duty soldiers (Reger & Gahm, 2008), but there are no studies of the effectiveness of VRE with active duty service members. This study is the first to report on the effectiveness of VRE in a military mental health clinic treating active duty soldiers.

**METHOD**

**Participants**

This retrospective study was approved by the Institutional Review Board at Madigan Army Medical Center. Thirty-one patients were referred for VRE. Of the seven patients who dropped out prior to receiving any VR exposure or prior to obtaining any follow-up screening, two patients perceived a poor match between their trauma memory and the VR, two patients were lost to follow-up, one patient was concerned about the impact of treatment on his medical administrative process, one patient had 19 days of prior treatment in a partial hospitalization program. Six patients had attempted two or more of these treatments.

Sixty-seven percent of patients (n = 16) were treated with psychotropics during VRE. Medications included antidepressants (n = 12), prazosin (n = 8), sleep aids (n = 7), an atypical antipsychotic (quetiapine; n = 1), anticonvulsant (lamotrigine; n = 1), and an antihistamine (hydroxyzine pamoate; n = 1). The one patient taking a benzodiazepine (lorazepam) was instructed not to take this medication prior to any appointment or exposure exercise. No stabilization of medications was required during VRE.

All index traumas were deployment-related and included improvised explosive device (IED) attacks involving first aid, body recovery, or exposure to fatalities (n = 9); exposure to IED, rocket propelled grenades, small arms fire or indirect fire without injury (n = 5); killing (n = 2); fire (n = 2); witnessing a fatal suicide attack (n = 1); rendering first aid following small arms fire or indirect fire (n = 3); or sustaining injuries from an IED or indirect fire (n = 2). On average, VRE was initiated 27.8 months (SD = 17.3) after the index trauma.

This retrospective study reports on a clinical sample and no formal inclusion/exclusion criteria were used. VRE was not used, however, if patients had a history of psychosis, bipolar disorder, seizure disorders, or if the patient reported being particularly prone to motion sickness. Additionally, VRE was not used when safety was the primary presenting problem. All patients who had received at least one session of VRE and for whom any follow-up screening was available were included in the analyses.

**VRE Treatment Protocol**

Patients were treated by one of three licensed clinical psychologists with formal training in PE and VRE. The VRE treatment protocol was adapted from manualized PE (Foa, Hembree, & Rothbaum, 2007) with the following exceptions. Session 2 included an introduction to VR in a pleasant virtual environment. During exposure to the memory, patients articulated their index trauma with their eyes open, in the first person, present tense while immersed in a three-dimensional (3D) virtual environment that was customized in real time by the clinician to resemble aspects of the patient’s traumatic event. Homework included listening to audio recordings of each VR exposure to the memory. Clinicians reviewed homework each session, but did not gather formal data on homework compliance. Patients received an average of 7.4 (SD = 3.3) 90-minute treatment sessions (range 3–12 sessions).

**Measures and Equipment**

The PTSD Checklist, Military Version (PCL-M; Weathers, Huska, J., & Keane, 1991) is a widely used, well-validated (Bliese, Wright,
Adler, Castro, & Hoge, 2008) 17-item self-report measure, which assesses symptoms of PTSD in response to a stressful military experience. The pretreatment PCL-M was administered either at intake (n = 12) or at Session 1 (n = 12). The average time between intake and Session 1 was 6.6 days (SD = 9.4; range = 2–33 days). Patients were assessed throughout treatment and the final PCL-M available was used as the posttreatment measure. Seven patients had one additional session following the final PCL-M and one patient had two sessions following the final PCL-M.

The VR equipment included two Dell XPS computers and an eMagin z800 head-mounted display system, which includes orientation head tracking while located on a platform with bass shaker speakers. Olfactory stimuli, such as burning rubber, body odor, or weapons fire, were delivered when relevant using an EnvironScent Scent Palette. Patients interacted with the virtual environment using a joystick mounted on a mock M4 rifle or a Logitech joystick.

Virtual Iraq (Rizzo, Reger, Gahm, Difede, & Rothbaum, 2009) includes one environment of a simulated convoy and the second is a simulated dismounted patrol in an Iraqi city. Time of day, location in convoy and the vehicle, small arms fire, improvised explosive devices, etc., can be customized to match the characteristics of the environment to the patient’s memory in real time.

RESULTS

Relative to the pretreatment PCL-M (M = 60.92; SD = 11.03), patients receiving VRE reported a statistically significant drop in PTSD symptoms (M = 47.08; SD = 12.70), t(23) = 6.53, p < .001, d = 1.17. There was no relationship between using an EnvironScent Scent Palette. Patients interacted with the virtual environment using a joystick mounted on a mock M4 rifle or a Logitech joystick.

DISCUSSION

Patients receiving an average of seven sessions of VRE reported statistically and clinically significant reductions in self-reported symptoms of PTSD. Consistent with prior studies (Keane et al., 1998; Schnurr et al., 2007), this study found that exposure therapy was an effective treatment for combat trauma. Further, this study extends prior research of VRE for PTSD (Difede et al., 2007; Rothbaum et al., 2001) to an active duty sample previously deployed in support of OIF and OEF. The VRE was an effective treatment even for those who had received prior treatment, including patients who had previously received another form of exposure therapy. These findings provide preliminary evidence for the effectiveness of VRE for combat-related PTSD symptoms and represents one of the first studies of exposure therapy with active duty soldiers.

It is noteworthy that the effect size in this study is somewhat larger (d = 1.17) than previous studies of veterans with combat-related trauma (d = .81; Bradley et al., 2005). Similarly, a study of veteran and active duty women treated with PE (Schnurr et al., 2007) found a pre- and posttreatment effect size on the PCL of d = .80. An important difference between the current study and previous research is the latency from trauma to treatment. Specifically, a strength of the current study is that treatment was rendered on average 2 years, 4 months after the index trauma rather than decades after trauma exposure. Additionally, exposure to the memory in this study was delivered via virtual reality in addition to imaginal exposure. Thus, these findings may support the application of multisensory virtual reality that is customized to resemble aspects of the patient’s index trauma to deliver a potent, emotionally engaging form of exposure for combat-related PTSD symptoms, even for those who did not respond to prior treatment.

Effectiveness studies are useful for maximizing external validity (Chambless & Hollon, 1998) and observational methods help ensure that previous findings of controlled efficacy studies are similar to those found in day-to-day clinical practice. Nonetheless, clinical effectiveness studies reduce experimental control, a limitation of this report. This study did not compare VRE to an existing standard of care and the treatment was not subject to fidelity ratings. The outcome measure was the PCL-M, a self-report measure of PTSD symptoms, thus no clinician-administered measure or blind assessment was included. However, several studies have found a strong relationship between the PTSD Checklist and the Clinician Administered PTSD Scale (Monson et al., 2008; Palmieri, Weathers, Difede, & King, 2007).

Further, the number of sessions varied across patients. However, it is noteworthy that this study included five patients who reported clinical benefit from five or fewer sessions. There was no dose-response relationship as the duration of treatment in clinical samples varies and is often determined by the time required for the patient to improve (Foa & Rothbaum, 1998). Thus, patients...
terminated when they achieved desired levels of symptom reduction, with individual variability in how many sessions were required to achieve this response. The promise of an effective, brief VR exposure therapy protocol is noteworthy, particularly if future research finds pharmacological agents that aid extinction in animals to be useful in facilitating exposure therapy in treatment of humans with PTSD (Davis, Ressler, Rothbaum, & Richardson, 2006). Future randomized clinical trials are needed to test this possibility and to compare VRE to other evidence-based treatments for PTSD.

REFERENCES


