Does Virtual Reality (VR) Increase Simulator Sickness During Exposure Therapy for PTSD?

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Source of the Work: This research was a secondary analysis of data supported by Grant W81XWH-08-2–0015 from the U.S. Army Medical Research and Materiel Command Military Operational Medicine Research Program. Disclaimer: The opinions or assertions contained herein are the private views of the authors and are not to be construed as official or reflecting the views of the Department of Army, the Department of Defense, or the Department of Veterans Affairs. The authors would like to acknowledge the many collaborating investigators, consultants and support staff from the original clinical trial, which made this secondary analysis possible.

Abstract

Purpose: Measurement of simulator-related side effects (SSEs) is an integral component of competent and ethical use of virtual reality exposure (VRE), but common SSEs may overlap with symptoms of anxiety. Limited research exists about the frequency of SSEs during VRE treatment for PTSD and no research compares self-reported SSEs for those undergoing VRE to those participating in exposure therapy without virtual reality. This study compared the SSEs of active duty soldiers with PTSD randomly assigned to exposure therapy via traditional prolonged exposure or VRE.

Methodology: A total of 108 soldiers participated in up to 10-sessions of exposure therapy. Of those, 93 provided data on simulator sickness both prior to and after initiation of imaginal exposure. Approximately half (n = 49) used the Virtual Iraq/Afghanistan system to support engagement with their trauma memory. Soldiers completed a four-item, self-reported measure of SSE after each session.

Results: Controlling for age, sex, baseline anxiety symptoms, and SSE symptom counts at the first two sessions of therapy (before initiating imaginal exposure), there was no statistically significant difference between the treatment groups in SSEs at the beginning of imaginal exposure or over the course of treatment. This finding suggests that caution should be exercised in the interpretation of SSE measurements during the use of VRE for PTSD. VR did not account for any increase in self-reported SSE. It is possible that anxiety accounts for a meaningful proportion of SSE reports during VRE.

Background and Introduction

Exposure therapy via virtual reality (VR) has shown efficacy in the treatment of trauma and anxiety disorders (1). However, patient use of VR can result in temporary simulator-related side effects (SSEs) in symptom clusters such as oculomotor problems, disorientation, and/or nausea.(2) Accordingly, the measurement of SSEs is an integral component of competent and ethical use of virtual reality exposure (VRE) (3).

However, common SSEs overlap with symptoms of anxiety (4). For example, SSEs include sweating, nausea, headache, vertigo, and confusion. These reactions overlap considerably with symptoms of anxiety, which may include sweating, dizziness or lightheadedness, fainting, and indigestion or discomfort in the abdomen (5).

Exposure therapy is a widely used, evidence-based treatment for trauma and anxiety disorders (6) that involves the patient's intentional confrontation of feared stimuli (7). As patients end maladaptive avoidance, state-based symptoms of anxiety are common. This is a problem for researchers conducting VRE. Providers need to know whether patient reactions represent negative side effects of VR use or expected clinical signs of productive psychotherapy. We are not aware of any research that compared the longitudinal patient-reported SSEs among patients receiving an exposure-based treatment who do and *do not* use VR.

Materials and Methods

This study represents a secondary analysis of data from a previously published trial (8) that compared the efficacy of prolonged exposure (PE) and VRE for soldiers with PTSD. Throughout the trial, we assessed SSEs in both treatment groups. A total of 108 soldiers were randomized to PE or use of the Virtual Iraq/Afghanistan system (9). Fifteen patients did not participate in enough sessions to begin the exposure components of therapy or did not provide

any data on the symptom measures. As a result, this study used data from 93 (PTSD; PE = 44; VRE = 49) participants. We adapted a brief four-item version of the Simulator Sickness Questionnaire (SSQ) (2). Two items assessed dizziness (eyes open/closed), one item assessed headache, and a fourth item inquired about sickness in the stomach. Patients placed an 'X' in one of four boxes for each item: *None, Slight, Moderate,* or *Severe*. For this study, we considered a patient endorsement of *Moderate* or *Severe* to reflect the presence of SSE. The brief SSQ was administered at the end of each of ten treatment sessions. Data were analyzed using generalized estimating equations with a log link and a Poisson error distribution. The outcome variable for each treatment session was the count of symptoms identified as moderate/severe (score of 0 to 4 possible). Data for a total of 564 treatment sessions were recorded.

Results

Prior to the first use of VR or trauma exposure (which occurred in session 3), there was no significant difference in the prevalence of SSEs among participants in the VRE group (23.58%) compared to those in the PE group (32.24%; prevalence risk ratio = 0.73, 95% CI = 0.51, 1.05). The degree of linear relationship between baseline SSE frequency and baseline anxiety scores was 0.41 (95% CI = 0.22, 0.60). There was no difference in the frequency of moderate/severe SSEs at the start of imaginal exposure (marginal mean PE = 0.48, marginal mean VRE = 0.46, rate ratio (RR) = 0.96, 95% CI = 0.60, 1.53). Moderate/severe SSE frequency decreased by approximately 10% for each subsequent session among the participants of the PE group (RR_{within} = 0.90, 95% CI = 0.84, 0.97). Controlling for age, sex, baseline anxiety symptoms, and SSE symptom counts at the first two sessions of therapy, the rate of SSE reduction for participants in the VRE group (RR_{within} = 0.94, 95% CI = 0.89, 1.00) was not statistically distinguishable from that of the PE group ($RR_{between}$ = 1.04, 95% CI = 0.95, 1.15).

Conclusion and Discussion

This study found that VR did not account for any differences in self-reported simulator sickness among soldiers receiving the same exposure therapy with or without VR. Consistent with previous studies of the relationship of anxiety to SSEs, these results may suggest caution in the interpretation of SSEs in the context of clinical VRE. Future studies might examine the extent to which the constructs of SSE and anxiety are unique. Limitations include the unknown validity of the brief adaptation of the SSQ, the possibility of different constructs being assessed by treatment groups, and the assessment of SSE at the end of each session (approximately 30-min post-VR use).

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