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Imagery Rehearsal for Posttraumatic Nightmares: A Randomized Controlled Trial*

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One hundred twenty-four male Vietnam War veterans with chronic, severe posttraumatic stress disorder (PTSD) were randomly assigned to imagery rehearsal (n = 61) or a credible active comparison condition (n = 63) for the treatment of combat-related nightmares. There was pre-post change in overall sleep quality and PTSD symptoms for both groups, but not in nightmare frequency. Intent-to-treat analyses showed that veterans who received imagery rehearsal had not improved significantly more than veterans in the comparison condition for the primary outcomes (nightmare frequency and sleep quality), or for a number of secondary outcomes, including PTSD. Six sessions of imagery rehearsal delivered in group format did not produce substantive improvement in Vietnam War veterans with chronic, severe PTSD. Possible explanations for findings are discussed.

Nightmares are a known hallmark of posttraumatic stress disorder (PTSD; Ross, Ball, Sullivan, & Caroff, 1989), cause significant distress and impairment in daytime functioning (Levin & Nielsen, 2007; Neylan et al., 1998; Zadra & Donderi, 2000), and can be difficult to treat. In fact, it has been suggested that PTSD-related sleep disturbance may endure even as other posttraumatic symptoms resolve (Galovski, Monson, Bruce & Resick, 2009; Spoormaker & Montgomery, 2008; Zayfert & DeViva, 2004).

Despite significant advances in psychotherapy for PTSD, there is a lack of specific interventions targeting trauma-related nightmares due to the assumption that nightmares are not distinct from other reexperiencing phenomena and should improve with an overall reduction in PTSD severity (Phelps, Forbes, & Creamer, 2008). Treatments to assist patients in coping with nightmares and other sleep disturbances have only been rigorously investigated during the past decade. Among these, a promising cognitive–behavioral technique, imagery rehearsal, demonstrated efficacy in two clinical trials (Davis & Wright, 2007; Krakow et al., 2001) and several pilot investigations in persons with PTSD or PTSD symptoms (Forbes, Phelps, & McHugh, 2001; Harb, Cook, Gehrman, Gamble, & Ross, 2009; Lu, Wagner, Van Male, Whitehead, & Boehnlein, 2009; Moore & Krakow, 2007; Nappi, Drummond, Thorp, & McQuaid, 2010).

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Imagery rehearsal is based on the notion that waking mental activity can influence the content of night-time dreams. In the version of imagery rehearsal tested in this trial, veterans chose a repetitive nightmare related to their war-zone experiences, altered the nightmare script during waking hours by using imagery techniques, and mentally rehearsed the revised script daily (Forbes et al., 2001). With practice during waking hours, the new imagery is thought to reduce the intensity and/or frequency of the nightmares. Proposed mechanisms of imagery rehearsal include exposure, mastery, and retrieval competition (Brewin et al., 2009; Marks, 1978).

The two previous randomized controlled trials of imagery rehearsal used wait-list as a comparison condition (Davis & Wright, 2007; Krakow et al., 2001). Also, these trials studied mainly women with posttraumatic symptoms, a significant number of whom did not meet full PTSD criteria and whose nightmares were not related to their traumatic event. In a small, uncontrolled pilot study of imagery rehearsal in Australian Vietnam War veterans with PTSD, significant reductions in trauma-related nightmare frequency and intensity and PTSD symptoms were found (Forbes et al., 2001) and maintained at 12-months posttreatment (Forbes et al., 2003). Despite encouraging preliminary results, it is not yet known whether imagery rehearsal offers any advantage over an active psychotherapy condition in combat veterans with chronic PTSD. Additional practical, clinical, and policy implications concern whether the benefits outweigh the costs of implementing specialized training for imagery rehearsal.

The objective of this randomized controlled trial was to test the efficacy of imagery rehearsal group therapy against a credible comparison form of group therapy in a sample of U.S. Vietnam War veterans with recurrent nightmares related to chronic, severe combat-related PTSD. Imagery rehearsal was compared with sleep and nightmare management, a treatment developed to incorporate both psychoeducation about posttraumatic nightmares with elements of standard cognitive–behavioral therapy for insomnia. We selected this comparison condition as a clinically valid, manual-based intervention that could be considered standard treatment for sleep disturbances associated with PTSD. It was thus the optimal control for both the nonspecific benefits of psychotherapy and the specific effects of treating PTSD-related, but non-nightmare-specific, sleep disturbances.

We hypothesized that imagery rehearsal would be more effective than sleep and nightmare management in primarily reducing nightmare frequency as well as improving global sleep disturbances. We further hypothesized that imagery rehearsal would be more efficacious in secondarily reducing PTSD symptoms manifested during waking hours and in alleviating depressive symptoms. This report utilizes intention-to-treat analyses, in which the data from each patient were analyzed according to the patient's assigned therapy condition, regardless of whether the treatment was completed.

METHOD

Participants

One hundred fifty-six male U.S. Vietnam War veterans receiving mental health services at the Philadelphia VA Medical Center were screened for eligibility between March 2005 and February 2008. Inclusion criteria were male gender, current PTSD due to combat in Vietnam (criteria according to the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* [*DSM-IV*], American Psychiatric Association, 1994, assessed with the Clinician-Administered PTSD Scale, CAPS; Blake et al., 1995), combat-related nightmares at least once a week for no less than 6 months, and global sleep disturbance indicated by a score of 5 or greater on the Pittsburgh Sleep Quality Index (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989). Veterans with concomitant major depression and/or an anxiety disorder other than PTSD were included. Individuals taking psychoactive medications were required to be on a stable regimen for a minimum of 3 months before participation. However, once entered into the trial, patients were allowed to change medication dosages as determined necessary by their treating psychiatrists. Patients were also permitted to continue to receive mental health "treatment as usual." Exclusion criteria were current or lifetime *DSM-IV* schizophrenia, other psychotic disorders, bipolar disorder, active substance abuse or dependence in the past 6 months, some medical disorders known to impact sleep (e.g., narcolepsy), and untreated sleep apnea. To determine if potential patients were likely to have undiagnosed sleep apnea, the Multivariable Apnea Predictor (Maislin et al., 1995) was also administered.

The flow of patients throughout the trial is shown in Figure 1. One hundred fifty-six veterans were evaluated for eligibility. Eighteen did not meet study criteria, and 4 elected not to participate prior to formally consenting. Of the 134 who signed consent forms, 10 withdrew before being assigned to a treatment condition. One hundred twenty-four veterans met criteria, agreed to participate, and were randomized to two groups: imagery rehearsal ($n = 61$) or sleep and nightmare management ($n = 63$).

Measures

The CAPS is a 30-item clinician-administered structured interview that measures the frequency and intensity of each *DSM-IV* PTSD symptom. It was used to ascertain whether the veteran had a current diagnosis of PTSD, using the "1/2 rule," which stipulates that symptoms occur at least monthly with moderate intensity (Blake et al., 1995). The CAPS has sound psychometric properties (Weathers, Keane, & Davidson, 2001). To ensure blinding of the independent raters who administered the CAPS, raters did not have access to study files and patients were asked to keep their treatment condition confidential during the follow-up assessment.

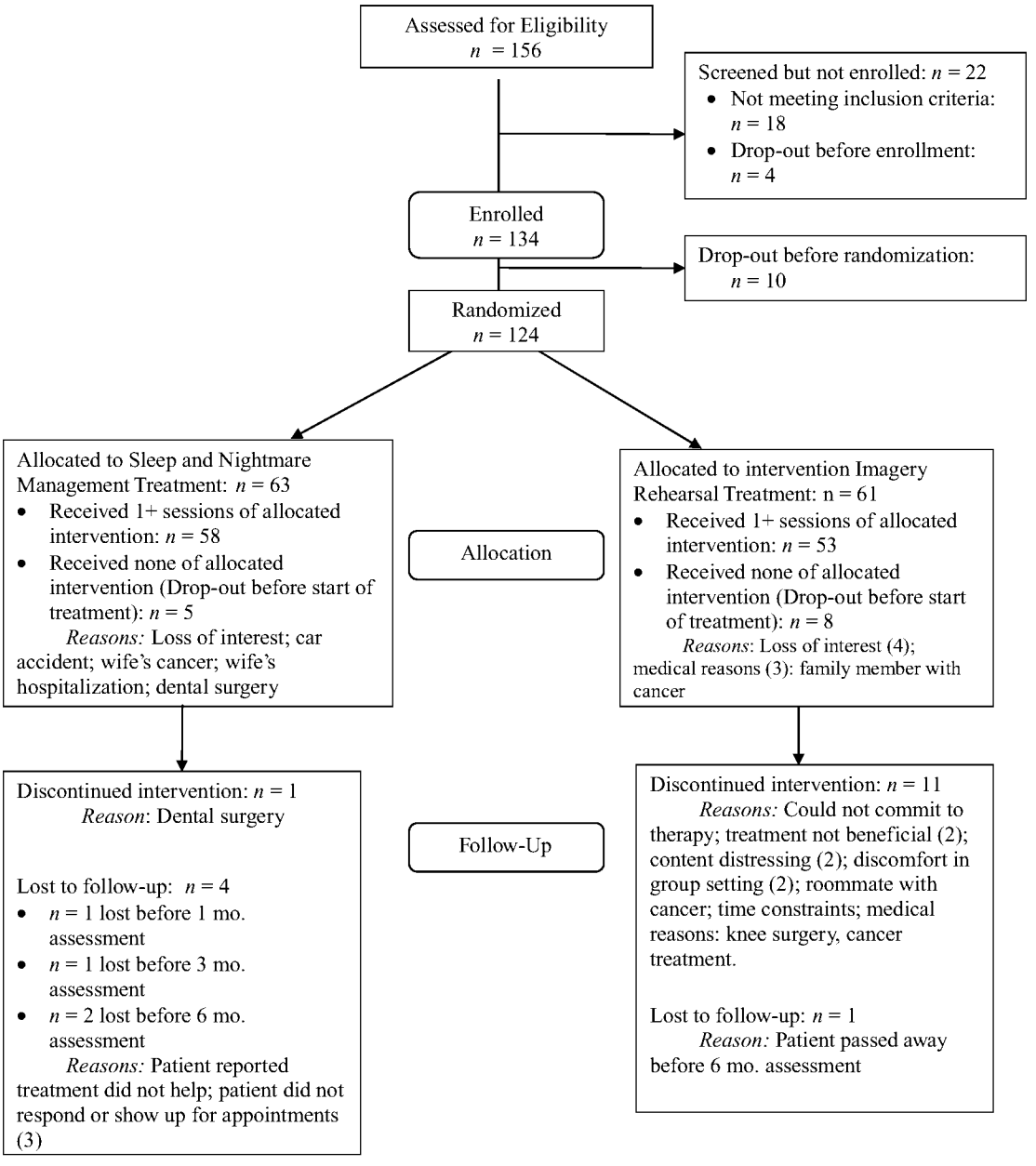

Figure 1. Patient flow throughout the trial.

The Structured Clinical Interview for DSM IV-Patient Version (SCID-IV-P; First, Spitzer, Gibbon, & Williams, 2001) is a widely used semistructured interview that was utilized to make current major Axis I diagnoses according to *DSM-IV* criteria, as well as to screen for psychotic symptoms, comorbid conditions, and some exclusion criteria.

The Nightmare Frequency Questionnaire (Krakow et al., 2000) is a reliable self-report measure that assesses nightmare frequency: number of nights with nightmares per unit of time (e.g., per week) and number of nightmares per unit of time. The questionnaire has demonstrated high test-retest reliability, significant correlations between retrospective and proximal report of nightmare frequency, and good discriminant validity with stronger associations with PTSD symptoms than with depression and general anxiety (Krakow et al., 2002).

The Pittsburgh Sleep Quality Index is a 19-item self-report measure of sleep quality and disturbances during the past month, generating seven component scores for sleep quality, latency,

duration, habitual efficiency, disturbance, use of sleeping medication, and daytime dysfunction. It has good internal consistency and test-retest reliability (Buysse et al., 1988), and good convergent and discriminant validity (Carpenter & Andrykowski, 1998). A global score greater or less than 5 distinguished between poor and good sleepers with good sensitivity and specificity (Buysse et al., 1988).

Secondary outcome measures included the CAPS total score; the Nightmare Effects Survey (a measure of psychosocial impairment attributed to nightmares; Krakow et al., 2000), the Pittsburgh Sleep Quality Index Addendum for PTSD (a measure of PTSD-related sleep and dream disturbances; Germain, Hall, Krakow, Shear, & Buysse, 2005), the PTSD Checklist-Military (a measure of PTSD symptoms; Weathers, Litz, Herman, Huska, & Keane, 1993), the Beck Depression Inventory (a measure of symptoms of depression; Beck & Steer, 1987), and the 36-Item Short Form Health Survey (a measure of physical and mental health functioning; Ware, Kosinski, & Keller, 1996). In addition, veterans in both treatment conditions completed nightly sleep and nightmare diaries (Wood & Bootzin, 1990) beginning the week before treatment and ending the last week of treatment, assessing relevant sleep data (e.g., sleep quality and quantity) and the frequency of and distress associated with nightmares.

Procedure

After approval by Philadelphia VA Medical Center's Institutional Review Board (IRB) and recruitment of a sufficient number of veterans (6 to 10) to form two therapy groups, the study statistician (MC) randomized the veterans to two groups (of equal size if the number available was even and n and $n + 1$ if the number was odd) for each cohort using RAND software (Piantadosi, 1999). In all, 16 cohorts of patients created 16 sleep and nightmare management groups and 16 imagery rehearsal groups. The first cohort began treatment in July 2005 and the final cohort in March 2008. The last follow-up assessment was completed in September 2008.

Treatment, Therapists, Supervision, and Fidelity

Ninety-minute group sessions occurred weekly for 6 weeks. The comparison condition (sleep and nightmare management) controlled for both the nonspecific effects of treatment (e.g., instillation of hope, expectation of improvement) and non-imagery rehearsal components that might ameliorate PTSD-related sleep disturbances (Borkovec, 1993; Schnurr et al., 2003). Sleep and nightmare management contained psychoeducation about PTSD nightmares and sleep disturbances and included elements of standard cognitive-behavioral therapy for insomnia (Morin et al., 2006). Additionally, basic psychoeducation about the characteristics of traumatic nightmares was presented, including their distressing nature, chronicity, and impact on sleep and daytime functioning. Although no nightmare content was discussed, veterans were given the opportunity to report on the effects of nightmares on their daily functioning. By design, the two treatments had equivalent amounts of therapist contact (number and length of sessions). In both treatments therapist manuals, handouts and homework were used, and psychoeducation as well as a credible treatment rationale was provided.

Two therapists, a doctoral-level psychologist with over 15 years experience in the treatment of combat-related PTSD and a psychiatric clinical nurse specialist with over 25 years of experience in treating veterans, cofacilitated both treatments. A $2\frac{1}{2}$-day training in imagery rehearsal was conducted by one of the authors (D.F.), a clinical psychologist with extensive experience with imagery rehearsal, who also published an open pilot study of imagery rehearsal with Australian Vietnam War veterans. A doctoral-level psychologist (P.G.) with extensive clinical and research experience in cognitive–behavioral therapy for insomnia trained the study therapists in conducting sleep and nightmare management by coleading a pilot group and demonstrating the techniques to the therapists.

All of the sessions were videotaped. After completion of each of the first five cohorts, therapists received e-mail or phone supervision with PTSD sleep and nightmare disturbance experts. Thereafter, therapists received expert supervision as needed and after the completion of every two to three cohorts.

To assess therapists' adherence to the protocol and competence in treatment delivery, a random sample of 10% of session tapes ($n = 20/192$) was rated by a licensed clinical psychologist independent of treatment delivery and the investigative team. Using measures adapted from previous psychotherapy trials for PTSD (Schnurr et al., 2003, 2007), no differences were found in therapist adherence to either treatment. Overall, 92% of the specific treatment elements were rated adherent to protocol, with only 8% deemed "not enough" or "too much." Additionally, 88% of the treatment elements were rated as delivered competently, with 65% being delivered more than competently. In addition, therapists were rated as very good or excellent in terms of interpersonal effectiveness.

Sample Size Estimation

Power calculations were based on the following effect sizes (Cohen's d; Cohen, 1988): approximately 0.6 for Pittsburgh Sleep Quality Index and 0.80 for number of nightmares in the Nightmare Frequency Questionnaire, based on the effects in a previous trial (Krakow et al., 2001). Using an effect size of Cohen's $d = 0.60$ for the Pittsburgh Sleep Quality Index scores, a power of .80, a two-sided alpha of .05, and an $r = .50$ between a pre- and post-wave, a sample of 55 was calculated per group. For a Cohen's $d = 0.80$ for the Nightmare Frequency Questionnaire with the same assumptions, a sample of 31 was calculated per group. An original goal of 75 per group was to allow for problems with recruitment and retention. All power calculations were based on a power of

.80 and a two-sided alpha equal to .05, and were performed using Gpower software (Erdfelder, Faul, & Buchner, 1996).

Data Analysis

All analyses were performed after the end of the data collection. Pittsburgh Sleep Quality Index total scores were missing in 14% of the assessments, because one to four subcomponents of the scale were missing. Rather than using prorated scores or mean imputation, SAS PROC MI was used to impute five datasets for the separate Pittsburgh Sleep Quality Index components that were missing. Scores were not imputed for times when the patient was not assessed or had dropped out. The Pittsburgh Sleep Quality Index scores were analyzed for each dataset and then combined using SAS PROC MIANALYZE for many analyses. For some analyses, such as the computation of clinically significant change scores, a randomly chosen imputation was used.

Between-group baseline characteristics were compared using independent chi-square or t tests. The primary analyses were performed according to intent-to-treat, by using data from all patients regardless of their compliance. Secondary analyses of the data were performed on patients who received an adequate amount (80% of sessions; 5 out of 6) of treatment (Schnurr et al., 2003).

Longitudinal variables were analyzed using a mixed effects model with a random intercept and slope for the patient nested within the therapy group and an additional random intercept for the therapy group to account for any effect due to the group administered treatment (Baldwin, Murray, & Shadish, 2005). Following recommendations, the baseline value was treated as an outcome rather than a covariate (Fitzmaurice, Laird, & Ware, 2004; Guanghan, Kaifeng, Mogg, Mallick, & Mehrotra, 2009). Treatment effect was also included as a main effect. Time was treated as a categorical variable to produce a response profile analysis and thus not assumed a particular parametric shape to the response. Wald tests were used for the overall treatment effect (the omnibus test of the interaction between treatment and time) and for tests for specific coefficients.

RESULTS

As shown in Table 1, there were no baseline differences between the two treatment groups on any sociodemographics, clinical characteristics, primary (Nightmare Frequency Questionnaire or Pittsburgh Sleep Quality Index) or any secondary outcome measures. The average age of patients was 59.4 ($SD = 3.6$), and most were either African American (52%) or Caucasian (42%). Forty-six percent attended some college or obtained a college degree; 40% completed their studies at the high school level. Most were either married/cohabitating (61%) or separated/divorced (28%). Seventy-eight percent of patients were receiving concurrent psychotherapy (primarily supportive) and 93% were receiving treatment from a psychiatrist. None of the patients had ever received a trauma-focused psychotherapy.

As stated previously, medication changes deemed necessary by primary treatment providers were allowed during the trial course. Although 6% were not prescribed any psychotropic medication the modal number of prescriptions over the course of the study was 3, with an average of 3.2 ($SD = 1.6$). Most commonly prescribed were selective serotonin reuptake inhibitors followed by serotonin and norepinephrine reuptake inhibitors and other antidepressants. There were no significant differences between the imagery rehearsal and sleep and nightmare management groups in medication quantity, stability, or prevalence.

Patients assigned to sleep and nightmare management completed more treatment sessions ($M = 5.05$, $SD = 1.66$) compared to those in imagery rehearsal ($M = 4.10$, $SD = 2.29$), $t(122) = -2.65$, $p < .01$. A higher percentage of patients in sleep and nightmare management (51/63 or 81%) completed the five or six treatment sessions than patients in imagery rehearsal (39/61 or 64%), χ^2 (1, $N = 124$) $= 4.51$, $p < .05$. Noncompleters were not different from completers in their baseline scores on nightmare frequency or CAPS total score.

Patients' pretreatment responses to a credibility/expectancy questionnaire (Borkovec & Nau, 1972) were compared. There was no significant difference between patients in imagery rehearsal ($M = -.18$, $SD = 2.73$) versus sleep and nightmare management ($M = .05$, $SD = 2.30$) in belief regarding credibility of treatment rationales, $t(103) = -0.46$. There was also no significant difference in veterans' expectancy of treatment outcome between those in imagery rehearsal ($M = .38$, $SD = 2.77$) and sleep and nightmare management ($M = -.41$, $SD = 2.48$), $t(99) = 1.51$.

Intention-to-Treat Analyses

Table 2 shows the means for the primary and secondary measures at baseline and across the assessment points and the significance of effect of treatment, which is a Wald omnibus test for the interactions of treatment with time. None of the effects of treatment was statistically significant. The effects of treatment on nightmares per week were −0.24, 0.45, and 0.06 for the 1-month, 3-month, and 6-month follow-up periods, with 95% confidence intervals (CI) of −1.44– 0.97, −0.76–1.66, and −1.17–1.28, respectively. The effects for the Pittsburgh Sleep Quality Index were 0.03, 0.55, and −0.30 with 95% CIs of −1.17–1.23, −0.57–1.66, −1.55–0.96, respectively. These effects correspond to a Cohen's d at 1-, 3-, and 6-months of 0.09, −0.19, and −0.03 for the weekly number of nightmares and −0.007, −0.14, and 0.07 for the Pittsburgh Sleep Quality Index, with the negative sign indicating effect size is in a direction contrary to the hypothesis that imagery rehearsal would be superior to sleep and nightmare management.

The mixed model analyses were then conducted removing the treatment effects to measure the reduction from baseline to 1-month posttreatment for the primary outcomes. The changes in

Table 1. Baseline Sociodemographics and Clinical Characteristics of Patients

	Imagery rehearsal ($n = 61$)		Sleep and nightmare management ($n = 63$)		Total ($N = 124$)		
	M/%	*SD*	*M*/%	*SD*	*M*/%	*SD*	Difference[a]
Age	59.79	3.18	59.06	3.86	59.42	3.55	$t(122) = 1.14$
Ethnicity, %							$\chi^2(2, N = 124) < 1$
Caucasian	44.3		39.7		41.9		
African American	49.2		54.0		51.6		
Other	6.6		6.4		6.4		
Marital status, %							$\chi^2(3, N = 124) = 1.21$
Married/cohabitating	60.7		60.3		60.5		
Separated/divorced	29.5		27.0		28.2		
Never married/widowed	9.8		12.7		11.3		
Education, %							$\chi^2(3, N = 124) = 1.51$
Did not complete high school	16.4		14.3		15.3		
Graduated from high school	37.7		41.3		39.5		
Completed some college	45.9		44.5		46.1		
Employment, %							$\chi^2(3, N = 122) = 6.00$
Full or part-time	9.8		26.2		28.0		
Retired	55.7		47.5		51.6		
Unemployed	34.4		26.2		30.3		
Service branch, %							$\chi^2(3, N = 123) = 4.15$
Army	65.6		60.3		62.9		
Navy	0		4.8		2.4		
Air Force	4.9		1.6		3.2		
Marines	29.5		33.3		31.4		
Percent with a service connected PTSD disability	65.6		69.8		67.7		$\chi^2(1, N = 124) < 1$
Combat Exposure Scale	28.38	9.34	29.31	7.79	29.86	8.53	$t(92) = < 1$
SCID-Depressive disorder, %	57.4		55.6		56.5		$\chi^2(1, N = 124) < 1$
SCID-Anxiety disorder, %	57.4		49.2		52.4		$\chi^2(1, N = 124) < 1$

Note: All cells show mean or percentage, unless otherwise noted. IR = imagery rehearsal; SN = sleep and nightmare management; PTSD = posttraumatic stress disorder; SCID = Structured Clinical Interview for DSM IV-Patient Version.

[a]None of the differences were statistically significant.

the nightmare frequency, Wald test: $\chi^2(1) = 2.55$, *ns*, and nights with nightmares, Wald test: $\chi^2(1) = 2.75$, *ns*, were not significant but the direction of change was as predicted, with lower scores at 1-month than in pretreatment. The main effect for change from pretreatment to 1-month posttreatment was significant for the Pittsburgh Sleep Quality Index, Wald test: χ^2 (1) = 10.37, p = .001, and CAPS score, Wald test: χ^2 (1) = 20.97, $p < .001$.

To determine clinically significant change between baseline and 1-month posttreatment, both improvement and deterioration were considered to be a change of two or more for the number of nights with nightmares and weekly number of nightmares and a change of over three for PTSD symptom severity. For the number of nights, 17% (17/101) showed improvement and 9% (9/101) showed deterioration. The difference between imagery rehearsal and sleep and nightmare management was not significant, χ^2 (2, $N = 101$) < 1, *ns*. For number of nightmares, 21% (21/100) improved, and 15% (15/100) worsened. The difference between imagery rehearsal and sleep and nightmare management was not significant, χ^2 (2, $N = 100$) = 1.76, *ns*. For the Pittsburgh Sleep Quality Index, 26% (26/101) improved and 10% (10/101) declined. The difference between imagery rehearsal and sleep and nightmare management was not significant, χ^2 (2, $N = 101$) < 1, *ns*. No respondents in either the imagery rehearsal or sleep and nightmare management group showed clinically significant change on all three measures between baseline and 1-month posttreatment.

Table 2. Mean and Standard Deviation for Outcome Measures With the Wald Omnibus Test for the Intention-to-Treat Treatment Effect

Outcome	Group	Baseline		1 Month		3 Months		6 Months		Treatment effect (Wald)[a]
		M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	
Weekly number of nightmares	IR	3.95	2.37	3.28	2.47	3.61	2.63	3.20	2.14	$\chi^2(3) = 1.20$
	SN	3.88	3.95	3.47	2.72	3.09	2.08	3.04	1.89	
Weekly nights with a nightmare	IR	2.96	1.39	2.67	1.64	3.10	1.70	2.98	1.69	$\chi^2(3) = 5.80$
	SN	3.00	1.43	2.78	1.54	2.55	1.41	2.68	1.42	
Pittsburgh Sleep Quality Index	IR	13.40	3.00	12.09	4.26	12.57	3.83	12.06	4.09	$\chi^2(3) = 1.93$
	SN	12.85	3.32	11.82	3.79	11.70	3.90	12.00	4.51	
PSQI-Addendum	IR	17.51	4.96	16.71	5.18	16.58	5.56	17.35	5.13	$\chi^2(3) = .23$
	SN	17.01	3.76	16.29	3.91	16.36	4.16	17.26	4.56	
Nightmare Effects Survey	IR	26.39	9.00	24.12	10.43	25.28	10.06	25.88	9.75	$\chi^2(3) = 1.36$
	SN	24.11	9.99	24.66	9.18	24.02	10.22	24.98	10.14	
Beck Depression Inventory	IR	26.85	11.82	24.16	13.35	24.80	13.14	25.02	13.30	$\chi^2(3) = 1.38$
	SN	23.51	11.92	22.31	12.76	23.76	12.76	23.37	12.34	
SF-36 Physical Component	IR	37.17	9.21	39.48	10.19	37.72	9.57	35.80	9.64	$\chi^2(3) = 5.75$
	SN	38.53	9.64	36.84	10.34	35.96	11.97	37.21	11.23	
SF-36 Mental Component	IR	29.69	9.08	32.33	10.63	30.98	9.33	32.15	8.99	$\chi^2(3) = 4.38$
	SN	34.52	12.06	32.84	9.75	34.00	10.35	34.78	10.87	
PTSD Military Checklist	IR	62.73	10.18	58.83	13.56	60.13	12.16	59.05	11.87	$\chi^2(3) = 2.32$
	SN	65.06	9.48	60.96	11.43	61.13	12.00	59.64	12.30	
Clinician-Administered PTSD Scale (CAPS)+	IR	81.34	14.00	74.04	20.36	—	—	—	—	$\chi^2(1) = .20$
	SN	79.48	15.27	74.85	19.52	—	—	—	—	

Note: All measures were given at pretreatment and at 1-, 3-, and 6-months posttreatment, except for the Clinician-Administered PTSD Scale, which was administered at pretreatment and 1-month posttreatment only. The number of respondents assessed at baseline, 1, 3, and 6 months was 61, 45, 44, 42, for IR and 63, 56, 55, 53 for sleep and nightmare management. Sample sizes vary slightly for each measure. PTSD = posttraumatic stress disorder; IR = imagery rehearsal; SN = sleep and nightmare management; SF-36 = 36-Item Short Form Health Survey.

[a]None of the differences were statistically significant.

Adequate Dose Analyses

Patients who received an adequate dose of treatment (completing five or six sessions) did not differ from the others in baseline weekly number of nights with nightmares, $t(122) < 1$, *ns*, weekly number of nightmares, $t(122) < 1$, *ns*, Pittsburgh Sleep Quality Index, $t(122) = -1.17$, *ns*, CAPS, $t(121) = -0.41$, *ns*, or nightmare intensity, $t(122) < 1$, *ns*. As shown in Table 3 for the adequate dose sample, there were no significant treatment effects for the primary outcome measures or the CAPS.

Exploratory Analyses

Several exploratory analyses were conducted in an attempt to explicate the lack of significant differences between the groups. As stated previously, there was a reduction in nightmare intensity found in an open pilot study of imagery rehearsal with Australian Vietnam War veterans (Forbes et al., 2001). Because this study did not include a nightmare intensity/distress measure, the CAPS nightmare item (administered at pretreatment and 1-month follow-up) was examined, consisting of two subitems, the frequency of unpleasant dreams in the past month and the intensity of nightmares (i.e., "How much distress or discomfort did these dreams cause you?"). A post-hoc mixed model analysis indicated that imagery rehearsal produced a significantly greater decrease ($M = -0.39$, 95% CI = −0.75– −0.04) than sleep and nightmare management (interaction between time and treatment: Wald test: $\chi^2(1) = 4.77$, $p < .05$). For nightmare frequency imagery rehearsal did not produce greater change ($M = -0.21$, 95% CI = −0.63–0.22) than sleep and nightmare management, Wald test: $\chi^2(1) < 1$, *ns*.

An additional post-hoc mixed model analysis looked for effects of treatment among those with baseline severity below the median for each primary measure separately. There were no significant treatment effects for Pittsburgh Sleep Quality Index, Wald test: $\chi^2(3) = 1.89$, *ns*, weekly number of nightmares, Wald test: $\chi^2(3) = 1.23$, *ns*, weekly nights with nightmares, Wald test: $\chi^2(3) < 1$, *ns*, or CAPS, Wald test: $\chi^2(1) < 1$, *ns*.

Table 3. Adequate Dose Analysis: Mean and Standard Deviation for Outcome Measures with the Wald Omnibus Test for the Treatment Effect

Outcome	Condition	Baseline		1 Month		3 Months		6 Months		Treatment effect (Wald)[a]
		M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	
Weekly number of nightmares	IR	3.87	2.52	2.95	1.92	3.57	2.69	3.24	2.17	$\chi^2(3) = 2.29$
	SN	3.87	4.20	3.54	2.79	3.00	1.80	3.15	1.92	
Weekly nights with a nightmare	IR	2.78	1.49	2.51	1.59	2.99	1.70	2.88	1.63	$\chi^2(3) = 5.19$
	SN	3.09	1.49	2.79	1.59	2.61	1.43	2.79	1.41	
Pittsburgh Sleep Quality Index	IR	12.89	3.15	12.02	4.40	12.23	3.79	11.94	4.13	$\chi^2(3) = 1.60$
	SN	12.92	3.39	11.78	3.82	11.62	3.84	12.08	4.51	
Clinician Administered PTSD Scale	IR	81.38	14.96	72.90	20.46	—	—	—	—	$\chi^2(1) = .65$
	SN	80.26	15.27	74.16	18.97	—	—	—	—	

Note: All measures were given at pretreatment and at 1-, 3-, and 6-months posttreatment, except for the Clinician-Administered PTSD Scale, which was administered at pretreatment and 1- month posttreatment only. The number of respondents assessed at baseline, 1, 3, and 6 months was 39, 39, 39, 38 for IR and 51, 51, 50, 48 for sleep and nightmare management. Sample sizes vary slightly for each measure. PTSD = posttraumatic stress disorder; IR = imagery rehearsal; SN = sleep and nightmare management.

[a]None of the differences were statistically significant.

DISCUSSION

This is the first randomized controlled trial to compare imagery rehearsal to a credible psychotherapy control condition in a population with chronic, severe PTSD. Although Vietnam War veterans in both imagery rehearsal and sleep and nightmare management showed some improvement in one of the primary sleep outcomes (Pittsburgh Sleep Quality Index), and the total CAPS score between the baseline and first posttreatment assessments, they did not report a significant change in the other primary outcome measure of nightmare frequency. Contrary to hypotheses, intent-to-treat and adequate dosing analyses all converged to show there were no lasting significant differences in improvement between the imagery rehearsal and sleep and nightmare management conditions at 1-, 3-, and 6-month follow-up assessments in terms of primary or secondary outcomes. Although the study was powered to detect a medium effect size of a Cohen's $d = 0.60$, the actual intent-to-treat effect sizes for the differences between treatments were small, in the range of 0.03 to 0.19 (Cohen, 1988), and often in the direction contrary to the hypotheses. In addition, examination of significant clinical change indicated that very few patients in either imagery rehearsal or sleep and nightmare management had meaningful long-term improvement.

Given two positive clinical trials indicating the efficacy of imagery rehearsal delivered in group format in other traumatized populations (Davis & Wright, 2007; Krakow et al., 2001) and positive findings from uncontrolled pilots of imagery rehearsal with veterans (Forbes et al., 2001; Harb et al., 2009; Lu et al., 2009; Moore & Krakow, 2007; Nappi et al., 2010), an explanation for these non-significant findings was sought. Even though there are certain similarities between this trial and the other two controlled trials of imagery rehearsal (Davis & Wright, 2007; Krakow et al., 2001), there are several important distinctions, namely in the choice of comparison conditions, the nature of the patient samples, and the particulars of the respective treatment strategies. First, we used a psychotherapy comparison condition rather than a wait-list control. Although our choice of comparison condition may partially explain the lack of differential treatment effects, it does not fully explain why the two previous trials found pre- and posttreatment effects and ours did not. Additionally, the previous trials used civilians, predominately women, some of whom did not meet full criteria for PTSD, whereas our trial targeted male U.S. Vietnam War veterans with chronic, severe PTSD, and recurrent replicative nightmares. In contrast, Davis and Wright (2007) reported that most of their patients' nightmares were not replays of traumatic events, but rather, similar to or entirely unrelated to the index trauma. Similarly, Krakow and colleagues (2001) instructed patients to work with a nightmare of lesser intensity and one that did not seem like a replay of trauma. Replay nightmares are typically associated with greater psychiatric distress (Davis, Byrd, Rhudy, & Wright, 2007) and are likely more difficult to treat. Another factor may be the chronicity of PTSD and comorbid disorders in Vietnam War veterans who use VA mental health services. Indeed, this population has had limited treatment responsiveness for a variety of psychotherapies (Fontana & Rosenheck, 1997; Friedman, Marmar, Baker, Sikes, & Farfel, 2007), although one study has demonstrated improvement (Monson et al., 2006). In general, the findings are consistent with a recent meta-analysis of psychotherapies for PTSD, in which treatment effect sizes differed as a function of trauma type, with the lowest effects sizes in studies

of combat (Bradley, Greene, Russ, Dutra, & Westen, 2005). In addition, in a number of studies comparing treatments for PTSD, there are gender-specific effects of treatment with superior response in women compared to men (Cason, Grubaugh, & Resick, 2002). Thus, our results may not reflect the efficacy of the treatments per se, but rather the chronicity and severity of the problems in this population of male combat veterans.

In exploratory analyses, differential treatment effects on the CAPS nightmare total item as well as its two separate components, nightmare frequency and nightmare intensity were examined. The CAPS nightmare total item score showed a significant treatment effect, with imagery rehearsal producing a greater effect than sleep and nightmare management. However, upon further examination, analyses showed a significantly greater reduction in blinded clinician-rated nightmare intensity in imagery rehearsal compared to sleep and nightmare management; although the frequency item was lower, it was not statistically significant. It appears that imagery rehearsal produced some improvement in the intensity of nightmares as assessed by independent raters blinded to treatment assignment. It is possible that in those patients with chronic, severe PTSD, a decrease in nightmare intensity and distress could precede a reduction in nightmare frequency. This is consistent with a literature review of the prevalence, etiology, and functional significance of nightmares (Levin & Nielsen, 2007), in which nightmare distress was found to be more strongly associated with measures of psychopathology than was nightmare frequency. Our study did not include a CAPS assessment at 3- and 6-month follow-up and the potential longitudinal course of a change in nightmare symptomatology as evaluated by independent raters cannot be examined.

Although our primary outcome of nightmare frequency was a single-item retrospective measure of nightmares over the past month and did not indicate significant pre- and postchange for either group, a post-hoc examination of veterans' weekly sleep diaries revealed that the number of nightmares decreased significantly over the course of treatment but did not differ between the two treatment groups. These results suggest that proximal charting may be more sensitive to changes in nightmares and other sleep symptoms than retrospective methods (David, De Faria, & Mellman, 2006; Wood & Bootzin, 1990).

A simple explanation for our results might be that imagery rehearsal is not an effective intervention for Vietnam War veterans. However, it may be that the "dose" of imagery rehearsal was not sufficient, that the group format for delivering imagery rehearsal was not optimal, or that additional treatment modalities should be added. Although 6 weeks of imagery rehearsal conducted in group format with veterans with chronic, severe PTSD may produce only modest effects, the treatment might prove effective if patients are given additional time and practice of rescripting techniques. It might be that imagery rehearsal, as it involves the alteration of trauma-related nightmare narratives, would be more beneficial in stepped care where veterans are first given an opportunity to address the traumatic experience itself in adjunctive to trauma-focused treatment. In fact, in the pilot study with Australian Vietnam veterans that had positive results (Forbes et al., 2001), patients had all completed a comprehensive inpatient treatment program for combat-related PTSD prior to participation in imagery rehearsal. Perhaps those veterans were therefore able to better benefit as they had already received trauma-focused treatment. In a chart review of veterans offered imagery rehearsal, those who completed a full course of PTSD treatment in the past year were more likely to engage in imagery rehearsal, suggesting such veterans may be more amenable to treatment, particularly if nightmares have persisted despite prior PTSD treatment (Nappi et al., 2010).

This study had several limitations. First, there was no immediate posttreatment assessment: Either or both therapies could have had transient strong effects that were not maintained at the 1-month postassessment. It is important to highlight, however, that two of our measures (Pittsburgh Sleep Quality Index and CAPS) capture symptoms in a 1-month timeframe, in our case the one-month posttreatment period. Because imagery rehearsal patients were still actively working on making changes to nightmare content in session 6, we did not believe that an immediate posttreatment assessment would adequately capture change because patients' continued practice of the techniques after session 6 would demonstrate the treatment effect at 1-month posttreatment. Second, except for the single CAPS item obtained at the 1-month follow-up, there was no measure of nightmare intensity nor was there any measure of distress caused by the nightmares, although there was a measure of the effects nightmares have on daily functioning. Nightmare intensity and distress are important domains to measure in future investigations, as nightmare-related distress compared to nightmare frequency, may be more indicative of psychopathology (Levin & Fireman, 2002; Levin & Nielsen, 2007) and more readily responsive to treatment. Third, there were no formal checks on the reliability of the administration of the CAPS and SCID by the two licensed clinical psychologists. However, we did verify PTSD diagnosis for congruence with existing VA hospital records. In all cases, diagnosis was confirmed by licensed mental health providers. Fourth, there were only two therapists who conducted both treatments. Utilizing only two therapists may not be ideal and may limit the generalizability to other therapists. Fifth, relative to some other exemplary psychotherapy trials (Schnurr et al., 2003, 2007), this study incorporated less-intensive supervision of the therapists.

Future studies may vary the content of imagery rehearsal to examine potential mechanisms of action. In the version of imagery rehearsal tested here, patients were only exposed to nightmare content when they wrote it out and read it aloud to the group. Because exposure to traumatic material is a fundamental component of evidence-based treatments for PTSD, augmenting imagery rehearsal for nightmares with an evidence-based trauma-processing treatment might maximize its potential (Arntz, Tiesema, & Kindt, 2007). However, although evidence-based treatments for PTSD

have been shown to produce significant changes in sleep disturbances in female adult rape survivors, their sleep disturbances remained in the clinically significant range after treatment (Galovski et al., 2009), suggesting that nightmares likely do require intervention beyond an evidence-based treatment for PTSD. Although participants in our trial were encouraged to practice imagery rehearsal during waking hours, particularly at bedtime, it is plausible that their application of the technique was not enough or consistent. Adherence to homework assignments may thus be a factor in treatment outcome, particularly as application of imagery rehearsal at bedtime was effective with children (St-Onge, Mercier, & De Koninck, 2009).

Anecdotal evidence from this trial and pilot work with U.S. veterans from Operation Iraqi Freedom (Harb et al., 2009) indicated that content of veterans' nightmares as well as particular changes that were made in the nightmare script during imagery rehearsal may be important modifiers of treatment outcome to be addressed in future large-scale research. Future investigations might also focus on the benefits of imagery rehearsal when delivered as an individual treatment.

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