Sleep Disturbance in Adults With Posttraumatic Stress Disorder: A Review

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Objective: To present a critical review of the literature and research on sleep difficulties in adults with posttraumatic stress disorder (PTSD), more specifically the existing treatment options, and to formulate recommendations regarding future treatment approaches and research related to sleep and PTSD.

Data Sources: The following databases were consulted: PsycInfo (1872–2006) and MEDLINE (1966–2006). The search was conducted using the following key terms: *PTSD and sleep*, *PTSD and nightmares*, *PTSD and dreams, PTSD and insomnia, PTSD and periodic limb movement disorder,* and *PTSD and sleep disordered breathing*. Only studies examining sleep disturbance among adults with PTSD were included, and only articles written in English were consulted.

Study Selection: Studies and reviews related to the prevalence, causes, and treatments of sleep disturbance among adults with PTSD, as well as those examining the relationship between sleep and PTSD, were selected.

Conclusions: Promising treatment options are available for treating sleep difficulties among adults with PTSD. In particular, cognitive-behavioral therapy including a component for nightmares (imagery rehearsal therapy) and insomnia has been found to significantly improve sleep disturbance among these individuals. It is proposed that with the inclusion of other components, such as a screening for other sleep disorders, relaxation exercises, positive self-talk, imagery rehearsal related to recurring images before bed, and a daytime nap, sleep-related symptoms may improve to a greater degree, which may then lead to a significant decrease in other PTSD symptoms and overall PTSD severity. The inclusion of sleep medicine specialists should also be considered for sleep medicine treatment of individuals with PTSD. Collaboration between mental health professionals and sleep medicine specialists is therefore recommended for treatment of sleep-related difficulties among individuals with PTSD.

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Sleep complaints are common for several psychiatric disorders.[1] Anxiety disorders are among the most prevalent disorders in the general population, and anxiety is, in fact, the symptom that is most often correlated with sleep difficulties such as insomnia.[1] More specifically, it has become clear from the literature that sleep difficulties are common among individuals with posttraumatic stress disorder (PTSD)[2] and may even be a predictor of the development of PTSD.[3]

The purpose of this article is to present a critical review of the literature and the research on sleep difficulties in adults with PTSD, more specifically the existing treatment options, and to formulate recommendations regarding future treatment approaches and research related to sleep and PTSD. Our literature review was conducted using the following databases: (1) PsycInfo (1872–2006) and (2) MEDLINE (1966–2006). The search was conducted using the following key terms: *PTSD and sleep, PTSD and nightmares, PTSD and dreams, PTSD and insomnia, PTSD and periodic limb movement disorder*, and *PTSD and sleep disordered breathing*. Studies and reviews related to the prevalence, causes, and treatments of sleep disturbance among adults with PTSD, as well as those examining the relationship between sleep and PTSD, were selected. Only articles written in the English language were consulted.

We will first define important terms and describe the specific sleep difficulties that are experienced by individuals with PTSD, as well as explore their prevalence rates and potential causes.

TAKE-HOME POINTS

- Promising treatment options are available for treating sleep difficulties among adults with posttraumatic stress disorder (PTSD), including cognitive-behavioral therapy, although limitations exist.
- The inclusion of additional components (e.g., screening for other sleep disorders, relaxation, positive self-talk, imagery rehearsal, daytime napping) in the treatment of sleep difficulties among adults with PTSD may prove to be valuable.
- Treatment aimed at improving sleep-related symptoms may also help to improve other symptoms of PTSD.

DESCRIPTION AND PREVALENCE OF SLEEP DISTURBANCE IN ADULTS WITH PTSD

According to the *Diagnostic and Statistical Manual of Mental Disorders,* Fourth Edition, Text Revision,[4] PTSD is characterized by the development of characteristic symptoms following exposure to an extreme traumatic stressor that elicits a response of fear, helplessness, or horror. Among the many symptoms reported by individuals with PTSD, sleep disturbance is one of the most prevalent[2] and has been labeled the "hallmark of PTSD."[5] For example, Jukié et al.[6] found that 87.2% of war sufferers with PTSD also suffer from sleep disturbances. More specifically, 2 aspects of subjective sleep-related symptoms are included as part of the hyperarousal and reexperiencing symptom clusters in the DSM-IV-TR for PTSD: insomnia and recurrent nightmares.[7]

Insomnia is "a complaint of difficulty initiating or maintaining sleep or of nonrestorative sleep."[8(p183)] Neylan et al.[9] found that difficulties with falling asleep (initial insomnia) occurred with a frequency varying from "sometimes" to "very frequently" in 44% of combat veterans with PTSD, 5.5% of combat veterans without PTSD, and 5% of healthy controls. These researchers also noted that difficulties with maintaining sleep (middle insomnia) occurred sometimes or more frequently in 90.7% of combat veterans with PTSD, 62.5% of combat veterans without PTSD, and 52.9% of healthy controls. However, others have failed to find any differences in sleep maintenance between those with and without PTSD.[10] Approximately 43% of individuals with PTSD report waking up too early in the morning (terminal insomnia), compared to 13% of individuals without PTSD.[11]

A nightmare is defined as "a long, frightening dream awakening the sleeper out of sleep."[12(p12)] Neylan et al.[9] found that nightmares occurred sometimes or very frequently in 52.4% of combat veterans with PTSD, 4.8% of combat veterans without PTSD, and 3.4% of healthy controls. Some researchers argue that these frightening dreams are similar to nightmares occurring in REM sleep because they tend to be vivid, visual, and emotional and can be recalled, while others suggest that they are more like night terrors occurring in non-REM (NREM) sleep because they are often accompanied by gross body movements and tend to occur early in sleep.[5] It may actually be that these anxiety dreams can occur in either NREM or REM sleep,[13] or that perhaps they consist of something other than nightmares or night terrors altogether.[12]

POTENTIAL RELATIONSHIP BETWEEN SLEEP AND PTSD SYMPTOMS

Possible Causes of Sleep Disturbance

Potential causes of sleep disturbances among individuals suffering from PTSD have been debated in the literature. Despite the research in this area, the underlying mechanisms are not yet completely understood.[14] However, some hypotheses, either biological or psychological in nature, have been put forward.

Biological/physiologic causes.

REM sleep mechanism disturbance. A REM-related abnormality is frequently found in patients with PTSD.[5] More specifically, sleep disturbance among these individuals may involve either an inappropriate recruitment of normal REM sleep processes or intrinsically dysfunctional REM sleep mechanisms.[5] In fact, several indications have led to this hypothesis. First, the usual muscle atonia that is characteristic of REM sleep may be lacking to some extent among these individuals.[5] Second, the high REM density and short REM latencies sometimes found in this population may represent an expression of REM pressure related to an unmet REM need.[5] On the other hand, the contradictory finding of an increased REM latency among some individuals with PTSD may be evidence of a dysfunction at the level of REM sleep initiation.[10] Despite such inconsistent findings, some type of REM-related abnormality is frequently found in patients with PTSD.[15,16] Since REM sleep is hypothesized to be involved in emotional processing,[17] it is questioned whether this REM abnormality is truly the problem among individuals with PTSD, or if instead it consists of an attempt to process emotionally charged material.[5] However,

emotional adaptation may be hindered by "the propensity to replay threatening events, disrupted REM sleep continuity due to symptomatic awakenings, and phasic muscle intrusion."[18(p303)]

Noradrenergic activity/hyperarousal. Noradrenergic activity is involved in the regulation of arousal levels during sleep.[19] Normally, noradrenergic firing decreases when arousal is reduced during non-REM sleep and increases when arousal is heightened prior to awakening from REM sleep.[20] However, Mellman et al.[19] noted that excretion of 3-methoxy-4-hydroxyphenylglycol (MHPG), a norepinephrine metabolite, did not decrease at night among individuals with PTSD, as it did among healthy controls. Abnormality of the central nervous system noradrenergic system is also related to the hyperarousal state experienced by these individuals, which can contribute to insomnia.[7] Support for this hyperarousal hypothesis comes from studies finding increased heart rate during rest[21] and increased cardiovascular arousal during sleep among individuals with PTSD.[22]

Sleep disorders. Krakow et al.[23] found that 71% of a sample of sexually assaulted females with PTSD who also reported insomnia endorsed complaints of a sleep movement disorder (SMD), which is associated with light sleep.[24] Similarly, Inman et al.[25] noted that individuals with PTSD were more likely to report waking up with the covers torn apart, restless legs in bed, and excessive body movements during sleep compared to individuals with insomnia and no PTSD. In general, studies show that periodic limb movement disorder is more prevalent among individuals with PTSD compared to control groups and the general population.[26] It is therefore suggested that SMDs may play a role in at least a portion of the sleep difficulties in some individuals with PTSD.[26,27] However, Lavie and Hertz[28] reported that although they found a higher rate of body movements among these individuals, it was not related to a sleep disturbance. Still, others found no differences in the rate of leg movements between individuals with and without PTSD and the general population.[11]

Incidences of sleep disordered breathing (SDB) have also been found in patients with PTSD.[21] For example, Krakow et al.[29] found that 40 out of 44 crime victims with PTSD and difficulties with sleep suffered from SDB. It has also been noted that reported nightmares, sleep quality, anxiety, depression, quality of life, and posttraumatic stress symptoms[30,31] are worse among individuals with diagnosed or suspected SDB than among individuals without SDB. Microarousals occur during sleep with breathing difficulties and may cause sleep fragmentation,[32] a disruption in the continuity of REM periods, and a decrease in the proportions of REM sleep and slow-wave sleep.[33] It is also postulated that since REM sleep tends to destabilize breathing,[34] the disrupted REM sleep mechanism found among individuals with PTSD increases the susceptibility to respiratory disturbances.[35] Some have suggested the presence of a cycle in which "insomnia leads to fragmentation that leads to greater airway collapsibility, resulting in more SDB events that lead to more fragmentation and insomnia, and so on."[36(p194)]

Psychological causes.

Sleep-related anxiety. Anxiety has been found to be related to sleep difficulties among individuals with PTSD.[25] Inman et al.[25] found that, compared to individuals suffering from insomnia without PTSD, individuals suffering from insomnia with PTSD tend to report more anxiety symptoms related to sleep, such as fear of going to sleep, fear of returning to sleep after being awake, fear of the dark, and other anxious thoughts at night. The traumatic experience itself may result in a conditioned anxiety reaction to sleeping at night.[25] For example, trauma that is connected with the night or the bed, such as war-related trauma or sexual abuse, is especially likely to generate perceptions of sleep as dangerous.[25,37] Among this general feeling of anxiety is a loss of control for coping with, regulating, and inhibiting distressing mental activities during sleep, which appears to be significantly related to sleep difficulties among individuals with PTSD.[38]

Nocturnal anxiety may also be closely related to the occurrence of nightmares among individuals with PTSD. These individuals may be anxious and distressed about having such dreams, which can lead to a fear of falling asleep.[9,39] In addition, they may be conditioned to awaken from nightmares in order to avoid the unpleasant emotions associated with these dreams.[39] Some individuals may be conditioned to wake themselves up as soon as they start having any dream, for fear that the dream will turn into a trauma-related nightmare.[39] This brings the individual to believe that remaining awake is the only way to avoid such anxiety.[39]

Comorbidity. Changes in REM sleep have been well described in major depression.[40] Some researchers indicate that coexisting depression among PTSD patients is more likely to cause the sleep disturbance than PTSD itself. For example, Dow et al.[40] found that individuals with both PTSD and major depression and individuals with only major depression had increased REM density compared to healthy controls. However, when Woodward et al.[41] compared individuals with both PTSD and major depression to patients with only PTSD, it was found that REM density was similar in both groups, leading to the conclusion that increased REM density is, in fact, associated with PTSD. Similarly, in a study by Ross et al.,[10] when adults with PTSD without current major depression were compared to healthy individuals, REM sleep differences were still apparent, although many of the individuals with PTSD had a history of depression. These findings suggest that all 3 groups (major depression, PTSD, major depression and PTSD) have increased REM density, and it is concluded that the possibility that depression explains

the REM sleep disturbance among individuals with PTSD is unlikely.[10]

The comorbidity of PTSD and substance abuse in particular needs to be considered. It has been noted that 60% to 80% of Vietnam veterans seeking treatment for PTSD abuse alcohol and/or drugs.[42] Individuals with PTSD and substance use tend to report significantly more sleep disturbance compared to individuals with PTSD alone.[43] Many individuals suffering from symptoms of PTSD who use alcohol report that they drink to reduce sleep problems or nightmares,[44] sometimes by inducing sleep through psychic numbing.[45] Although acute alcohol use tends to decrease wakefulness for the first few hours of sleep, increased wakefulness and REM sleep are typically noted throughout the remainder of the night.[46] Similarly, although the short-term use of alcohol decreases sleep latency, increases sleep duration, and minimizes nightmares through REM sleep suppression,[47] chronic use tends to increase fragmentation of sleep and increase awakenings.[46] In addition, withdrawal from alcohol is associated with an increase in REM sleep, frequent nightmares,[47] fragmentation of sleep, and a reduction in slow-wave sleep.[46] The initial positive effects of alcohol use on sleep may therefore act as a reinforcer for individuals with PTSD to use alcohol, and the withdrawal effects may prevent them from stopping.[48] In addition, it has been found that alcohol can decrease the inspiratory activity of the tongue muscle, genioglossus, which may then contribute to the exacerbation of SDB.[49]

Sleep Disturbance as a Contributor to the Development of PTSD

It is evident that sleeping problems are quite prominent among individuals with PTSD. The literature has debated for quite some time about whether sleep difficulties predispose individuals to the development of PTSD or whether symptoms of PTSD lead to the development or exacerbation of sleep difficulties. It seems that some individuals with PTSD suffer from sleeping problems before the occurrence of the trauma. For example, one third of the veterans included in a study by Van der Kolk et al.[50] reported a history of lifelong nightmares rather than nightmares that began with combat trauma.

Whether early sleep difficulties after a trauma can predict onset of PTSD has also been debated. In a study by Harvey and Bryant,[3] it was found that the probability of developing PTSD is moderate when individuals experience sleep difficulties soon after the trauma, whereas the probability of not developing PTSD is high when individuals do not experience any sleep problems soon after the trauma. More specifically, these researchers found that of those who had sleep disturbances within 1 month of the trauma, 72% went on to develop PTSD. Further evidence for the role of sleep disturbance in the development or maintenance of PTSD symptoms comes from studies showing that when sleep disturbance is treated, PTSD symptoms are significantly reduced.[33,35,39,51,52] Therefore, there seems to be some indication that sleep is a contributing factor in the development of PTSD. This can have important implications for the individual's sleep environment after a traumatic event has occurred (e.g., shelters after a natural disaster), such that a more comfortable and favorable environment may promote sleep, which may in turn help reduce or prevent the development of some PTSD symptoms.

CURRENT TREATMENT APPROACHES AND LIMITATIONS

It is not common for treatments for PTSD to include a specific sleep component.[53] However, since sleep disturbance may actually occur before the development of PTSD and not necessarily result from it,[54] it is important that it be conceptualized as something that is independent from the effects of a psychological condition.[55] Before making treatment recommendations, it is important to get a good understanding of the type of sleep problem (sleep initiation insomnia, sleep maintenance insomnia, nightmares, etc.) experienced by the trauma survivor, as treatment may differ depending on the presenting issue. In addition, given the strong comorbidity of PTSD with other disorders such as depression and substance abuse,[56] it is crucial to assess for comorbid conditions.[53] Getting a good sense of the individual's sleep and wake activities such as time of bed, time of wake, total sleep time, daytime sleepiness, napping, shiftwork,[57] bedtime routine, and sleep-related thoughts and feelings is also important.

Although research focusing on improving sleep difficulties among patients with PTSD is lacking to some extent, the effectiveness of certain treatments in reducing sleep difficulties in this population has been examined. A synthesis of current treatment approaches for sleep difficulties among adults with PTSD, as well as their limitations, is presented below.

Pharmacologic/Medical Approaches

Pharmacotherapy.

Antidepressants. In general, the acute administration of a range of tricyclic antidepressants can decrease the percentage of REM sleep,[58] lengthen the sleep cycle, and decrease the number of awakenings.[59] More specifically, amitriptyline[18,60] and imipramine[61] have been associated with significant improvements in sleep among individuals with PTSD. However, side effects of tricyclics may include dry mouth, sweating, blurred vision, urinary retention, and confusion,[62] and discontinuation of some tricyclics can cause REM rebound and poorer sleep.[63] Some monoamine oxidase inhibitors such as phenelzine can help improve initial insomnia[64] and reduce nightmares.[64,65] However, side effects such as dizziness, erectile dysfunc-

tion, blurred vision, drowsiness, and even intensification of preexisting sleep disturbances have been reported in some patients.[65] Another concern with this medication is that patients may not be compliant with the restriction from drugs and alcohol required for its usage,[66] especially given the high comorbidity of substance abuse among individuals with PTSD.[42]

The effects of serotonin reuptake inhibitors on symptoms among adults with PTSD have been examined. However, their effects on sleep remain unclear. For example, some have found that fluoxetine can lead to significant improvements in sleep such as objective measures of wake after sleep onset and total sleep time, as well as self-reported sleep onset latency,[67] while others find that it decreases total sleep time, results in shallower sleep, and increases daytime fatigue.[63] Similarly, whereas some find improvements in nightmares, insomnia,[68,69] and other PTSD symptoms following administration of fluvoxamine,[69] others find that insomnia is actually a side effect of this medication[70] and that it decreases sleep efficiency and sleep maintenance and increases awake time.[71]

The potential of the antidepressants trazodone and nefazodone in reducing sleep difficulties in adults with PTSD seems somewhat promising. Studies have found that trazodone can be used to treat insomnia, without addictive potential.[72] Warner et al.[73] found that 100% of their sample of 60 veterans with PTSD reported improvements with overall sleep after administration of this medication. More specifically, 92% reported that it helped with falling asleep, and 78% reported that it helped with staying asleep. In addition, 40 out of the 55 patients who used it for nightmares reported a moderate to significant decrease in occurrence of nightmares. However, no control group was included in this study, and certain intolerable side effects (painful or prolonged erection, daytime sedation, more vivid nightmares, and muscle pain) may lead to discontinuation.[73] Nefazodone is known to improve total sleep time, ability to fall asleep, and overall quality of sleep in individuals with PTSD,[74] as well as increase total REM sleep time[75] and decrease the number of bad dreams[72] and PTSD severity.[74,76,77] However, mild side effects may be experienced with its administration.[74] In fact, in a study by McRae et al.,[76] side effects such as delayed ejaculation or anorgasmia, fatigue, nightmares, and dry mouth were reported in over 10% of the study participants.

Sedatives/hypnotics. Zolpidem is a sedative that has been linked with improvements in sleep among adults with PTSD. For example, Dieperink and Drogemuller[78] found that, among a group of veterans, this medication improved insomnia, decreased nightmares, and increased sleep duration, with no side effects. However, some individuals discontinued the medication due to lack of efficacy. Studies looking at the effectiveness of certain benzodiazepines on the sleep of adults with PTSD have produced mixed results. Some have found that these medications can be helpful for reducing nightmares and increasing duration of sleep[79]; however, others have found that insomnia can result from their withdrawal,[80] which may imply that the medication has to be taken continuously. Other side effects of benzodiazepines include excessive daytime sedation, memory impairment, tolerance, and abuse.[79] Given the side effects of these medications, their potential for effect tolerance,[79] and the fact that data examining the long-term effects of benzodiazepines in chronic insomnia are lacking,[81] their potential for long-term usage is limited.[79]

Adrenergic antagonists/anticonvulsants. Since increased noradrenergic activity is one of the possible causes of the sleep difficulties in adults with PTSD,[19] studies have looked at the effects of active α-adrenergic antagonists on the sleep of these patients. For example, Peskind et al.[82] found that the administration of prazosin to older war veterans with chronic PTSD resulted in a reduction of trauma-related nightmares and sleep disturbance as well as PTSD severity. However, the lack of a control group in this study does not permit firm conclusions to be drawn about the effectiveness of this treatment. Similar results were obtained in a 20-week crossover study by Raskind et al.,[83] who found a reduction in difficulty falling or staying asleep as well as a reduction in nightmares. Improvements in sleep among PTSD patients have also been noted with certain anticonvulsants. For example, insomnia and frequency and/or intensity of nightmares have been found to decrease with the administration of gabapentin.[79] However, side effects may include mild sedation, mild dizziness, and nonspecific swelling.[79] Similarly, carbamazepine may improve recurrent dreams, overall sleep disturbance, and intensity of other PTSD symptoms in adults with PTSD.[84] However, reports of discontinuation due to side effects have been noted.[85]

Limitations of pharmacotherapy. Results from the above studies indicate that pharmacotherapy has shown some promising results in terms of reducing insomnia and nightmares and improving sleep quality. However, many of these medications act by suppressing REM sleep in order to decrease nightmares. This may be problematic, since REM sleep has been found to play an important role in memory[86] as well as emotional processing.[34] Therefore, although these medications may help decrease certain symptoms, it is possible that other symptoms are being maintained or perhaps even developed. For example, antidepressant medication has been found to be related to the development or worsening of restless legs syndrome.[87] Other limitations of pharmacotherapy include sleep difficulties sometimes reappearing when medication is discontinued.[61] For example, Peskind et al.[82] found that when patients discontinued prazosin, nightmares strongly reappeared in every case. Other limitations of pharmacotherapy include the presence of side effects as well as possible

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tolerance and dependence when used long term.[88] In addition, pharmacotherapy does not target the attitudes and behaviors related to sleep that may maintain insomnia.[89]

Treatment of sleep disordered breathing. Since some researchers have suggested that the high rate of SDB among adults with PTSD may contribute to their sleep difficulties, the impact of continuous positive airway pressure (CPAP) on their sleep has been studied. In a case report by Youakim et al.,[33] CPAP resulted not only in effective control of sleep apnea, normalization of sleep architecture, and decreased daytime sleepiness for a veteran with PTSD, but also in a reduction in nightmare frequency and intensity. If CPAP became dislodged, the nightmares returned. Similarly, although lacking a control group, a study by Melendrez et al.[90] noted marked improvement in insomnia and sleep quality, beyond that resulting from a behavioral treatment program, among female crime victims with sleep breathing difficulties who were enrolled in a nightmare and insomnia treatment program.

Limitations of treatment for sleep disordered breathing. Both insomnia[29] and nightmares[33] have improved with the use of CPAP for SDB among adults with PTSD. Nightmares may be reduced regardless of the normalization in the amount of REM sleep, which indicates that REM sleep does not necessarily need to decrease for improvements to occur.[33] However, there is no indication that increased oxygen saturation in the brain during sleep, from CPAP, would be beneficial for individuals with PTSD who do not suffer from SDB. This therefore limits the generalizability of this treatment.

Psychological Treatments

The greatest number of controlled outcome studies related to treating symptoms of PTSD is found in the area of cognitive-behavioral therapy (CBT).[91]

General CBT for PTSD. Imaginal exposure is used to help individuals with PTSD confront their trauma-related memories for a prolonged period of time, in the context of a supportive therapeutic relationship.[92] This therapy mainly consists of choosing significant scenes of the trauma, describing them in as much detail as possible, and monitoring anxiety levels afterward. This sequence is repeated until anxiety has been substantially reduced.[93]

In a study by Cooper and Clum,[93] improvements in nightmares (96% reduction in exposure group vs. 15% in control group) and sleep disturbance were noted when imaginal flooding was used as an adjunct to standard psychosocial and pharmacologic treatment in veterans with combat-related PTSD. Peniston[94] also examined the use of imaginal exposure in treating symptoms of veterans with PTSD and recurring combat nightmares, but added a component of electromyographic biofeedback for relaxation training. Results from this study showed that such a treatment led to a reduction of anxiety-provoking nightmares/flashbacks compared to a control group, and improvements were maintained after 1 year. Simon[95] also found that exposure led to a clinically significant reduction in sleep disturbance and intrusive symptoms, and improvements were maintained for at least 120 days. The results of this study should be interpreted cautiously, however, due to the limited sample size of 2 participants. Keane et al.[96] found that although exposure led to a significant decrease in reexperiencing symptoms (nightmares, dissociative experiences, ruminative thoughts) and subjective distress compared to a wait-list control group among combat veterans with chronic PTSD, therapists' ratings of sleep disturbance according to a PTSD symptom checklist did not significantly change.

The extent to which insomnia diminishes following a general treatment for PTSD was investigated by Zayfert and DeViva[97] in order to determine the necessity of a specific insomnia treatment component for this population. In this study, the records of patients with PTSD and insomnia who completed CBT for PTSD, and afterwards no longer met criteria for PTSD, were reviewed. Treatment sessions consisted mainly of imaginal and in vivo exposure, cognitive restructuring, problem solving, and activity scheduling, while specific CBT for insomnia was not included. Results showed that although nightmares had decreased after completion of treatment, a considerable proportion (48%) of the sample still complained of significant insomnia. It therefore appears that a specific sleep treatment component is needed to effectively treat sleep difficulties among adults with PTSD complaining of insomnia.[97]

Limitations of general CBT for PTSD. General CBT treatments for PTSD have had some success at improving nightmares and sleep disturbances.[93] However, their success for treating insomnia-related symptoms is limited. It is postulated that the presence of sleep difficulties after a treatment of CBT for PTSD may be due to the lack of elements aimed at treating hyperarousal symptoms among this population, since CBT is mostly focused on treating the intrusion and avoidance symptoms.[97] In addition, some studies have noted that imaginal exposure, specifically, can lead to exacerbation of depression, relapse of alcoholism, self-harm, and precipitation of panic disorder.[98]

CBT for insomnia. Efficacy of CBT for improving insomnia is well documented.[99] Since some studies have found that the severity of insomnia is no different from that exhibited by individuals from the general population with insomnia,[25] the effects of a general treatment for insomnia on the sleep of individuals with PTSD have been examined. Cognitive-behavioral therapy for insomnia generally consists of (1) a behavioral treatment component, consisting of sleep restriction (reducing time spent in bed) and stimulus control (eliminating learned sleep-preventing associations); (2) a cognitive therapy component, consisting of education about cognitive factors in insomnia and an alteration of beliefs and attitudes about

sleep; and (3) an educational component, consisting of sleep hygiene principles.[89]

The benefits of CBT for insomnia among individuals with PTSD have been well noted. For example, Walker[100] found that, compared to a self-relaxation expectancy placebo group and a wait-list control group, sleep duration was increased and sleep onset latency was decreased among combat veterans who received CBT for insomnia that included progressive relaxation, stimulus control, and cognitive restructuring related to sleep. In a study by Owen,[101] the effects of CBT for insomnia (consisting of education about sleep, cognitive therapy related to maladaptive thinking with regards to sleep, sleep restriction, stimulus control, sleep hygiene, and relapse prevention) in combination with a standard 3-month inpatient treatment for PTSD for combat veterans (consisting of an active, directive approach to uncovering and working through inner conflict, grieving losses, developing alternative coping strategies, and restructuring maladaptive behavior patterns) resulted in greater improvements in sleep quality compared to a control group receiving standard treatment for PTSD only. Whereas sleep duration was the only component that improved for the control group, sleep quality, sleep duration, and sleep latency all improved for the treatment group. In addition, while improvements for the treatment group were nearly all maintained 3 months later, the control group did not sustain any improvements.

In a study by DeViva et al.,[102] the effects of a 5-session CBT for insomnia were examined among 5 women with PTSD who responded to CBT for PTSD but had residual insomnia. Results indicated that self-reported total sleep time, sleep onset latency, wake after sleep onset, and sleep efficiency, as well as sleep quality, impairment from sleep difficulty, and maladaptive sleep-related cognition, were improved after treatment was complete. However, some measure of sleep difficulties remained in the clinical range, perhaps due to the limited number of sessions or the small sample size, and a control group was not included in this study.[102] The authors suggest that although treatment for PTSD may help decrease symptoms, more work such as CBT for insomnia specifically may be required to improve sleep among these individuals. It is unknown at this point whether it is more effective for individuals to first engage in CBT treatment for PTSD followed by CBT treatment for insomnia, or if insomnia treatment should be introduced before or at the same time as PTSD treatment.

Limitations of CBT for insomnia. While general CBT for insomnia has been quite successful at improving insomnia-related symptoms among individuals with PTSD,[101] reductions in nightmare frequency are not often reported. For example, one of the participants in DeViva and colleagues'[102] study no longer met criteria for PTSD after a CBT for insomnia treatment was implemented, but continued to experience disturbing dreams. Since techniques aimed at specifically treating nightmares are not included in this treatment, individuals may still experience a high frequency of nightmares and fear, which may continue to contribute to sleep disruption. Since it is common for individuals with PTSD to experience both insomnia and nightmare, the generalizability and success of general treatments for PTSD and insomnia separately are therefore limited.

Imagery rehearsal for nightmares. Among the general population, nightmares have been successfully treated with imagery rehearsal therapy (IRT).[51] This technique teaches individuals that they can have control over their nightmares and can change them in any way wanted using imagery exercises and cognitive-behavioral tools.[39] The procedure consists of the following steps: writing down the recurring dream, changing it in any way desired, writing down the changed dream, and rehearsing the new dream using imagery for between 5–20 minutes per day.[39] Participants are generally encouraged to start with a nightmare of lesser intensity and, if possible, one that does not exactly replay the trauma.[36] This technique has been identified as an effective treatment for chronic nightmares among individuals with PTSD.[103]

Krakow et al.[39] examined the effects of IRT among a group of female sexual assault survivors suffering from nightmares and insomnia (95% had PTSD, 5% had mild posttraumatic symptoms). These women were randomly assigned to either an IRT group or a wait-list control group. Results indicated that IRT led to a substantial decrease in nightmares and PTSD symptoms, as well as an improvement in sleep, compared to the control group, and such effects were maintained at 6 months. Similar results were obtained by Krakow et al.,[51] who also implemented IRT in a group of female assault survivors with PTSD or posttraumatic stress symptoms who complained of insomnia and nightmares. In addition to the previous findings, this study found that IRT led to a 52% reduction in nights per week that nightmares occurred, relative to the control group.

Some participants even report using imagery rehearsal to deal with daytime distress.[39,104] This may indicate that the decrease in PTSD symptoms may not only be due directly to improvements in sleep but also perhaps to the application during the daytime of a technique learned for sleep, with IRT therefore indirectly serving as an intervention for trauma as well.

Limitations of imagery rehearsal for nightmares. Imagery rehearsal therapy has been found to be quite successful at reducing nightmare in individuals with PTSD,[39] in that nightmares are improved in 90% or more of individuals who use the technique.[102] However, some individuals may be intimidated by this technique[105] or report negative imagery.[36] This latter limitation could be addressed by encouraging individuals to first practice pleasant imagery and learn cognitive-behavioral tools for

dealing with unpleasant images that might emerge before learning to use IRT on a single self-selected nightmare, as was done by Krakow et al.[39] It is also important to note that this technique may be not work well with individuals with severe PTSD and other psychiatric disorders.[103] Again, improvements in insomnia symptoms may be lacking with this approach.

Combination of imagery rehearsal therapy for nightmares and CBT for insomnia. Some studies have looked at the effects of a combination of the different treatments described above. For example, Krakow et al.[104] found that IRT in combination with CBT for insomnia (including sleep hygiene, stimulus control, sleep restriction, and cognitive restructuring related to sleep) resulted in reductions of nightmare frequency, increased sleep quality, and a decrease in the severity of PTSD symptoms among crime victims. All changes in sleep quality scores were roughly equivalent to a change from severe to moderate sleep disturbance. However, the study lacked a control group.

Similarly, Krakow et al.[52] have recently developed a treatment called sleep dynamic therapy (SDT), which consists of a combination of components of CBT for insomnia (deconditioning of maladaptive learned behaviors and habits that promote sleep disturbance, stimulus control, sleep restriction, sleep hygiene principles), emotional processing, and IRT for chronic nightmares. In addition, individuals are encouraged to assess and manage their own sleep difficulties by comparing their sleep with that of normal sleepers in order to help them recognize the markers of poor sleep quality, and to learn to identify signs and symptoms of SDB or SMD. Results from a pilot study of SDT implemented in Cerro Grande fire evacuees complaining of insomnia or nightmares indicated that although a significant improvement occurred during the treatment period for insomnia, nightmares, and PTSD symptoms, further improvements were only modest at the follow-up period 12 weeks later. For sleep quality, total sleep time, and sleep efficiency, only small effects were noted following treatment. In addition, the lack of a control group does not permit firm conclusions to be drawn about the effectiveness of this treatment. It is speculated that such modest improvements at follow-up may be explained by the potential for persistent physiologic sleep disruption likely due to SDB.[52]

Limitations of the combination of imagery rehearsal therapy for nightmares and CBT for insomnia. Studies that combine both a treatment for nightmares such as IRT and a combination of techniques for insomnia, such as sleep hygiene, stimulus control, sleep restriction, and cognitive restructuring for beliefs and behaviors related to sleep habits, have been successful at improving both nightmares and insomnia.[104] However, despite such improvements, sleep difficulties are still present and sleep quality remains in the abnormal range, as found in the studies by Krakow et al.[39,104]

Nightmares as a Form of Exposure

Since some evidence indicates that imaginal exposure is effective at reducing sleep difficulties among patients with PTSD, the possibility that trauma-related nightmares can also serve as a form of therapeutic exposure has been investigated. However, research suggests that nightmares do not play the same role as imaginal exposure and do not help improve PTSD-related symptoms.[92] The terrified state that the individual awakes in and the short duration of the nightmare, which does not allow habituation to occur, as well as the perception that the dream is real, may prevent a therapeutic response from occurring among these individuals. In addition, a sense of control is not promoted with nightmares, and the perception and the meaning of the trauma are unlikely to be altered. It is more likely, in fact, that these nightmare exposures are actually serving to maintain some PTSD symptoms.[92]

Summary of Current Treatment Approaches

From the treatments currently available for reducing sleep-related difficulties among individuals with PTSD, it appears that CBT techniques are most successful and have fewer drawbacks. More specifically, a treatment that includes a combination of a treatment for nightmares and a treatment for insomnia seems to be most beneficial for these individuals, since both of the major sleep problems are targeted. Other sleep-related difficulties, such as the fear and hypervigilance surrounding nightmares, the sense of loss of control over sleep, and the maladaptive thinking patterns, that all contribute to an overall disturbed sleep are also addressed. The complexity of this disorder likely suggests that a generalized treatment does not exist and that the treatment should be tailored to each individual by combining different treatment components.[106]

RECOMMENDATION OF FUTURE TREATMENT APPROACHES

Assessing Sleep Disturbance Before Full Onset of PTSD

As mentioned previously, it has been found that individuals who experience sleep difficulties soon after a trauma are more likely to later develop PTSD and that such sleep difficulties may actually contribute to the development of PTSD.[3] For this reason, screening for sleep disturbances as soon as possible after the traumatic event could not only help identify those who would benefit from treatment aimed at preventing the development of PTSD,[107] but also potentially serve to identify those in need of a treatment specifically aimed at sleep, which in turn may help prevent the development of PTSD. Although further research is needed to identify exactly to what extent sleep difficulties can serve as identifiers for

the eventual development of PTSD, as well as whether some of these sleep abnormalities are more important predictors than others, the immediate treatment of detected sleep disturbance is recommended.

Screening for Sleep Disordered Breathing and Sleep Movement Disorder During Assessment Phase

Since it has been found that individuals with PTSD may have comorbid sleep movement and breathing disorders, and that these disorders may actually be the cause of sleeping difficulties for some individuals, it seems that screening for them during the assessment phase of treatment would be valuable.[108] Of course, it is not suggested that a sleep laboratory assessment be done with every patient with PTSD who is experiencing sleep difficulties, but screening questions aimed at ruling out such disorders should be included in the initial assessment phase. Trauma survivors with SDB tend to have worse symptoms of PTSD, depression, and anxiety compared to trauma survivors without SDB.[109] Krakow et al.[110] found that trauma survivors with SDB report more insomnia, nightmares, poor sleep quality, leg jerks, cognitive-affective symptoms, psychotropic medication usage, and more upper airway resistance syndrome compared to typical sleep clinic patients with SDB. It is therefore suggested that such features could potentially serve to help detect SDB among trauma survivors and should be used in the screening process.[110]

If signs indicate that such a disorder may be present, a more detailed assessment of the individual's sleep, such as a polysomnographic recording, could then be conducted. Such an assessment is important because it has been suggested that limited improvements of certain treatments for sleep difficulties in individuals with PTSD may be due to underlying SDB.[52] If a disorder is detected, a treatment aimed directly at resolving it (i.e., CPAP) could prove to be quite helpful. In addition, the use of less intrusive methods to treat a SDB, such as weight loss, reduction in alcohol consumption and smoking, and change in sleep positions (i.e., sleeping on one's side instead of back),[111] may prove to be beneficial.

Inclusion of Partner in Assessment and Treatment

If the patient has a partner, it may be quite helpful to get their feedback related to the trauma survivor's sleep.[5] This is something that is often ignored in treating sleep problems among these individuals. The partner may be able to provide valuable information not only about movement and breathing disorders, but also about insomnia symptoms and nightmare frequency and intensity. Including the partner at some point in the treatment plan may also be important. For example, if an individual with PTSD experiences recurring nightmares, strategies such as having the partner hold the individual in their arms after they have awakened from a nightmare (S. Johnson, Ed.D.; personal communication; October 4, 2004) could provide them with a sense of security and help decrease their level of anxiety, which may help them return to sleep.

Imagery Rehearsal Therapy for Mental Activity Before Sleep Onset/Relaxation/Positive Self-Talk

It appears, from the literature reviewed above, that an approach that combines IRT and a treatment for insomnia is one of the most successful treatments for sleep difficulties among individuals with PTSD. IRT addresses the recurring nightmares and fear related to those nightmares, whereas insomnia treatment addresses maladaptive habits and distorted cognitions related to sleep in general. If these individuals also experience recurring trauma-related or non–trauma-related images before sleep initiation, which could also contribute to sleep-related anxiety, an imagery rehearsal technique similar to that used for nightmares could potentially prove to be beneficial. It is therefore suggested that the use of IRT be extended to other mental activity occurring before sleep onset. In addition, since these individuals tend to have increased levels of anxiety and hyperarousal, especially at nighttime, it may be useful for them to learn techniques such as relaxation and positive self-talk, in order to help decrease anxiety before going to sleep and also during nighttime awakenings. Although progressive muscle relaxation is sometimes included as part of a general treatment for insomnia, it seems that it is not being used as often as it could.

Short Mid-Afternoon Nap

Studies have found that individuals with PTSD and sleep difficulties may also experience increased daytime sleepiness[112] compared to those without PTSD.[113] A decrease in daytime energy levels, due to disrupted sleep, may contribute to increased anxiety and other symptoms of distress.[23] Daytime sleepiness could also potentially contribute to the development or maintenance of other PTSD symptoms and hamper the processing of the trauma, which may interfere with the ability to progress during therapy.

A daytime nap can decrease sleepiness and fatigue and increase performance.[114,115] Naps as short as 10 to 15 minutes, and taken during the early to mid afternoon, can be efficient for reducing sleepiness and improving alertness.[116–121] Brooks and Lack[119] noted that, following mildly restricted nocturnal sleep, a shorter mid-afternoon nap of 10 minutes was more effective than naps of 20 and 30 minutes in length for reducing sleepiness and improving alertness over a period of 3 hours. In addition, a short mid-afternoon nap has very little impact on nocturnal sleep and can actually serve to enhance quality of sleep.[122] Therefore, the introduction of a mid-afternoon nap in individuals with PTSD could potentially help counteract their daytime sleepiness, help alleviate some of their PTSD symptoms, and even enhance sleep quality.

It should be noted that the suggestion of taking a nap goes against recommendations included as part of the general CBT treatment for insomnia. However, individuals with PTSD are suffering from much more than occasional sleep restriction and may have more to gain from daytime alertness and improved functioning than individuals suffering strictly from insomnia. In addition, it is known that many individuals with PTSD have a fear of going to sleep because they are afraid of reexperiencing the trauma through nightmares, especially if the traumatic event was experienced in a sleep-related context, such as with sexual abuse survivors.[123] They may therefore be more hypervigilant and less likely to fall asleep at this time. Sleep initiated during the day may be less threatening and fearful to these individuals than sleep initiated during the night. Napping may serve to break the association between sleeping and danger during the night and may help these individuals learn to fall asleep again without experiencing so much anxiety. The sense of mastery of sleep and feeling of relaxation with sleep that they may develop with napping could potentially eventually transfer to nighttime sleep. Since no research on napping among individuals with PTSD has been conducted to date, the above suggestion can only be based on speculation. Of course, there is the possibility that individuals with PTSD will not benefit from napping, that they are unable to nap during the day, or that they are unable to keep their nap to such a short duration. In addition, the possibility that napping further deteriorates nocturnal sleep among these individuals should also be considered.

A flowchart outlining the diagnostic tree that lists current and proposed treatment options for sleep disturbances after having experienced a traumatic event is presented in Figure 1. The recommended treatment options differ depending on whether the individual has developed PTSD as well as according to the specific presenting sleep problem (i.e., insomnia, nightmares, SDB).

FINAL CONSIDERATIONS

Given the limitations of these treatment approaches, as well as the lack of consistency of the studies in this area, it may be difficult to draw definite conclusions regarding the effectiveness of available treatment options. There is room for future research, with the most significant areas being outlined below.

Future Research Directions

Although most studies in this area included individuals with chronic PTSD, many studies fail to distinguish between the acute and chronic phases of PTSD. Since it has been found that, as the duration of PTSD increases, more factors such as comorbidity may be contributing to sleep difficulties,[53] it is possible that those with chronic PTSD respond differently to treatments than those with acute PTSD and that as such it may be more difficult to treat them. Future studies should perhaps therefore compare the differences in sleeping patterns and the responsiveness to different treatment options between those with acute and chronic PTSD.

Studies have examined the effectiveness of pharmacologic and psychological treatments individually. What seems to be lacking is research comparing these 2 types of treatment,[100] as well as research examining the benefits of combining them sequentially and concomitantly, such as has been done with insomniacs.[88,99,124–128] Overall, insomnia studies have demonstrated that although concurrent treatment of CBT and medication is effective in treating insomnia, it may not be more effective than each treatment separately.[88] Sequential treatment has also been found to be effective in treating insomnia, with CBT being necessary for improvement to occur, and response to treatment of each individual may depend on the sequence of treatment modality.[88] It is postulated that medication may help with general psychotherapy for PTSD by decreasing the intrusive symptoms and improving sleep disturbances.[129] However, the combination of pharmacotherapy and psychotherapy among individuals with PTSD and sleep difficulties has been understudied, and controlled studies examining its efficacy are largely lacking.[130] For now, it is recommended that if symptoms remain after initial therapy, whether it be pharmacotherapy or psychotherapy, the other treatment should be added.[130]

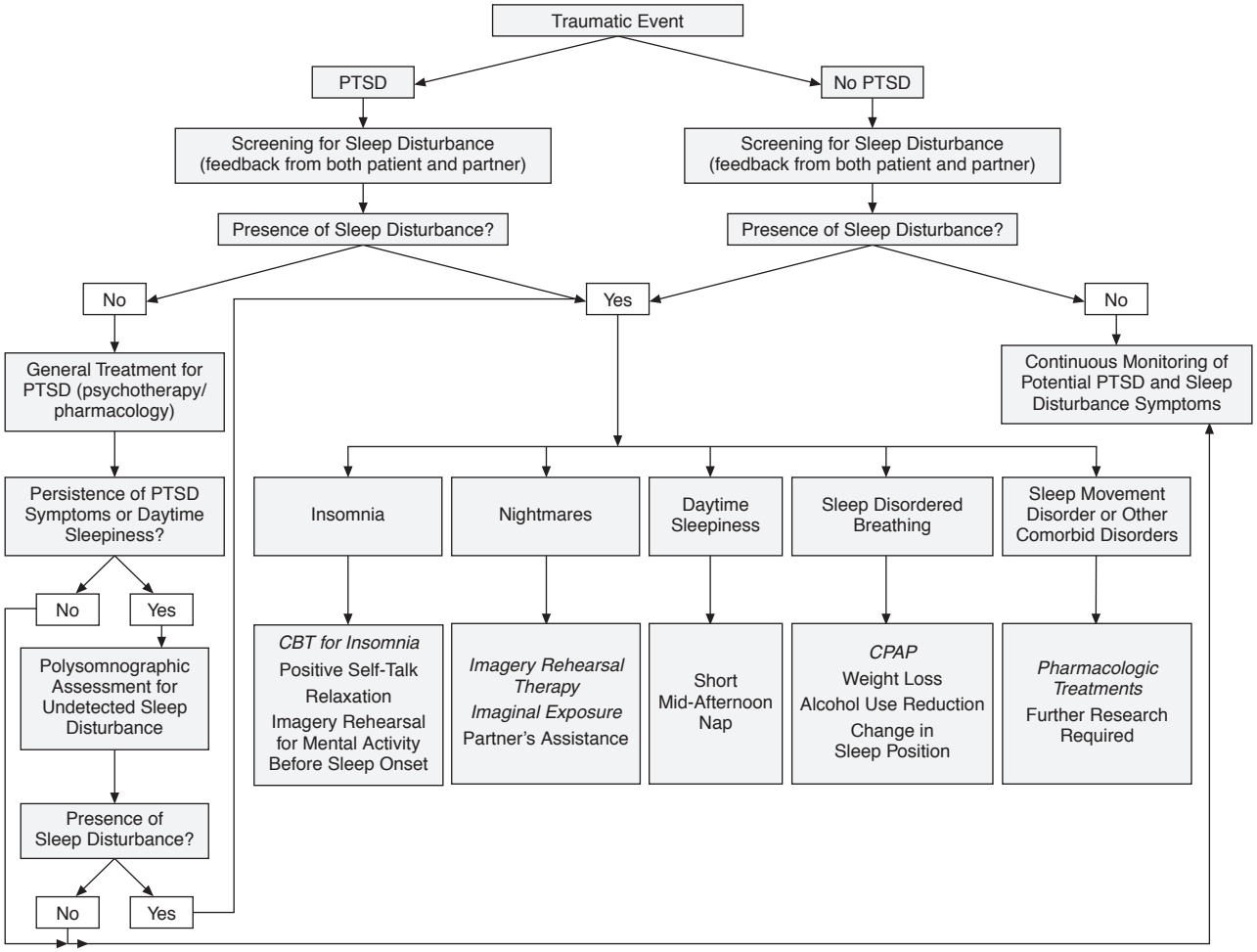
It would also be important to examine the effects of CBT for insomnia in combination with CBT treatment for PTSD. Selective studies have integrated CBT for insomnia with some elements of psychotherapy for PTSD.[52,101] However, the combination of the 2 programs in full remains to be explored. Given the potential benefits of both of these programs individually, including a program that consists of both of these components may address the limitations that arise when they are implemented on their own and further add to improvements in sleep difficulties among individuals with PTSD.

Practice Points

One factor that may affect results of the studies discussed is whether sleep difficulties are present before the trauma. This is a factor that is often ignored. Perhaps individuals who were already experiencing sleep difficulties before the traumatic event are those who are most susceptible to developing PTSD and experience exacerbated sleep difficulties. These individuals may therefore be more resistant to treatment because the problem is longer-standing.

One of the biggest sources of conflict among these studies is whether the individuals included suffer from any other disorders. The National Comorbidity Survey found that 88% of men and 79% of women with PTSD

Figure 1. Flowchart Outlining a Diagnostic Tree With Proposed Treatment Options for Sleep Disturbances After a Traumatic Event (current options shown in italics)



Abbreviations: CBT = cognitive-behavioral therapy, CPAP = continuous positive airway pressure, PTSD = posttraumatic stress disorder.

have at least 1 other psychiatric diagnosis.[131] Whether individuals with PTSD only exhibit sleep difficulties that are different from those experienced by individuals with other psychological disorders is a question that still needs to be fully addressed.[53] The effectiveness of treatments may therefore differ depending on whether individuals suffer solely from PTSD or also exhibit a range of other comorbid disorders.[91]

CONCLUSION

Although findings in the area of PTSD among adults have not been consistent, there is evidence that sleep difficulties are present among individuals with PTSD. Regardless of whether it is sleep difficulties that lead to the development of PTSD or PTSD that leads to sleep disturbances, a vicious cycle seems to be present among these individuals. Although the causes of sleep difficulties among these individuals are not yet clearly defined, certain hypotheses have led to the development of promising treatment options. In particular, CBT including a component for nightmares (IRT) and insomnia (general insomnia treatment) has been found to significantly improve sleep disturbance among these individuals. With the inclusion of other components, such as a screening for other sleep disorders, relaxation exercises, positive self-talk, IRT related to recurring images before bed, and a daytime nap, sleep-related symptoms may improve to a greater degree, which may then lead to a significant decrease in other PTSD symptoms and overall PTSD severity.

The inclusion of sleep medicine specialists should also be considered for sleep medicine treatment of individuals with PTSD. Collaboration between mental health professionals and sleep medicine specialists is therefore recommended for treatment of sleep-related difficulties among individuals with PTSD.[31]

Drug names: carbamazepine (Equetro, Carbatrol, and others), fluoxetine (Prozac and others), gabapentin (Neurontin and others), imipramine (Tofranil and others), phenelzine (Nardil), prazosin (Minipress and others), zolpidem (Ambien).

Disclosure of off-label usage: The authors have determined that, to the best of their knowledge, no investigational information about pharmaceutical agents that is outside U.S. Food and Drug Administration–approved labeling has been presented in this article.

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