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REVIEW ARTICLE

Sleep Terrors: An Updated Review

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Abstract: ***Background*:** Sleep terrors are common, frightening, but fortunately benign events. Familiarity with this condition is important so that an accurate diagnosis can be made.

***Objective*:** To familiarize physicians with the clinical manifestations, diagnosis, and management of children with sleep terrors.

***Methods*:** A PubMed search was completed in Clinical Queries using the key terms " sleep terrors" OR " night terrors". The search strategy included meta-analyses, randomized controlled trials, clinical trials, observational studies, and reviews. Only papers published in the English literature were included in this review. The information retrieved from the above search was used in the compilation of the present article.

***Results*:** It is estimated that sleep terrors occur in 1 to 6.5% of children 1 to 12 years of age. Sleep terrors typically occur in children between 4 and 12 years of age, with a peak between 5 and 7 years of age. The exact etiology is not known. Developmental, environmental, organic, psychological, and genetic factors have been identified as a potential cause of sleep terrors. Sleep terrors tend to occur within the first three hours of the major sleep episode, during arousal from stage three or four non-rapid eye movement (NREM) sleep. In a typical attack, the child awakens abruptly from sleep, sits upright in bed or jumps out of bed, screams in terror and intense fear, is panicky, and has a frightened expression. The child is confused and incoherent: verbalization is generally present but disorganized. Autonomic hyperactivity is manifested by tachycardia, tachypnea, diaphoresis, flushed face, dilated pupils, agitation, tremulousness, and increased muscle tone. The child is difficult to arouse and console and may express feelings of anxiety or doom. In the majority of cases, the patient does not awaken fully and settles back to quiet and deep sleep. There is retrograde amnesia for the attack the following morning. Attempts to interrupt a sleep terror episode should be avoided. As sleep deprivation can predispose to sleep terrors, it is important that the child has good sleep hygiene and an appropriate sleeping environment. Medical intervention is usually not necessary, but clonazepam may be considered on a short-term basis at bedtime if sleep terrors are frequent and severe or are associated with functional impairment, such as fatigue, daytime sleepiness, and distress. Anticipatory awakening, performed approximately half an hour before the child is most likely to experience a sleep terror episode, is often effective for the treatment of frequently occurring sleep terrors.

***Conclusion*:** Most children outgrow the disorder by late adolescence. In the majority of cases, there is no specific treatment other than reassurance and parental education. Underlying conditions, however, should be treated if possible and precipitating factors should be avoided.

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1. INTRODUCTION

Sleep terrors (also known as night terrors or pavor nocturnus) are characterized by episodes of extreme terror and panic associated with intense vocalization and motility, and high levels of autonomic discharge that occur suddenly out of sleep [1, 2]. The term "sleep terrors" is preferred to "night terrors" because the terrors may occur at any time during the 24-hour continuum when sleep occurs [3]. Sleep terrors are considered a disorder of impaired arousal [4].

A PubMed search was completed in Clinical Queries using the key terms "sleep terrors", OR "night terrors" OR

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"pavor nocturnus". The search strategy included meta-analyses, randomized controlled trials, clinical trials, observational studies, and reviews. Only papers published in the English literature were included in this review. The information retrieved from the above search was used in the compilation of the present article.

2. PHYSIOLOGY OF SLEEP

According to the International Classification of Sleep Disorders (ICSD-2), parasomnias are undesirable physical events or experiences that occur during entry into sleep, within sleep, or during arousals from sleep [5, 6]. The parasomnias of childhood are divided into those occurring in rapid eye movement (REM) and non-rapid eye movement (NREM) sleep. REM sleep is characterized by bilateral synchronous rapid eye movements, low voltage fast-activity brain waves, suppressed muscle tone, and increased heart rate and respiratory rate [7]. In contrast, NREM sleep is characterized by no rapid eye movement, tonic muscle activity, and regular heart rate and respiratory rate [7]. Sympathetic influence is high in REM sleep whereas parasympathetic influence is high in NREM sleep.

REM sleep is a very active state physiologically and mentally. Nightmares result from awakening during REM sleep, usually with good dream recalls [2]. NREM sleep is composed of four stages, during which there is a gradual and progressive increase in the depth of sleep [2]. Electroencephalogram (EEG) shows rapid, low-voltage, dyssynchronous alpha waves in stage one NREM sleep, sleep spindles and "K" complexes in stage two NREM sleep, and varying degrees of slow, high-voltage, rhythmic delta or theta wave activities in stage three and four NREM sleep [1, 2, 8-10]. Delta waves are prevalent in stage three sleep and predominant in stage four sleep [10]. After the onset of sleep, there is a gradual progression from stage one NREM sleep into stage four NREM sleep [11]. NREM sleep may last for 70 to 100 minutes. This deep sleep may be followed by a return to stage one NREM sleep and another course of drifting through the NREM stages in succession [12]. Having traversed NREM sleep once or twice, the sleeper then enters the first REM sleep of the night [11]. There are three to five sleep cycles during the night. Each episode of REM sleep lasts a progressively longer period of time. Accordingly, during the first part of the night more time is spent in NREM sleep, whereas during the last third of the night, REM sleep predominates. Sleep terrors, sleepwalking (somnambulism), and confusional arousals are disorders of arousal that typically occur when the child is in a transitional state in between stage three or four NREM sleep and wakefulness [4-6, 13-16]. As such, sleep terrors usually occur within one to three hours of sleep onset during the first third of the sleep, and almost always in the first half of the sleep [1, 2, 9, 18]. There is usually amnesia for the events. Respiratory and cardiac rates are regular and skeletal muscle activity is largely retained during NREM sleep [19].

3. PREVALENCE

Sleep terrors typically occur in children between 4 and 12 years of age, with a peak between 5 and 7 years of age [20-22]. It is estimated that sleep terrors occur in 1 to 6.5% of children 1 to 12 years of age, although a prevalence of 14% or higher has also been reported [5, 17, 21-28]. The wide variation in prevalence can be attributed to differences in definitions of a sleep terror, methodology, and studied population. The lifetime prevalence of sleep terrors has been estimated to be approximately 10% [9, 17, 23, 29]. The condition is uncommon after puberty [30, 31]. In the pediatric aged group, the condition is more common in boys than in girls [32]. In the adult population, both sexes are equally affected [32].

4. ETIOLOGY

The exact etiology is not known. Developmental, environmental, organic, psychological, and genetic factors have been identified as a potential cause of sleep terrors. Developmental (maturational) factors may play a role in the pathogenesis as many children outgrow sleep terrors [33, 34].

Sleep terrors occur with increased frequency in individuals with intercurrent febrile illness, a full bladder during sleep, noisy sleeping environment, excessive physical activity, fatigue, emotional stress, separation anxiety, frequent headaches, victims of bullying, sleep deprivation, anxiety, attention-deficit/hyperactivity disorder, autistic disorder, epilepsy, excessive caffeine or alcohol intake, obstructive sleep apnea syndrome, periodic limb movements, restless leg syndrome, and post-traumatic syndrome [35-47]. The above external or internal events may cause arousal usually from stage three or four NREM sleep and the occurrence of a sleep terror [48]. Sleep terrors may follow treatment with neuroleptics, sedatives/hypnotics, stimulants, clonidine, cocaine, opiates, and antihistamines as these medications have the potential to increase the amount of stage three and four sleep [5, 33, 49, 50]. Medical conditions such as nocturnal asthma and gastroesophageal reflux may precipitate sleep terrors [5, 14, 15, 51].

Psychological factors are not frequent in children with sleep terrors but are common in adults with this disorder [1, 2]. There is an association between psychiatric disorders and sleep terrors in youths and adults, but not in young children [21, 22, 25, 48, 52, 53]. Very rarely, a thalamic lesion, disrupting the arousal system, may provoke sleep terrors [54].

Sleep terrors may be familial and there is a strong genetic predisposition [4, 22, 51, 55]. A high prevalence of human leukocyte antigen (HLA) DQB1*04 and HLA DQB1*05:01 alleles have been demonstrated in patients with sleep terrors [29, 56, 57]. In one study, the HLA DQB1*05:01 allele was present in 29 (40.8%) of the 71 patients with NREM parasomnia compared to 24.2% in the regional-matched reference allele group ($p < 0.05$) [56]. This haplotype did not differ within the NREM parasomnia type. The prevalence of sleep terrors in first degree relatives of an affected individual is at least ten times greater than that in the general population [58]. In one study, there was a 60% risk of having sleep terrors if both parents were affected [58]. The condition is much more common in monozygotic versus dizygotic twins [32, 51, 59]. In a prospective study of 390 pairs of monozygotic and dizygotic twins recruited at birth, the prevalence of frequency of sleep terrors was assessed at 18 months and 30 months of age [51]. At 18 months, the polychoric correla-

tions were 0.63 for the monozygotic twins and 0.36 for the dizygotic twins. At 30 months, the polychoric correlations were 0.68 for the monozygotic twins and 0.24 for the dizygotic twins. In children, there is a strong correlation between sleep terrors and sleepwalking and sleep talking (somniloquy) [36, 41, 57, 58]. In one study, one-third of children who had sleep terrors developed sleepwalking later in childhood [42].

5. CLINICAL MANIFESTATIONS

Sleep terrors tend to occur within the first three hours of the major sleep episode, during arousal from stage three or four NREM sleep [52, 60]. Descriptively, sleep terrors consist of sudden awakening from quiescent sleep, usually in the first third of the sleep, during which the sleeper shows violent bodily activity and marked evidence of physiological activation [1, 2, 52]. In a typical attack, the child awakens abruptly from sleep, sits upright in bed or jumps out of bed, screams in terror and intense fear, is panicky, and has a frightened expression [14, 21]. Occasionally, the child may run frantically into furniture or walls in an apparent attempt to avoid harm or escape from an unseen danger, thereby injuring himself/herself [16, 19, 48]. The child is confused and incoherent: verbalization is generally present but disorganized [21, 22]. The speech is usually incomprehensive and monosyllabic [4]. Autonomic hyperactivity is manifested by tachycardia, tachypnea, diaphoresis, flushed face, dilated pupils, agitation, tremulousness, and increased muscle tone [5, 6, 8, 17, 22, 51, 57]. The child is sometimes noted to have a glassy stare [61]. The child is difficult to arouse and console and may express feelings of anxiety or doom [17, 18, 21, 24, 51]. Attempts to console the child may add to his state of panic and may prolong or intensify the episode [9]. A typical episode usually lasts no more than a few minutes, but may be protracted, lasting up to an hour [9, 18, 19, 21, 32]. Usually, only one episode of sleep terror will occur during a major sleep episode [2, 32, 52]. Occasionally, several episodes of sleep terrors may occur at intervals throughout a major sleep episode [32]. Sleep terrors rarely occur during naptime [32, 52]. If the child is successfully "awakened" at the termination, immediate dream recall is fragmentary, if present at all [2, 5, 6, 52]. The child may, however, describe a feeling of primitive threat or danger [9]. In the majority of cases, the patient does not awaken fully and will settle back to quiet and deep sleep [5, 6, 9, 19, 32]. There is retrograde amnesia for the attack the following morning [18, 21, 32].

6. CLINICAL EVALUATION

Evaluation of a patient with sleep terrors should begin with a description of the event by the parents which may help to distinguish sleep terror from other conditions. A thorough history may help to determine whether the disorder is due primarily to an underlying developmental, environmental, organic, psychological, or genetic factor. The age of onset, frequency of sleep terrors, daytime symptoms, numbers of hours of sleep per day, emotional stress, family history of sleep terrors or sleepwalking, intercurrent illness, past health, use of illicit drugs, and medication use should be sought. Underlying psychopathology should be considered in the presence of the following: onset of sleep terrors after 12 years of age, high frequency of episodes for a long period of time, negative family history of sleep terrors or sleepwalking, daytime symptoms that suggest a functional disorder, or occurrence of a major life stress event at the time of onset. A complete physical examination must be performed if sleep terrors are frequent, with particular emphasis on a comprehensive developmental and neurological evaluation.

7. DIAGNOSTIC CRITERIA AND DIAGNOSIS

According to the Diagnostic and Statistical Manual of Mental Disorders, 5th edition (DSM-5), sleep terrors are recurrent episodes of partial, abrupt awakening from deep (NREM) sleep, usually during the first third of the major sleep episode, accompanied by panicky/inconsolable screaming, intense fear, relative unresponsiveness, and signs of autonomic arousal such as tachycardia, tachypnea, diaphoresis, and dilated pupil during each episode [32]. Other features include little or no recall of dreams, retrograde amnesia of the episode, and significant distress or impairment in social, academic, or other areas of functioning [32]. The episode cannot be explained by another mental or psychological disorder or accounted for by the use of illicit drugs of abuse or medication [32].

The diagnosis of sleep terror is mainly clinical and is based on a careful history taking which helps to establish the correct diagnosis and to distinguish sleep terror from other disorders such as nightmare, confusional arousal, and nocturnal frontal lobe epilepsy [9]. A videotape of a typical event recorded by parents can be very helpful to the physician. A sleep diary is a useful tool. A complete physical examination should be done to look for developmental and neurological abnormalities. Routine laboratory testing is neither cost-effective nor necessary [9]. Video-polysomnography should be considered if sleep terrors are atypical or unusual in terms of age of onset, duration, or specific behavior. Video-polysomnography should also be considered if night terrors occur more than 2 times a week, if the episodes are potentially originating from epileptogenic activity, or if a prior evaluation has been inconclusive [62].

8. DIFFERENTIAL DIAGNOSIS

Sleep terrors have often been confused with nightmares. In contrast to sleep terrors, nightmares are accompanied by much less anxiety, vocalization, motility, and autonomic discharge [63]. In addition, a child with nightmares is more easily and completely aroused [63]. On awakening, the child is fully alert and can recall details of the nightmare [28, 63]. Most sleep terrors occur in the first two to three hours of sleep and arise out of stages three and four of NREM sleep. In contrast, nightmares are related to REM sleep and usually occur in the middle of the night or early hours in the morning [63, 64]. The family history is frequently positive in patients with sleep terrors although it may also be positive in patients with nightmares. The distinction can, occasionally, be difficult as nightmares and sleep terrors may coexist. Also, the occasional vivid recall from a sleep terror episode may be misconstrued as a vivid story-like recall from a nightmare [63].

Confusional arousals (also known as sleep drunkenness, morning sleep inertia, or Elpenor syndrome) are NREM

sleep parasomnias that may simulate sleep terrors as both conditions are characterized by retrograde amnesia for the event [17, 33]. During a typical episode of confusional arousal, the child wakes up, sits up in bed in a disorientated state, cries, whimpers, moans, mumbles, appears distressed and confused, and may be inconsolable [8, 15, 16, 57]. Ambulation, stereotypic motor behavior, screaming, agitation, fear, sweating, and flushing of the face are characteristically absent [5, 6, 8, 33]. The episode is usually less than 10 minutes long [14, 16]. Prolonged episodes usually occur in the setting of poly-neuropharmacy, particularly sedative hypnotics [65].

It is important to differentiate sleep terrors from terrors that one might experience in the night. Some children may feel terror in the night and they may experience fear even when they close the eyes [1, 2]. Terrors at nighttime may also result from "sensory shock" or sleep paralysis [1, 2]. Sensory shocks may take the form of a sudden, unformed flash of light, or an electric surge passing through the body, a bang or feeling of explosion in the head, often with a bodily jerk and brief arousal [1, 2]. Sleep paralysis presents with transient inability to make voluntary movement and speak despite an intense desire to escape from unpleasant dream events [17]. Although the individual may feel as if he/she is unable to breathe, respiration is unaffected [48]. Each episode of sleep paralysis lasts for a few seconds to minutes [48]. Recurrent sleep paralysis is often associated with narcolepsy and other neuropsychiatric disorders [8, 19, 48]. Individuals with nocturnal panic typically awaken from sleep in a state of fear and panic without an obvious trigger [66]. Motor and autonomic activities typical of sleep terrors, confusion, and amnesia are characteristically absent [32]. Most individuals with nocturnal panic experience panic attacks during the day as well [66].

Sleep terrors also need to be differentiated from nocturnal seizures [67]. Both sleep terrors and nocturnal seizures may present with confused behavior, disorganized bodily movement, vocalization, staring, and unresponsiveness [8, 14, 67]. With nocturnal seizures, the patient would at no point in time sit, stand, or walk. In addition, seizures tend to be stereotypic in nature and may occur randomly through the sleep and during the day [14, 32, 33]. Nocturnal frontal lobe epilepsy deserves a special mention. Nocturnal frontal lobe epilepsy is a focal epilepsy characterized by frontal lobe seizures with more than 90% of seizures arising from sleep [68]. Clinical manifestations include vocalization, dystonic posturing, repetitive movements of arms and legs, kicking, pelvic thrusting, and sometimes ambulation (walking or running) [68, 69]. The seizures are often less than 30 seconds in duration and rarely last longer than two minutes [68,70]. They can occur at any time of the sleep but are more common soon after falling asleep or just before waking [68,70]. The seizures frequently occur many times per sleep episode and the onset can occur at any lifetime [68].

Gastroesophageal reflux disease may present with episodes of abrupt arousal from sleep, irritability, excessive crying, opisthotonus, and torticollis [71]. Children with gastroesophageal reflux disease also have symptoms during the day which help to differentiate the condition from sleep terrors.

Sleep terrors should also be differentiated from hysterical dissociative phenomena such as amnesia, fugue states, and multiple personalities. In the latter condition, the patient often shows complex and purposeful behaviors.

9. COMPLICATION

In the majority of cases, sleep terrors alone do not cause injuries [57]. Occasionally, individuals with sleep terrors may walk, or run during the attacks. Thus, bodily injury and property damage are possible [5, 6]. Sleep terrors can cause sleep disruption and can cause significant parental anxiety [57, 72]. Individuals with sleep terrors are at risk for daytime sleepiness, fatigue, anxiety, and depression [32, 73, 74]. It has been shown that migraine in the adolescent population is strongly associated with a history of sleep terrors, possibly because of a common underlying disturbance in serotonin level [5, 75].

10. MANAGEMENT

For sporadic sleep terrors, reassurance that the child will outgrow the disorder will often allay parental anxiety [11, 17, 22, 25]. Parental education and support cannot be overemphasized. Otherwise, no medical intervention is required [76]. Attempts to interrupt a sleep terror episode should be avoided as such intervention may confuse and frighten the child even more and can lead to paradoxical increase in aggression [33, 61, 76]. Underlying conditions should be treated if possible and precipitating factors should be avoided. As sleep deprivation can predispose to sleep terrors, it is important that the child has good sleep hygiene and an appropriate sleeping environment [28]. The American Academy of Sleep Medicine recommends infants 4 months to 12 months, children 1 to 2 years of age, children 3 to 5 years of age, children 6 to 12 years of age, and teenagers 13 to 18 years of age to have 12 to 16 hours, 11 to 14 hours, 10 to 13 hours, 9 to 12 hours, and 8 to 10 hours, respectively, of sleep per 24 hours on a regular basis to promote optimal health in children and adolescents [77].

Caffeine-containing beverages should be avoided as caffeine may keep the child awake and decrease sleep efficiency [5, 6]. Likewise, medications that can trigger sleep terrors should be avoided. Clearly, if there is unreasonable and avoidable stress on the child, this should be reduced as a general measure [11]. Consideration should be given to factors that may disturb sleep or half awaken the child, such as discomfort of a distended bladder, pets jumping on the child's bed, and environmental sounds. Objects in the surrounding area that could potentially harm the patient should be removed [28]. Safety precautions are recommended [78].

Clonazepam, a benzodiazepine that can markedly suppress stages three and four NREM sleep, may be tried on a short-term basis at bedtime if sleep terrors are frequent and severe or are associated with a functional impairment, such as fatigue, daytime sleepiness, and distress [4-6, 16, 17, 57, 78, 79]. The medication should be given at least 90 minutes before the child goes to sleep to achieve an effective drug level in the early hours of sleep when sleep terrors predominate [5,6]. With improvement or resolution of the sleep terrors, clonazepam should be slowly tapered because abrupt discontinuation may result in slow-wave sleep rebound and

recurrence of sleep terrors [22]. Melatonin (N-acetyl-5-methoxytryptamine) has also been found to be useful [17, 76, 80-82]. Tricyclic antidepressants (such as imipramine, amitriptyline), selective serotonin reuptake inhibitors (such as paroxetine, fluoxetine), mirtazapine, and ramelteon have also been used for the treatment of sleep terrors with varying success [25, 57, 65, 83-88]. Anticipatory awakening, performed approximately half an hour before the child is most likely to experience a sleep terror episode, is often effective for the treatment of frequently occurring sleep terrors [9, 22, 42, 57, 65, 76]. Psychotherapeutic intervention is indicated if an underlying psychopathology is suspected.

11. PROGNOSIS

Most children outgrow the disorder by late adolescence, if not sooner, particularly if it has an onset in early childhood [9, 31]. On the other hand, if the onset occurs at puberty or later, the disorder may persist into adulthood.

CONCLUSION

Sleep terrors are a common childhood parasomnia characterized by episodes of extreme terror and panic that occur suddenly out of NREM, slow-wave sleep. Typically, the child has no recollection of the event ever happening. In the majority of cases, there is no specific treatment other than reassurance and parental education. The prognosis is good and most children outgrow the condition by adolescence.

CONSENT FOR PUBLICATION

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CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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