Sleep, Violence, and Forensic Implications

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Michel A. Cramer Bornemann and Carlos H. Schenck

Introduction

Increasingly, sleep medicine practitioners are asked to render formal opinions in a court of law regarding criminal allegations pertaining to violent or injurious behaviors arising from the sleep period. Automatic behaviors (automatisms) resulting in acts that may result in illegal behaviors have been described in many different conditions. Those automatisms arising from wakefulness are reasonably well understood. Recent advances in sleep medicine have made it apparent that some complex behaviors, occasionally resulting in forensic science implications, are exquisitely state dependent, meaning that they occur exclusively, or predominately, during the sleep period.

Case Examples

Two sleep forensics court cases involving sexual assault, one resulting in acquittal and the other resulting in a guilty verdict, will now be presented.

Acts done by a person asleep cannot be criminal, there being no consciousness [1].

M.A. Cramer Bornemann (✉)
Sleep Forensics Associates, Twin Cities, Minnesota, USA
e-mail: michel9626@yahoo.com

M.A. Cramer Bornemann
Sleep Medicine Services, Olmsted Medical Center, Rochester, Minnesota, USA

C.H. Schenck
Department of Psychiatry, University of Minnesota School of Medicine, Twin Cities, Minnesota, USA
e-mail: schen010@umn.edu

C.H. Schenck
Minnesota Regional Sleep Disorders Center, Hennepin County Medical Center, Minneapolis, Minnesota, USA

Case 1

As reported by The Copenhagen Post and Associated Press on April 10, 2013, Danish legal history was made on that date when a sexual assault charge (i.e., molestation form of rape) for the first time resulted in acquittal by use of the "Sexsomnia Defense"—which is in regard to a NREM Parasomnia formally referred to as Sleep-related Abnormal Sexual Behavior. The Glostrup District Court cleared a 32-year-old man of "sex crime charges." Two years previously, in 2011, the man had fondled two 17-year-old females while they were sleeping in his suburban Copenhagen apartment after a party in 2011. (This raises the question about any use, and extent of any use, of alcohol by the accused during the party.) The girls awoke and stopped the man, and later reported him to police. The defendant said he had no recollection of what happened, as he claims to have been asleep.

"It is the first time that someone has been acquitted under these circumstances in Denmark," the man's lawyer, Andro Vrlic, stated. "The defendant had always claimed that he was asleep when the incident took place, but he was charged by police who did not believe his explanation."

> According to his explanation, he did not know that there was anything wrong with him," the prosecutor, Martin von Bülow, told Ekstra Bladet. "But when former girlfriends told him that they had experienced something similar while he slept, he sought out a sleep specialist [who tested him].

The man was subsequently studied in a sleep laboratory, and the conclusions were pronounced in court during the trial to support the diagnosis of Sleep-related Abnormal Sexual Behavior—but the details of the sleep laboratory findings were not disclosed to the public and were sealed in the court records. However, an expert for the defense testified in regard to the sleep laboratory findings: "It's not something that can be faked."

Von Bülow added that the testimony from the girls supported the man's claim that he was asleep when he touched one and made sexual motions against the other. He added

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that given that the man's defense was supported both by the victims and by experts in court, he was not surprised by the acquittal.

One of the authors of this chapter (CHS) was interviewed by a Danish journalist, Nola Grace Gaardmand, shortly after the court ruling, who then published two related articles about this case (**see Add Reference Addendum** [103, 104]). Ms. Gaardmand provided more details about the case after interviewing the defendant's attorney.

The accused previously had dated the older sister of one of the 17-year-old girls, and after they terminated their relationship subsequently remained close friends over the years. Furthermore, the man and the younger sister were "kind-of like family, like an older brother–younger sister relationship," the lawyer explained. She had just moved to Copenhagen and was staying in a guest-room at his apartment until she found her own place; on the night of the assault, she happened to have a girlfriend stay over with her for that night. They slept together in a separate bedroom from the accused. According to the girls' lawyer, there were no lingering ill sentiments among any of them (the two girls, and the older sister [ex-girlfriend of the accused]) after the sexual assault and trial, and the man and the older sister (i.e., the man's ex-girlfriend) apparently have remained good friends.

Comments: The court testimony of previous recurrent episodes of Sleep-related Abnormal Sexual Behavior provided by the former girlfriend of the accused, with whom he had remained friends for years, considering themselves as "family" together with the younger sister of the former girlfriend (and sexual assault victim), was strong supportive evidence presented in favor of the "Sexsomnia Defense." The sleep laboratory evaluation reportedly provided additional strong support to sustain the argument in favor of the "Sexsomnia Defense," as acknowledged by the presiding judge. However, since details of this testing were not made available to the public, it remains indeterminate whether this was a legitimate, science-based finding that would be critically upheld after peer review consensus among experts in the fields of sleep medicine and sleep forensics. Finally, in regard to the party held at the apartment of the accused on the night of the sexual assault, the possible use, and extent of any use, any possible role of alcohol consumption in the sexual assault remains indeterminate. This could possibly have been a troublesome, confounding factor, which may contaminate the case and has been addressed carefully in the peer-reviewed literature (**see Add Reference Addendum** [104, 105]).

Case 2

This pertains to a court case in rural western Norway involving a 42-year-old married man, with acknowledged marital problems, who sexually assaulted a 12-year-old girl who was spending the night with his 12-year-old daughter at the family home. (The sleep medicine expert Stale Pallesen, PhD, from Bergen, Norway, informally consulted with one of the authors of this chapter [CHS] prior to rendering his opinion in court.) On the night in question, the accused and his wife drove from their home at 8 PM to visit friends, but did not consume any alcohol. They returned home at 12:30 AM. The accused had previously sustained significant physical injuries, and regularly struggled with persistent pain, for which he was prescribed codeine, paracetamol, and gabapentin, which he took nightly for the week leading up to the sexual assault. On the night of the assault, he also took some methotrimeprazine.

His wife then went to bed and fell asleep in their second floor bedroom; she had left the bedroom window open, creating a chill that the accused found uncomfortable in tandem with his pain. He decided to sleep on a couch on the first floor, as he subsequently claimed. He fell asleep in approximately 30 min. At 3 AM, he gradually awakened and found himself in a separate room, lying on the same mattress as the 12-year-old girl who was visiting his daughter. He was lying behind her with an erect penis pressed against her. According to her court statement, he tried to pry his hands between her thighs, which she attempted to keep tightly together. However, she believed that his fingers might have penetrated between her vaginal labia. She estimated that the incident lasted approximately 15 min, and she was too frightened to scream. Her friend (daughter of the accused) was sleeping 3 ft. away in her own bed—but she suffered from deafness. After the victim repeatedly tried to pull away, the assault suddenly ceased. The man looked at the girl, and believed she was asleep, and so he decided that "no good would come of it" were he to subsequently report what had transpired. He then went to the kitchen to drink some water, noticed the time of 3:15 AM, and then went to join his wife in their bed on the second floor. He slept until 10–11 AM.

The following day the girl told her parents about the incident, and the police was notified. At trial, he was eventually convicted of sexual assault, a decision which was then appealed whereby Dr. Stale Pallesen then consequently became involved as a court expert (not an expert hired by either the Defense or the Prosecution, a highly desired impartial forensic expert role that is not often available in the USA).

Although the patient and his wife subsequently were divorced, she testified that he had engaged in sexualized behaviors which apparently arose from sleep with her about 1–2 nights weekly during their 15-year marriage. However, the sexual behavior was limited to fondling and never penile penetration. She would typically push him away, which would immediately abort the "sexsomnia" episode. He had

previously been married and his first wife never recalled any such sexualized behavior in the midst of sleep on his part.

The accused had infrequent episodes of sleepwalking during childhood, including a cousin (with whom he shared a bedroom) who had observed at least one such episode. However, there had been no reported sleepwalking during adolescence or that which persisted into adulthood.

The accused lost his appeal, and his conviction was upheld. The role of the sleep forensics expert (as with all forensic experts in Norway) was to determine whether there was a greater or lesser probability than 50 % that the accused had engaged in the behavior for which he was claiming as his defense. In this case, the sleep medicine expert (Dr. Pallesen), after his informal consultation with one of the authors (CHS), gave the opinion of less than 50 % probability that a Sleep-related Abnormal Sexual Behavior had occurred, mainly for three reasons: first, the accused had not engaged in sleepwalking since childhood; second, the accused sought out his victim, which is quite rare in sleepwalking; (**see Add Reference Addendum** [107]) and third, in the preponderance of published cases on Sleep-related Abnormal Sexual Behavior, the sexual behaviors during sleep occurred in the context of confusional arousals with the individual remaining in bed, and in only a small percent of cases did sleepwalking proceed to culminate in a Sleep-related Abnormal Sexual Behavior (**see Add Reference Addendum** [108]).

Neurophysiology of Sleep-Related Violence

The State-Dependent Nature of Violence

The concept that sleep is simply the passive absence of wakefulness is no longer tenable. Not only is sleep an active rather than passive process; it is now clear that sleep comprises two completely different states: non-rapid eye movement (NREM) sleep and rapid eye movement (REM) sleep. Therefore, our lives are spent in three entirely different states of being: wakefulness, REM sleep, and NREM sleep. Studies have indicated that bizarre behavioral syndromes can occur as a result of the incomplete declaration or rapid oscillation of these states [2, 3]. Although the automatic behaviors of some "mixed states" are relatively benign (i.e., shoplifting in narcolepsy) [4], others may be associated with violent behaviors.

The fact that violent or injurious behaviors may arise in the absence of conscious wakefulness and without conscious awareness raises the crucial question of how such complex behavior can occur. Examination of extensive animal experimental studies provides preliminary answers. The widely held concept that the brain stem and other more "primitive" neural structures primarily participate in elemental/vegetative rather than behavioral activities is inaccurate. There are overwhelming data documenting that extremely complex emotional and motor behaviors can originate from these more primitive structures—without involvement of "higher" neural structures such as the prefrontal cortex [5–11].

Sleep-Related Disorders Associated with Violence

Violent sleep-related behaviors have been reviewed in the context of automatized behavior in general. There are well-documented cases of (1) somnambulistic homicide, attempted homicide, and suicide; (2) murders and other crimes with sleep drunkenness (confusional arousals); and (3) sleep terrors/sleepwalking with potential violence/injury. A wide variety of disorders may result in sleep-related violence [12, 13]. Conditions associated with sleep period-related violence are listed in Table 54.1. These conveniently fall into two major categories: neurologic and psychiatric.

Neurologic Conditions Associated with Violent Behaviors

Extrapolating from animal data to the human condition, it has been shown that structural lesions at multiple levels of the nervous system may result in wakeful violence [14–17]. The animal studies provide insights into violent behaviors in the disorders of arousal, REM sleep behavior disorder (RBD), and sleep-related seizures.

Disorders of Arousal (Confusional Arousals, Sleepwalking, Sleep Terrors)

The disorders of arousal comprise a spectrum ranging from confusional arousals (sleep drunkenness) to sleepwalking to sleep terrors [18]. Although there is usually amnesia for the event, vivid dream-like mentation may be experienced and reported [19]. Contrary to popular opinion, these disorders may actually begin in adulthood and are most often *not* associated with psychopathology [19]. The commonly held belief that sleepwalking and sleep terrors are always benign is erroneous: The accompanying behaviors may be violent, resulting in considerable injury to the individual or others, or damage to the environment.

Febrile illness, prior sleep deprivation, emotional stress, and the inadvertent interaction from those who may be sleeping in close proximity may serve to trigger disorders of arousal in susceptible individuals [20–22]. Sleep deprivation is well known to result in confusion, disorientation, and hallucinatory phenomena [23]. Medications such as

Table 54.1 Conditions associated with sleep-related violent behavior

Neurologic sleep disorders
• Disorders of arousal (confusional arousals [sleep drunkenness], sleepwalking, sleep terrors)[a]
– REM sleep behavior disorder[a]
– Nocturnal seizures[a]
– Automatic behavior
i Narcolepsy and idiopathic hypersomnia
ii Sleep apnea
iii Sleep deprivation (including jetlag)
Psychiatric sleep disorders
• Psychogenic dissociative states (may arise exclusively from sleep)
– Fugues
– Multiple personality disorder
– Psychogenic amnesia
• Malingering
• Munchausen syndrome by proxy

[a]Obstructive sleep apnea may mimic or trigger these episodes

sedative-hypnotics, neuroleptics, minor tranquilizers, stimulants, and antihistamines, often in combination with each other or with alcohol, may also play a role [18].

Confusional arousals (also termed *sleep drunkenness*) occur during the transition between sleep and wakefulness and represent a disturbance of cognition and attention despite the motor behavior of wakefulness, resulting in complex behavior without conscious awareness [24–26]. These may be potentiated by prior sleep deprivation or the ingestion of sedative-hypnotics before sleep onset [27]. These episodes of "automatic behavior" occur in the setting of chronic sleep deprivation or other conditions associated with state admixture. Examples of such behaviors cover a broad spectrum including sleep eating, sleep driving, and sleep texting, to cite but a few. In one unusual case, even shoplifting has been reported during a period of automatic behavior in an individual with narcolepsy [4, 28, 29] (**see Add Reference Addendum** [109]).

Numerous associations exist between obstructive sleep apnea (OSA) and confusional arousals. Patients suffering from OSA may experience frequent arousals that may serve to trigger arousal-induced precipitous motor activity [30]. Therefore, the observed clinical behavior—a confusional arousal—is actually the result of another underlying primary sleep disorder, OSA. Guilleminault and Silvestri have made the following observations [30]:

It is well known that adult patients with OSA syndrome may engage in nocturnal wandering during sleep. These patients frequently demonstrate yelling and screaming during sleep, as well as confusion, disorientation, and sleepwalking. The nocturnal hypoxia and the repetitive sleep disruptions secondary to the OSA syndrome readily explain these symptoms.

This is another example of why overnight polysomnographic (PSG) studies with extensive physiologic monitoring are mandatory in the evaluation of problematic motor parasomnias. Disorders of arousal may also be precipitated by inadequate or incomplete treatment of sleep apnea with nasal continuous positive airway pressure [31, 32].

To remind us that apparently criminal acts without conscious awareness occurring during sleep drunkenness (formerly termed *somnolentia*) are not a recently described condition, dramatic cases were described in a classic book on sleep well over a century ago. The author's conclusion regarding sleep drunkenness was: "It is a natural phenomenon, to which all are liable" [33]. Treatment of the disorders of arousal includes both pharmacologic (benzodiazepines and tricyclic antidepressants) and behavioral (hypnosis) approaches [34].

The behavioral similarities between documented sleepwalking and sleep terrors violence in humans and "sham rage," as exhibited in the "hypothalamic savage" syndrome, are striking [35]. Although it has been assumed that the "sham rage" animal preparations are "awake," there is some suggestion that similar preparations are behaviorally awake and yet (partially) physiologically asleep, with apparent "hallucinatory" behavior possibly representing cross interference of REM sleep dream mentation into wakefulness, dissociated from other REM state markers [36].

The neural bases of aggression and rage in the cat have been reviewed, indicating that there is clearly an anatomic basis for some forms of violent behavior [37]. The prosencephalic system may serve to control and promulgate, rather than initiate, behaviors originating from deeper structures [10]. In humans, during confusional arousals (sleep drunkenness), which can result in confusion or aggression, there is clear electroencephalographic (EEG) evidence of rapid oscillations between wakefulness and sleep [26, 38]. It may be that such behaviors occurring in states other than wakefulness are the expression of motor/affective activity generated by lower structures—unmonitored and unmodified by the cortex. As sleep is a very active process coupled with the generators or effectors of many components of both REM and NREM sleep that reside in the brain stem and other

"lower" centers, it is not surprising that, during sleep, prominent motoric and affective behaviors do occur given the close neuroanatomic real estate in which these reside.

Some very dramatic cases have been tried in a court of law to utilize confusional arousals as an explanation for an alleged criminal offense. This avenue for potential acquittal has been popularly referred to as the "Sleepwalking Defense." In one, the "Parks" case in Canada, the defendant drove alone 23 km across town, entered the home of his in-laws, killed his mother-in-law, and attempted to kill his father-in-law. Somnambulism was the legal defense, and he was acquitted [39]. In another, the "Butler, PA" case, a confusional arousal attributed to underlying OSA was offered as a criminal defense for a man who fatally shot his wife during his usual sleeping hours. He was found guilty [40]. In a highly publicized homicide case out of Phoenix, Arizona, a man stabbed his wife 44 times then left her body in the backyard pool. This case was particularly curious as both the prosecution and the defense were each able to secure the services of well-respected notable sleep medicine experts that offered sharply contrasting opposing opinions. He was found guilty of 1st Degree Murder and continues to serve his life sentence in prison without chance for parole [41].

Inappropriate sexual behaviors during the sleep state, presumably the results of an admixture of wakefulness and sleep, have been well described [42–51]. The "*Sleepwalking Defense*" has been well-received by defense attorneys and has been successfully applied in the USA in cases of purported "*Sexsomnia*" resulting in a complete acquittal, as in *State of Oregon v. James Kirchner* (**see Add Reference Addendum** [110]). Cramer Bornemann presented at SLEEP 2014 (the annual meeting of the Affiliated Professional Sleep Societies) in Minneapolis, Minnesota that over 33 % of the more than 260 forensics cases submitted between 2006 and 2013 for formal medico-legal review to a sleep forensics consulting consortium were associated with charges of sexual assault for which a Sleep-related Abnormal Sexual Behavior was considered (**see Add Reference Addendum** [111]). Furthermore, recurrent sexually oriented hypnagogic hallucinations experienced by patients with narcolepsy may be so vivid and convincing to the victim that they may serve as false accusations [52]. Despite the broad clinical acceptance of this condition and some success in the court of law, many in the legal community remain skeptical over the legitimacy of "Sexsomnia" as demonstrated by a recent update put forth by the National Center for the Prosecution of Child Abuse entitled "*Overcoming the Sleep Disorder Defense*" (**see Add Reference Addendum** [112]).

Sleep talking has also been addressed by the legal system; it is interesting to ponder whether utterances made during sleep are admissible in court [53].

Specific incidents of violence associated with disorders of arousal include [13]

1. Somnambulistic homicide and attempted homicide
2. Murders and other crimes during sleep drunkenness, including sleep apnea and narcolepsy
3. Suicide or suicide attempts [54, 55]
4. Violence/injury during sleep terrors or sleepwalking; these episodes may be drug-induced.

Violent sleep behaviors may result in post-traumatic stress disorder in the spouse or bed partner [56].

Other, very important factors beyond the scope of this chapter include (1) the known effect of genetics on violence and (2) the well-demonstrated effects of environmental and social factors upon the structure and function of the nervous system [57]. (In one study of 31 individuals awaiting trial or sentencing for murder, none was neurologically or psychiatrically normal [15].) The plasticity of the nervous system is greater than previously thought [58, 59]. These factors are undoubtedly operant in both wakeful and sleep-related violence.

REM Sleep Behavior Disorder

RBD represents an experiment of nature, predicted in 1965 by animal experiments [60] and more recently identified in humans [61]. Normally, during REM sleep, there is active paralysis of all somatic muscles (sparing the diaphragm and eye movement muscles). In RBD, there is the absence of REM sleep atonia, which permits the "acting out" of dreams, often with dramatic and violent or injurious behaviors. The oneiric (dream) behavior demonstrated by cats with bilateral peri-locus coeruleus lesions and by humans with spontaneously occurring RBD clearly arises from and continues to occur *during* REM sleep. These oneiric behaviors displayed by patients with RBD are often misdiagnosed as manifestations of a seizure or psychiatric disorder. Longitudinal research studies tracking RBD have revealed a compelling association between this condition and the eventual development of any of a number of chronic neurodegenerative disorders, most notably the synucleinopathies (Parkinson's disease, multiple system atrophy (Shy-Drager syndrome), and dementia with Lewy body disease). RBD may be the first manifestation of these conditions and may precede any other manifestation of the underlying neurodegenerative process by more than 10 years [62, 144] (**see Add Reference Addendum** [113, 114]). The overwhelming male predominance (90 %) of RBD raises interesting questions about the relationship of sexual hormones to aggression and violence [63, 64]. The violent and injurious nature of RBD behaviors has been extensively reviewed

elsewhere [62]. Treatment with clonazepam is highly effective [62].

As with the disorders of arousal, underlying sleep apnea may simulate RBD, again underscoring the necessity for thorough formal PSG evaluation of all bothersome complex behaviors arising during the sleep period [65].

Nocturnal Seizures

The association between seizures and violence has long been debated. It is plain that, on occasion, seizures may result in violent, murderous, or injurious behaviors [2, 66]. Of particular note is the frantic and elaborate nocturnal motor activity that may result from seizures originating in the orbital, mesial, or prefrontal region [67]. "Episodic nocturnal wanderings," a condition clinically indistinguishable from other forms of sleep-related motor activity such as complex sleepwalking, but that is responsive to anticonvulsant therapy, has also been described [68–70]. Aggression and violence may be seen pre-ictally, ictally, and postictally. The postictal violence is often induced or perpetuated by the good intentions of bystanders trying to "calm" the patient following a seizure [71]. As with disorders of arousal, OSA may masquerade as nocturnal seizures [72–74].

Psychiatric Conditions

Psychogenic Dissociative States

Waking dissociative states may result in violence [75]. It is now apparent that dissociative disorders may arise exclusively or predominately from the sleep period [2, 76]. Virtually all patients with nocturnal dissociative disorders evaluated at our center were victims of repeated physical and/or sexual abuse beginning in childhood [77].

Malingering

Although relatively uncommon in a clinical sleep medicine setting, malingering must also be considered in cases of apparent sleep-related violence In contrast, malingering is not uncommon in criminal proceedings and should be strongly suspected if: (i) the case is presented in a medico-legal context or has potential criminal implications, (ii) marked discrepancy between reported symptoms and objective findings, (iii) lack of cooperation with evaluation, and (iv) the presence of Anti-Social Personality Disorder (**see Add Reference Addendum** [115, 116]). Additionally, malingering should be distinguished from Factitious as well as somatoform disorders. In cases involving sleep-related violence, opportunistic malingering would appear to be the most relevant subtype of this condition with its potential for exploiting a naturally occurring event or preexisting condition. Our center has recently seen a young adult male who developed progressively violent behaviors, apparently arising from sleep, directed exclusively at his wife. This behavior included beating her and chasing her with a hammer. Following extensive neurologic, psychiatric, and PSG evaluation, it was determined that this behavior represented malingering.

Munchausen Syndrome by Proxy

In this syndrome, a child is reported to have apparently medically serious symptoms that, in fact, are induced by an adult—usually a caregiver, often a parent. The use of surreptitious video monitoring in sleep disorder centers during sleep (with the parent present) has documented the true etiology for reported sleep apnea and other unusual nocturnal spells [78–80].

Medicolegal Evaluation

Clinical and Laboratory Evaluation of Waking and Sleep Violence

The history of complex, violent, or potentially injurious motor behavior arising from the sleep period should suggest the possibility of one of the previously mentioned conditions. Our sleep forensics consulting consortium experience with over 300 adult cases of sleep-related injury/violence has repeatedly indicated that clinical differentiation, without PSG study, among RBD, disorders of arousal, sleep apnea, and sleep-related psychogenic dissociative states and other psychiatric conditions may be impossible [13]. It is likely that violence arising from the sleep period is more frequent than previously assumed.

The legal implications of automatic behavior have been discussed and debated in both the medical and legal literature [1, 81–83]. As with nonsleep automatisms, the identification of a specific underlying organic or psychiatric sleep violence condition does not establish causality for any given deed as the two are not temporally linked.

These conditions are diagnosable, and most are treatable. Clinical evaluation should include a complete review of sleep/wake complaints from both the victim and bed partner (if available). This should be followed by a thorough general physical, neurologic, and psychiatric examination. The diagnosis may only be suspected clinically. Extensive polygraphic study employing a full EEG montage, electromyographic monitoring of all four extremities, and continuous audiovisual recording is mandatory for correct diagnosis in atypical cases; and clinical and laboratory evaluations are best performed by experienced clinicians [13].

Establishing the diagnosis of nocturnal seizures may be extremely difficult, as the motor activity associated with the spell often obscures the EEG pattern. Further, there may be no scalp-EEG manifestation of the seizure activity. Numerous well-documented cases of scalp electrode EEG-negative but depth electrode EEG-positive electrical seizure activity or video-documented clinical seizure activity have been reported [84–86]. Another possible explanation for "scalp electrode EEG-negative" seizures is that some seizures manifest electrically with only generalized low-voltage fast activity, not followed by postictal slowing [87]. Such activity arising from EEG-recorded sleep may be misinterpreted as an "arousal," rather than as electrical seizure activity. Seizure activity arising in the limbic system may spread to other more "primitive" structures, with resultant clinical behaviors, without EEG involvement of the neocortex [9]. The treatment of nocturnal seizures is similar to that of diurnal seizures. The previously mentioned difficulties in evaluating nocturnal seizures (obscuring of the record by movement artifact, the absence of surface EEG abnormality or electrical seizure activity, lack of postictal slowing, misinterpretation of electrical seizure activity as an "arousal") emphasize the necessity of extensive, in-person laboratory monitoring. (Scantily channeled "ambulatory" EEG monitoring has led to the misdiagnosis of functional psychiatric disease in a number of our patients subsequently demonstrated to have bona fide nocturnal seizures.) If the history or physical examination suggests underlying neurologic disease, further studies such as magnetic resonance imaging or computed tomography scanning of the brain, multimodal (visual, auditory, and somatosensory) evoked potentials, and/or formal neuropsychometric evaluation are indicated.

While it is often possible to state that a given violent act may conceivably have arisen from the sleep period or from a mixed state of wakefulness and sleep, it is usually impossible to prove that a given incident did, in fact, represent a sleep-related phenomenon. To assist in the determination of the putative role of an underlying sleep disorder in a specific violent act, we have proposed guidelines, modified from Bonkalo (sleepwalking) [21], Walker (epilepsy) [88], and Glasgow (automatism in general) [89] and formulated from our clinical experience [2]:

1. There should be reason by history to suspect a *bona fide* sleep disorder. Similar episodes, with benign or morbid outcome, should have occurred previously. (It must be remembered that disorders of arousal may begin in adulthood.)
2. The duration of the action is usually brief (seconds), though action of longer duration (minutes) does not necessarily exclude a sleep disorder or a sleep-related behavior.
3. The behavior is usually abrupt, immediate, impulsive, and senseless—without apparent motivation. Although ostensibly purposeful, it is completely inappropriate to the total situation, out of (waking) character for the individual, and without evidence of premeditation.
4. The victim is someone who merely happened to be present, usually in proximity, and who may have been the stimulus for the arousal. Sleepwalkers rarely, if ever, seek out victims (**see Add Reference Addendum** [107])
5. Immediately following return of consciousness, there is perplexity or horror, without attempt to escape, conceal, or cover up the action. There is evidence of lack of awareness on the part of the individual during the event.
6. There is usually some degree of amnesia for the event; however, this amnesia need not be complete.
7. Sleep is an analgesic state. The sensory pathway for pain for the most part is considered "off-line" during sleep. Consequently, pain associated with acts committed during disorders of arousal may not be perceived until awakening after the event.
8. In the case of sleep terrors/sleepwalking or sleep inertia, the act:

   A. May occur upon awakening (rarely immediately upon falling asleep)—usually at least 1 h after sleep onset
   B. Occurs upon attempts to awaken the subject
   C. Has been potentiated by sedative-hypnotic administration or prior sleep deprivation
9. Polysomnographic studies performed "after the fact" are of absolutely no value in determining whether a parasomnia accounted for the remote act in question. Even capturing a parasomnia event during a sleep would indicate behavior at the time of the recording, not remotely. Furthermore, there is no scientific basis for attempting to replicate conditions surrounding the event in question (sleep deprivation, alcohol, or other substance ingestion) during a sleep study. Provocation tests to trigger parasomnias by any intoxicants or mind-altering agents would appear to be ethically challenged until well-controlled validated research studies have been performed.
10. Voluntary intoxication by alcohol over the legal limit, or other illicit mind-altering intoxicants, precludes the sleepwalking defense.
11. Lastly, the violent criminal allegation cannot be better explained by another mental disorder, medical condition, or substance use. This last guideline is also in accordance with the diagnostic guidelines for parasomnias as set forth in the most recent International Classification of Sleep Disorders 3rd edition (ICSD-3).

Sleep forensics has been defined as the application of the principles and tools of neuroscience as applied to Somnology and Sleep Medicine that have been widely accepted under international scientific peer review to the investigation in understanding unusual, irrational, and/or bizarre human behaviors associated with alleged criminal behavior which is to undergo further examination in a conflict resolution legal atmosphere and/or courtroom. The proposition that sleep disorders may be a legitimate defense in cases of violence arising from the sleep period has been met understandably with much skepticism [90] (**see Add Reference Addendum** [112]). For credibility, evaluations of such complex cases are best performed in experienced sleep disorders centers with interpretation by a veteran clinical polysomnographer. Due to the complex nature of many of these disorders, a multidisciplinary approach is highly recommended.

One fortunate, and unexplained, fact is that nocturnal sleep-related violence is seldom a recurrent phenomenon [90]. Very rarely, recurrence is reported, and possibly could be termed a "noninsane automatism." Thorough evaluation, effective treatment, and longitudinal clinical management are mandatory before the patient can be regarded as no longer a menace to society [91]. In other cases, clear precipitating events can be identified and must be avoided to be exonerated from legal culpability. This concept has led to the proposal of two new forensic categories: (1) "parasomnia with continuing danger as a noninsane automatism" and (2) "(intermittent) state-dependent continuing danger" [91].

Legal and Forensic Medicine Evaluation

With the identification of ever-increasing causes, manifestations, and consequences of sleep-related violence comes an opportunity for neurologists and sleep medicine specialists to educate the general public and practicing clinicians as to the occurrence and nature of such behaviors, and about their successful treatment. More important, the onus is on the sleep medicine professional to educate and assist the legal profession in cases of sleep-related violence that result in forensic medicine issues. This often presents difficult ethical problems, as most "expert witnesses" are retained by either the defense or the prosecution, leading to the tendency for expert witnesses to become advocates or partisans for either one side or the other. Historically, this has been fertile ground for the appearance of "junk science" in the courtroom [92]—from Bendectin to triazolam to breast implants. Junk science leads to junk justice, and altered standards of care [93]. Recently, much attention has been paid to the existence and prevalence of junk science in the courtroom, with recommendations to minimize its occurrence. Prior to accepting any given case, the sleep professional should familiarize him/herself with this most important issue. A good starting point is the highly informative book, *Galileo's Revenge: Junk Science in the Courtroom* [92]. There is some hope that the judicial system is paying more attention to the process of authentic science and may move to accept only valid scientific evidence [94, 95]. To address the problem of junk science in the courtroom, many professional societies are calling for, and some have developed guidelines for, expert witness qualifications and testimony. Similarly, the American Sleep Disorders Association (the American Academy of Sleep Medicine) and the American Academy of Neurology have adopted their own guidelines, which include [96, 97]:

A. Expert witness qualifications:
   1. Must have a current, valid, unrestricted medical ,or psychology license.
   2. Must be a Diplomat of the American Board of Sleep Medicine or have passed the American Board of Internal Medicine specialty examination in sleep medicine.
   3. Membership in the Sleep Research Society is strongly encouraged.
   4. Must be a recognized resource within the sleep medicine community and should have been actively involved in clinical practice in a manner consistent with the requirement of the criminal case at the time of the event.
   5. Given the essential position of *mens rea* in criminal law and the pivotal role of levels of consciousness must have significant direct experience in either neurology and/or neuroscience.

B. Guidelines for expert testimony:
   1. The practitioner must be impartial: The ultimate test for accuracy and impartiality is a willingness to prepare testimony that could be presented unchanged for use by either the plaintiff or the defendant.
   2. Fees should relate to time and effort, not be contingent upon the outcome of the claim. Fees should not exceed 20 % of the practitioner's annual income.
   3. The practitioner should be willing to submit such testimony for peer review.
   4. To establish consistency, the practitioner should make records from his or her previous expert witness testimony available to the attorneys and expert witnesses of both parties.
   5. The practitioner must not become a partisan or advocate in the legal proceeding.

Familiarizing oneself with these guidelines may be helpful in a given case, as the expert witnesses for each side should be held to the same standards [98].

The current legal system unfortunately must consider a parasomnia case strictly in terms of choosing between "insane" or "noninsane" automatism. Such a choice results in two very different consequences for the accused: either commitment to a mental hospital for an indefinite period of time if "insane" or acquittal without any mandated medical consultation or follow-up, or without any stipulated deterrent concerning a recurrence of the behavior with criminal charges that was induced by a recurrence of the high-risk behavior. One reasonable approach in dealing with these automatisms from a legal standpoint would be to add a category of acquittal that allowed for innocence based on lack of guilt consequent to set diagnoses—specific illnesses that could be categorized by a group of subspecialty clinicians in consultation with the legal profession [99]. Another suggestion has been a two-stage trial, which would first establish who committed the act and then deal separately with the issue of culpability. The first part would be held before a jury; the second would be held in front of a judge with medical advisors present [100].

Forensic Sleep Medicine Experts as Impartial Friends of the Court (Amicus Curae)

One infrequently used tactic to improve scientific testimony is to use a court-appointed "impartial expert" [92]. When approached to testify, volunteering to serve as a court-appointed expert, rather than one appointed by either the prosecution or defense, may encourage this practice. Other proposed measures include the development of a specific section in scientific journals dedicated to expert witness testimony extracted from public documents with request for opinions and consensus statements from appropriate specialists, or the development of a library of circulating expert testimony that could be used to discredit irresponsible "professional witnesses" [92]. Good science is determined not by the credentials of the expert witness, but rather by scientific consensus [93].

Summary and Directions for the Future

It is abundantly clear that violence may occur during any one of the three states of being. That which occurs during REM or NREM sleep may have occurred without conscious awareness and may be due to one of a number of completely different disorders. Violent behaviors during sleep may result in events that have forensic science implications. The apparent suicide (e.g., leaping to death from a third-story window), assault, or murder (e.g., molestation, strangulation, stabbing, shooting) may be the unintentional, nonculpable but catastrophic result of disorders of arousal, sleep-related seizures, RBD, or psychogenic dissociative states. The majority of these conditions are diagnosable and, more important, are treatable. The social and legal implications are obvious.

The fields of neurology and sleep medicine must pursue further productive study and discourse and request adequate funding to objectively study the following important questions: What is the true prevalence of these disorders? How are they best and most accurately diagnosed? How can the usually present prodromes be taken seriously? Why the male predominance in many? How can they best be treated or, better yet, prevented? Are "social stressors" truly more prevalent in this population? What is the best way to deal with forensic science issues? What to do with the offender? What is the likelihood of recurrence? Is such behavior a sane or an insane automatism? [101]. How to protect the potential victim?

More research, both basic science and clinical, is urgently needed to further identify and elaborate upon the components of both waking and sleep-related violence, with particular emphasis upon neurobiologic, neuroplastic, genetic, and socioenvironmental factors [15, 16, 102]. The study of violence and aggression will be greatly enhanced by close cooperation among clinicians, basic science researchers, and social scientists.

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