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Forensic Sleep Medicine: Nocturnal Wandering and Violence

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Summary: Forty-one subjects between 12 and 63 years of age with a complaint of nocturnal wandering were reviewed retrospectively, and a prospective investigation of their compliance to treatment was performed. Twenty-nine of 41 subjects committed violence against themselves or others ("violent group"). Clinical investigation of their problem involved polysomnography, wake and sleep EEGs and ambulatory EEG recording in the home environment. The nocturnal wandering may have started from NREM sleep or REM sleep, and violence was observed in both of these sleep states. Arousal from sleep may have been triggered by sleep-disordered breathing or may have been related to temporal lobe abnormalities, and, in some cases, no abnormal polygraphic features were noted. Violence was always preceded by many instances of nocturnal wandering that had received little clinical attention. Temporal lobe abnormalities, a rare cause of nocturnal wandering, were present only in the "violent" group. This group also had a higher percentage of men than the "nonviolent" group. In both groups, the frequency of nocturnal wandering increased with an increase in daytime stressors. Pharmacological and psychiatric treatment approaches were beneficial in both groups. **Key Words:** Forensic medicine—Nocturnal wandering—Violence—Parasomnia—Temporal lobe epilepsy—NREM sleep somnambulism—REM behavior disorder.

Violence during sleep is an important concern of forensic sleep medicine. Bartholomew (1) and Fenwick (2) have considered some of the medicolegal aspects of the problem and, recently, Broughton et al. (3) reported on a controversial homicide case that was deliberated on by the Canadian Supreme Court. In 1977, Pedley and Guilleminault (4) reported on abnormal, often aggressive, behavior and wandering in a population of late teenagers and young adults, and related their abnormal behavior to epilepsy during sleep. In 1988, Maselli et al. (5) considered a closely related population but emphasized the nonepileptic nature of the abnormal sleep-related behavior. Schenck et al. (6) in 1986 reviewed 100 adult subjects with sleep-related injuries, and recently, Guilleminault et al. (7) reported on violent versus nonviolent subjects with nocturnal wandering. From these studies, it is clear that subjects with "disorders of arousal", as defined by Gastaut and Broughton (8), are at risk for self-inflicted injuries and may inflict injuries on others.

In cases where nocturnal wandering occurs, the sleep medicine specialist may be faced with several questions asked by the patient, the family or the legal system. The most obvious are: i) Is the violent behavior related to a sleep, or sleep-induced, disorder?; ii) What type of investigation should be used to verify this contention?; iii) If a "disorder of arousal" is suspected, what type of disorder is it?; iv) What type of immediate therapeutic action should be taken?; v) What type of follow-up is needed and what is the expected long-term evolution of this nocturnal behavior under treatment?

To address these questions, we performed a retrospective investigation of all subjects who came to our clinic with a complaint of chronic nocturnal wandering. On this retrospectively collected cohort, we performed a prospective study to evaluate their long-term evolution and their compliance to treatment.

POPULATION

"Violent" and "nonviolent" groups

Subjects were included in the "violent" group if an episode of nocturnal wandering led to self-inflicted injury or injury to others. The violent group included 29 subjects (19 men) with a mean age of 37.3 ± 12 years and a range of 13 to 63 years. The median age was 28 years.

Subjects in the "nonviolent" group had a history of nocturnal wandering without injury. The nonviolent group consisted of 12 subjects (seven women) with a

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TABLE 1. *Characteristics and main variables of the patient population*

	Violent (n = 29)	Nonviolent (n = 12)
Mean age (years)	37.3	29.9
Mean BMI (kg/m²)	24.8	24.2
BMI range (kg/m²)	21.9–29.8	22.2–26.0
	n (%)	n (%)
Women	10 (35)	7 (58)
OSA subjects	3 (10)	1 (8)
UARS subjects	0 (0)	2 (17)
Subjects with other significant past medical history	1 (3)	0 (0)
Obsessive-compulsive personality subjects	6 (21)	6 (50)*
Hamilton Depression Scale >24 (depressed)	3 (10)	3 (25)
Subjects from dysfunctional families	3 (10)	3 (25)*
Subjects with relative with nocturnal wandering and/or night terrors	8 (27)	6 (50)*
Subjects with spike or spike/wave during EEG recording	2 (7)	0 (0)
Subjects reporting wandering during first third of night	16 (55)	7 (58)
Subjects reporting wandering during last third of night	7 (24)	3 (25)
Medilog recording results[a]		
Subjects with REM behavior disorder	1 (4)	4 (36)
Subjects with onset stage 2	5 (26)	2 (11)
Subjects with onset stage 3–4 NREM	20 (76)	5 (45)
Final diagnosis[b]		
Nocturnal temporal lobe epilepsy with nocturnal wandering	2	0
Somnambulism with sleep-disordered breathing	3	1
Somnambulism	23	7
REM behavior disorder	1	4

Abbreviations used: OSA, obstructive sleep apnea; UARS, upper airway resistance syndrome; Medilog, Medilog® ambulatory recording device; BMI, body mass index (in kg/m²).

The nonviolent group is smaller than the violent group, due to the bias of referrals: violent wanderings lead to specialized consultation more frequently than do nonviolent wanderings. The main differences were noted in the neuropsychiatric information. The only epileptic subjects were in the violent group, but they represent only 7% of this population. The nonviolent group had a higher percentage of obsessive-compulsive subjects, depressed subjects (based on Hamilton Depression Scale scores) and subjects from dysfunctional families. The depressed subjects were also the subjects from dysfunctional families. Finally, statistical analyses between the two groups on percentages using chi-square or Fisher tests have little value as the numbers per cell are, for the most part, too low. When performed (*), in spite of the low number of subjects, the results were not significantly different.

[a] n = 26 for violent characteristics, n = 11 for nonviolent characteristics.

[b] n = 29 for violent characteristics, n = 12 for nonviolent characteristics.

mean age of 29 ± 9 years and a range of 17 to 42 years. The median age was 26 years. Whereas in the violent group, consultation was triggered by the most recent violent event, consultation in the nonviolent group was triggered by social pressure or by the recommendation of a psychiatrist. The main variables investigated in the two groups are presented in Table 1.

The reported violent behavior

The violent group could itself be divided into two subgroups: those with self-inflicted injuries, and those who caused injury to others. In 21 of the 29 subjects, a third-party inquiry (e.g. police, insurance companies, juvenile court) was associated with the evaluation. Thirteen of the 29 subjects had self-inflicted injuries only, 11 had only injured others, and five subjects had demonstrated both types of violence. Violence inflicted on others resulted in broken noses, broken ribs and multiple bruises, and in two cases, which surprisingly did not result in any injuries other than bruises, children were thrown out of windows. In cases where subjects threw themselves through open or closed windows, the results were more serious. One subject suffered a near complete section of right axillary artery with full section of the muscles and tendons of the arm, while another suffered a coma related to a skull fracture. Other cases of violence resulted in single and multiple bone fractures. The least serious of these was a fractured big toe in the 63-year-old subject.

Clinical interviews

Interviews had been conducted with the subjects and a bed partner and/or family member when available. Nocturnal wanderings were not a new event. In all subjects, they had occurred previously and, with the exception of the 63-year-old man, had occurred since childhood. Subjects had incomplete memory of these episodes, but often had vague recollections of nightmarish imagery. These "impressions" were always terrifying and always involved some type of perceived threat to the subject or a loved one (e.g. the impression of being attacked, being buried alive, being caught in a house on fire, being burglarized, etc.). The subject's response to these perceived threats often was the cause of injury.

Witnesses reported that the subjects were unresponsive, appeared distant or "in their own world", unaware of their surroundings. Often they appeared confused and disoriented. They were sometimes clumsy, running into furniture, pulling down drapes, knocking over lamps or other objects, apparently unintentionally, due to what witnesses felt was a lack of awareness of objects that were in their way. In the midst of this confused behavior, however, subjects could make a series of gestures that were very decisive, sometimes threatening (e.g. fist movements, leg kicks and the assumption of a defensive posture). At other times, subjects appeared to be attempting escape from a danger

that only they perceived, but their movements were not appropriate for the real situation and surroundings (for example, running into a closet and trying to get out through the wall, or mistaking a window for a door). Onlookers were often ignored, or, if in the way, were treated as a hindrance to be pushed aside. Sometimes, subjects appeared calm but determined. One subject was found pounding on the wall with bleeding fists, repeating this behavior with a determined smile, apparently unaware of his self-inflicted wounds.

The abnormal behavior may have involved bed partners or sleeping family members. One subject would throw his wife to the floor, run into the room of his two children, take them into his arms and run outside. The "impression" that the subject had afterwards of the event was that the house was on fire. This sort of abrupt behavior often resulted in injury of household and/or bed partners. In some cases, this behavior may have occurred many times before treatment was considered.

During the episodes, subjects might have been mumbling or yelling coherent phrases such as "help", "fire", "run, run", "someone's coming", even insults of various types. At other times, subjects were silent, with a frightened or angry expression. Often subjects continued running or moving in an attempt to get out of the room or the house, even after injury to self or another had occurred, stopping only minutes later, away from the bedroom.

In the nonviolent group, results of the clinical interview were similar to those in the violent group. All subjects in the nonviolent group had experienced nocturnal wanderings since childhood. Their behavior was described in similar terms to that of subjects in the violent group (i.e. "distant", "unresponsive", etc.), with the exception that their behavior did not lead to injury of self or others.

Reported time of occurrence during the night

The most common time for occurrence of the nocturnal episode was during the first third of the night. Sixteen of 29 subjects (55.2%) in the violent group were reported to wander during the first third of the night. Seven of 29 subjects (24.1%) in the violent group were reported to wander in the last third of the night.

In comparison, seven of 12 subjects (58.3%) in the nonviolent group wandered during the first third of the night, and three of 12 (25%) wandered during the last third of the night.

Family history of nocturnal wanderings or night terrors

Eight subjects in the violent group had a first-degree relative with a history of nocturnal wandering or night terrors. Six subjects in the nonviolent group had such a relative. In these 14 cases, the affected relative was a parent in eight cases and a sibling in six cases. It involved nocturnal wandering in 10 subjects and night terrors in four subjects.

Medical history

Only one subject, the 63-year-old, had a significant, relevant medical history. Six months prior to his first episode of nocturnal wandering, he suffered a myocardial infarction with loss of consciousness. A magnetic resonance imaging (MRI) performed 3 months prior to the development of nocturnal wandering showed the presence of a small lesion in the left subcortical frontal region, believed to be the result of anoxia at the time of myocardial infarction. At the time of the MRI, a clinical EEG had been interpreted as nonspecific and without evidence of paroxystic discharges.

Otherwise, two subjects were overweight (BMI = 29.8 and 28.1 kg/m^2) and six subjects, including the 13-year-old, were known to be regular, loud snorers.

Psychiatric evaluation

All subjects were submitted to a structured psychiatric interview that included evaluation of alcohol consumption and illegal drug use. History of abuse, dysfunctional family life during childhood and a family history of psychiatric problems were investigated. Similarly, the presence of significant stressors during the period of time leading up to the "violent" behavior was noted, as were the subject's major personality traits. Alcohol intake was assessed based on interviews with the subject, family members and friends. "Chronic alcoholism" was defined as consumption of more than four glasses of wine (or the equivalent alcohol content) per day. Information about the time of alcohol consumption was also obtained. Urine drug screens were performed on all subjects the night of the polygraphic recording. At the end of the psychiatric evaluation, subjects were classified according to DSM III or DSM IIIR criteria.

Three subjects in the violent group had Hamilton Depression Scale scores of 25 to 29, and three came from dysfunctional families. The nonviolent group also had three subjects with Hamilton Depression Scale scores of 25 to 29, and three from dysfunctional families.

Four of the six subjects (three women) from dysfunctional families had been sexually abused and two had been physically abused during childhood, all starting at prepubertal ages. Five of these subjects were referred by psychiatrists.

None of the other subjects had a significant past psychiatric history. Only one subject, a fireman, was subjected to demanding shift work and severe occupational stress. He was in the violent group. None of the subjects were chronic alcohol or drug abusers. Seventeen consumed moderate amounts of alcohol (usually a glass of wine or a beer with dinner or at social encounters). Twelve subjects (six in the violent group) had an axis II (DSM IIIR) classification, at the end of the structured psychiatric interview, of "obsessive-compulsive personality disorder".

Family members and bed partners reported an increase in frequency of nocturnal wanderings during periods of increased stress, and violence was associated with these periods of increased wanderings. In five cases, "violence" occurred after one of the three major California earthquakes (San Francisco, central California and Los Angeles) between 1989 and 1994. Family members reported significantly increased fears of property damage or injury during this time period. The other cases arose from more mundane situations, but one violent event occurred within a few days of when the subject's car was broken into, and another after a subject was the victim of an unsuccessful burglary attempt.

Clinical neurophysiological investigation

A sleep-deprived EEG (awake and asleep) was performed, most frequently with nasopharyngeal electrodes. A nocturnal recording of sleep/wake variables was performed, including monitoring of EEG, EOG, chin and leg EMG, ECG (modified V2 lead) airflow, thoracic and abdominal efforts with uncalibrated inductive respiratory plethysmography, pulse oximetry and recording breathing noises with a microphone. If there was any suspicion, based on the above variables or on clinical evaluation, of a narrow upper airway, a second polygraphic recording was performed with the addition of an esophageal-pressure-monitoring probe and pressure transducer. Polygraphic recording was always performed at a paper speed of 10 mm per second. Most subjects (37 of 41) also had ambulatory monitoring at home using the Medilog® nine-channel recorder. Electrode placement was performed in the sleep laboratory in the evening (7:00–9:00 p.m.) with monitoring of sleep states (one EEG, EOG and chin EMG channels) and EEGs, mostly centered on temporoparietal and frontal regions.

Results from polysomnography. These investigations were performed first with polysomnography. None of our subjects had a wandering episode during nocturnal polysomnography. Four subjects had some types of suspicious arousals with mumbling or night terrors. Isolated or short runs of sharp transients, monophasic or diphasic sharp slow waves, sharp and slow wave complexes, asymmetrical bursts of slow waves and EEG patterns that could be associated with seizure disorder were never identified during polysomnography.

Polysomnography clearly demonstrated, however, the presence of sleep-disordered breathing in four subjects. Two subjects (the two overweight men) were recognized during the first night's monitoring. The other two subjects, including the 13-year-old boy, were recognized after use of esophageal pressure measurements. The increased respiratory efforts related to their breathing disorder during sleep induced sleep fragmentation. In these two subjects, the arousal induced by the breathing disorder led to a monitored night terror. In one of these two cases (the 13-year-old boy), the night terror occurred after an arousal in stage 3 NREM sleep. The night terror occurred without a drop in SaO_2 but with a peak inspiratory Pes nadir of -41 cm H_2O. The most significant Pes nadir reached during the night was -44 cm H_2O in the 13-year-old, in stage 2 NREM sleep, but this did not trigger a night terror. In the other case, the night terror occurred after a 27-second obstructive sleep apnea in stage 2 NREM sleep with an SaO_2 drop to 86%. The lowest SaO_2 drop was to 81% during REM sleep, but this did not trigger a night terror or nocturnal wandering.

Three subjects showed evidence of arousals from REM sleep, mumbling and gesticulating during this sleep state (once again, without nocturnal wandering).

In summary, polysomnography was useful in making a presumptive diagnosis of sleep-disordered breathing in four of 41 subjects and a presumptive diagnosis of REM behavior disorder in three of 41 subjects. Four of these subjects were in the violent group. Polysomnography also demonstrated somniloquy in 11 cases. These episodes were associated with limb movements in four cases and abrupt sitting up in bed in four cases. These events occurred in stages 3–4 NREM sleep, but none of them were strong diagnostic indicators, and no conclusion concerning the relationship of the abnormal behavior to a specific sleep state could be definitively drawn. Several subjects, including the 63-year-old, had a completely normal polysomnographic monitoring without any abnormal awakening.

Clinical EEG results. Wake and sleep EEG recording indicated the presence of temporal abnormalities in two subjects, both in the violent group (see Figs. 1 and 2).

Non-attended, ambulatory monitoring. Thirty-seven of 41 subjects in both the violent and nonviolent groups underwent Medilog® ambulatory recordings. It took a mean of 6.5 successive nights (range 4 to 10 nights) to document a nocturnal wandering in the home environment. In 25 subjects, the nocturnal wandering oc-

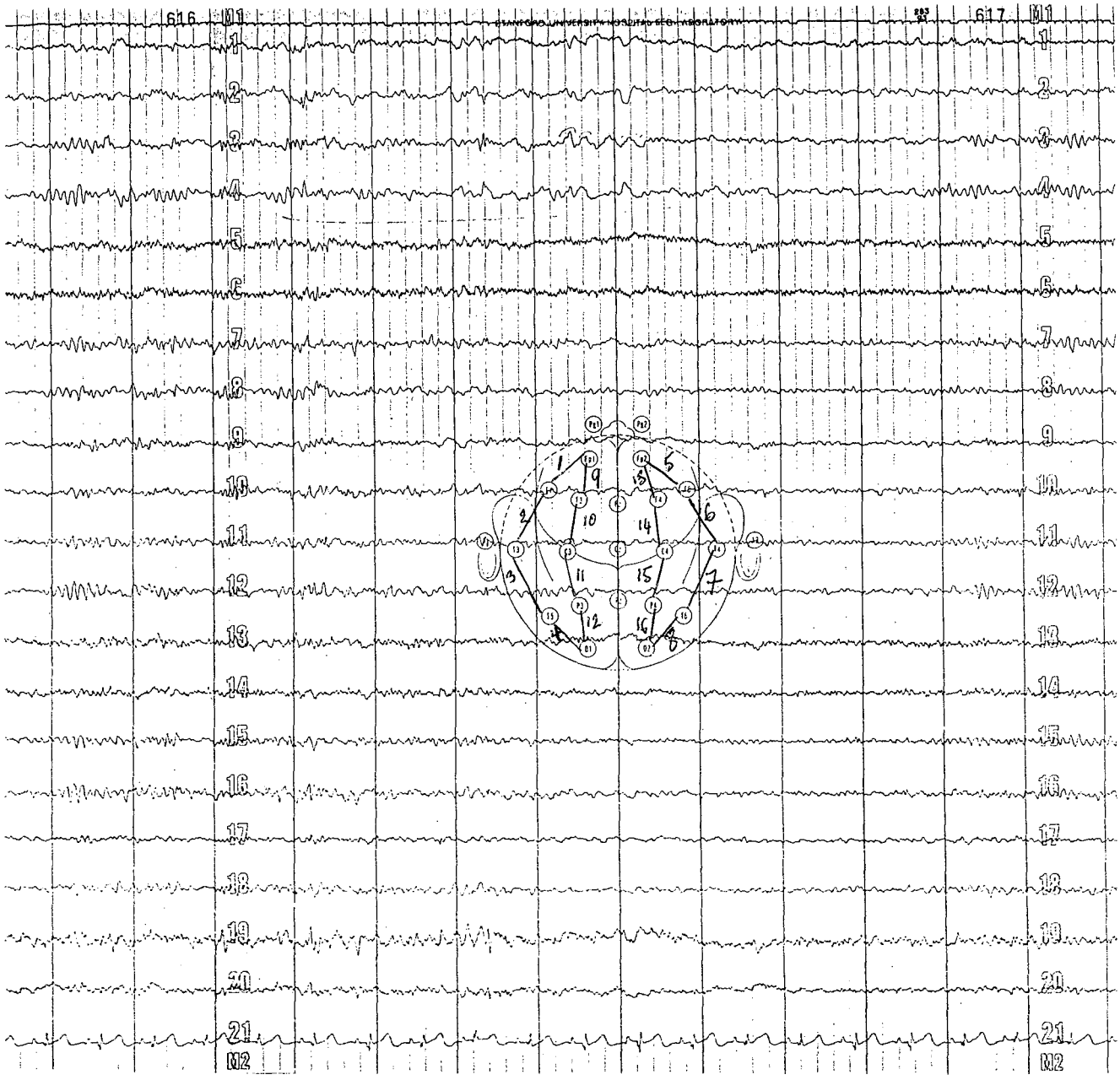

FIG. 1. EEG monitoring of one violent subject with intercritical spikes discharge. The subject is drowsy behaviorally and goes into stage 1 NREM sleep intermittently. During the awake and drowsy state, intermixed background theta frequency slowing at 4–5 Hz is seen in the left temporal region (channels 3 and 4). Superimposed upon this intermixed left temporal slowing are occasional spike discharges with a phase reversing that can be seen in the F7/T3 region (channel 3). The "double banana" montage is indicated on the head. Channel 21 is ECG, #20 is R10-A2 and #19 is Fp2-A2.

curred from 3 to 9 minutes (mean = 5.5 min) after the presence of at least 20% of high-amplitude slow wave (1–2 Hz) in several successive 30-second epochs. In only seven subjects was the wandering immediately preceded by hypersynchronous, high-amplitude slow wave, lasting 8–14 seconds before the onset of movement artifacts. In seven subjects, a sleep spindle was noted within 2 minutes of the first movement artifact and a K complex within 60 seconds. In six subjects, the EEG pattern seen during at least the 90 seconds preceding the first movement artifact was a theta rhythm (6–7 Hz). In five out of these six subjects, the movement artifacts were preceded for 60 to 120 seconds by a drop of chin EMG and abrupt bursts of high amplitude chin EMG activity that lasted 2–6 seconds. In these five subjects, 2 to 10 rapid eye movements were noted during that period.

Most commonly, increase in chin EMG amplitude

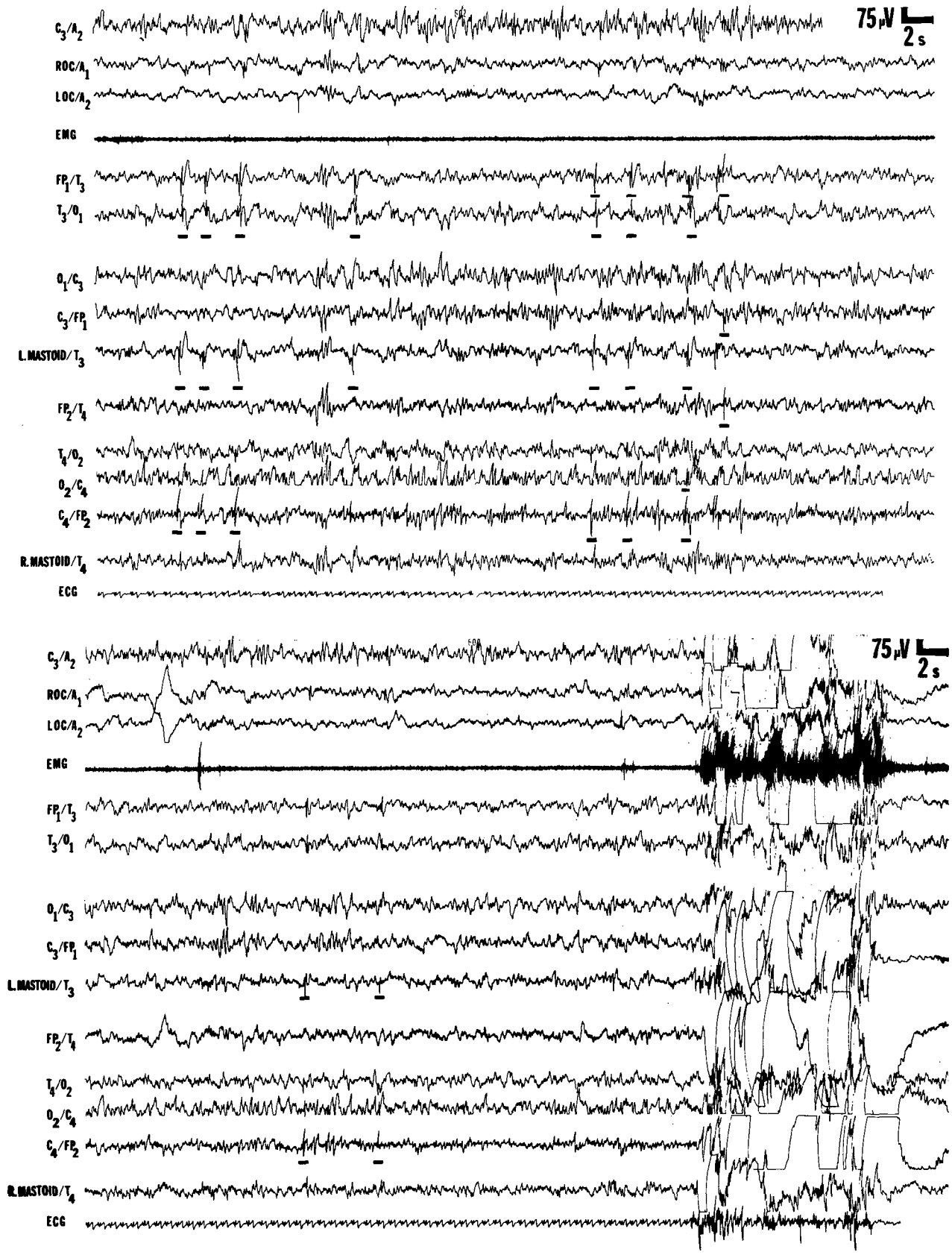

FIG. 2. Continuous recording of a subject during NREM sleep prior to arousal and during movement (sitting on the side of the bed, confused and disoriented). Spikes are underlined on the recording, which was obtained in stage 2 NREM sleep.

happened 4–8 seconds before the first movement artifacts were noted in EEG channels. During the first 30 seconds after the onset of movement artifacts, some EEG channels were briefly and intermittently readable. In these cases, two patterns could be seen: either persistence of high-amplitude slow wave or presence of a 5–7 theta rhythm of lower amplitude. In our subjects, the recordings were completely obscured by movement artifacts within a maximum of 60 seconds from the first appearance of the EMG burst and movement artifacts. The recordings were completely obscured by artifacts for 4–11 minutes.

Based on the EEG patterns seen prior to the onset of the movement artifacts, we concluded that nocturnal wandering occurred from stages 3–4 NREM sleep in 25 subjects, from stage 2 NREM in seven subjects and from REM sleep in five subjects. Subjects in both the violent and nonviolent groups wandered from each of these sleep states and stages. In two of the subjects who wandered from stage 2 NREM sleep, sharp transients were noted unilaterally in the temporal region. Unfortunately, movement artifacts masked any further correlation.

When movement artifacts decreased and no longer completely obscured the recording, it appeared that one to six channels were dysfunctional due to broken or disconnected electrodes, indicating that the subject performed movements with a large amount of strength. When EEG signals were seen, they were of poor quality with substantial EMG artifacts. In spite of poor definition, however, the EEG could be seen to be one of low amplitude–mixed frequency, as seen in an awake individual.

There were two discrepancies between the polygraphic findings and the Medilog® monitorings. One subject suspected of stage 3–4 NREM sleep nocturnal wandering based on polysomnography showed wandering from stage 2 NREM sleep with Medilog® (an acceptable discrepancy). Another subject with polygraphic monitoring features of REM behavior disorder wandered from stage 2 NREM sleep.

Subjects and/or bed partners had been asked to indicate, using an event marker, which is part of the recorder, the moment when the subject became quiet and aware of the surroundings. This signal was noted 1–4 minutes after the decrease of movement artifacts and intermittent recognition of poor-quality EEG signals suggesting wake. Subjects had also been asked to fill out a short report indicating any traces of memory associated with the wandering. Six subjects did not fill out the form. It is unclear if the unfilled forms were a result of lack of memory or noncompliance. During the morning interview, these subjects reported no recollection of any imagery associated with the wandering. Two of these subjects wandered from stage 2 sleep, and four wandered from stage 3–4 NREM sleep. The five subjects that wandered from REM sleep reported vivid scenes, from "building a wall and splashing stucco", to "bicycling in the country", to, interestingly, "doing brain research experiments with electrical equipment". The other subjects, all of whom wandered from NREM sleep, wrote very brief (often 3–4-word) notes with very little information, such as: "someone breaking in", "stones shattering my window", "ceiling falling on bed", "earthquake with bed moving", "girlfriend threatened by people", etc. The morning interview brought no additional information. For example, the subject who reported the image of his girlfriend being threatened could not recall the gender of the threatening individuals. Although fear or impending threat were common themes, they were not always present. The notes of some subjects were as commonplace as "feed the child", "take the dog out" and "racing".

None of the monitored events were associated with violence, but in 81% of the cases, subjects ended up outside of the bedroom.

Treatment trials

All subjects with history of "violence" were placed under drug treatment. Medications were selected based on clinical neurophysiologic results. Subjects in whom a temporomesial focus was recorded received sodium phenytoin or carbamazepine. All other subjects were prescribed carbamazepine due to the decision of the sleep specialist and a positive history of violence. Five subjects from the nonviolent group were also treated with carbamazepine. Thirty-five of 41 subjects received recommendations to see a psychiatrist or to follow through on already-started psychotherapy. Four subjects were treated for breathing disorders during sleep, two with nasal CPAP and two with surgery.

PROSPECTIVE LONG-TERM FOLLOW-UP INVESTIGATION

Forty of 41 subjects or the immediate family were recontacted. The time elapsed between first contact and follow-up varied between 10 years and 2 months for a mean of 4.2 ± 6.8 years. None of them has had a recurrence of violence during sleep since treatment, but five have experienced nocturnal wanderings since having been seen.

The 63-year-old subject demonstrated wandering from stage 2 NREM sleep during Medilog® ambulatory monitoring. Abnormal electrical discharges during sleep were suspected but never shown. He was treated with carbamazepine, stopped using his treatment 6 months later, experienced infrequent wander-

ings and, more frequently, awakenings from sleep with somniloquy. He died at age 66 of cardiac failure.

The two overweight subjects discontinued medication very quickly after beginning nasal CPAP treatment, with the rationale that the nCPAP was treatment of their nighttime problem. Neither had a recurrence of their nocturnal wandering. One had psychotherapy for a year and found it useful, while the other stopped after a brief (2-month) interaction with a psychotherapist. The two subjects treated with upper airway surgery included the 13-year-old subject, who had a short follow-up (2 months) after surgery. Although he had surgery, the recommended drug treatment was not prescribed by the pediatrician. Nocturnal wanderings ceased, but very frightening nightmares persisted and psychiatric follow-up was recommended. Nocturnal wanderings also ceased in the other subject treated with surgery. He had regular psychotherapy for 23 months and is back to normal life. Subjects with temporal foci have been followed regularly by specialists. One subject initially had anticonvulsant therapeutic blood levels that were too low, and she had persistent vivid and frightening imagery, despite the absence of nocturnal wandering. After appropriate adjustment, nocturnal symptoms have disappeared.

Eighteen subjects from the violent group used the prescribed medications for the first 7 months with control of nocturnal wandering in all cases. Fifteen were seen on a regular basis by psychiatrists. Medications were discontinued based on the recommendation of specialists after a mean of 10 ± 4 months in 12 of these cases. One subject experienced nocturnal wandering again, after termination of drug intake, while the other 11 did not experience nocturnal wandering for a mean of 20 ± 9 months. Three of these 18 subjects refused to see psychiatrists and have had irregular follow-up with irregular medication intake. It seems that these subjects may have experienced intermittent nocturnal wanderings and were subsequently prompted to resume medication intake with the reappearance of symptoms.

Subjects in the nonviolent group received a variety of treatment recommendations, including hypnosis, psychotherapy and benzodiazepines. Benzodiazepines (clonazepam, 2 mg at bedtime; diazepam, 10 mg at bedtime) also produced positive results but, as in the violent group, some were poorly compliant. Two subjects were helped by treatment associating hypnosis and psychotherapy. At the time of the last contact, half of the population was still receiving some type of psychiatric help and reported either a complete disappearance of nocturnal symptoms or, in four cases, a great reduction in symptoms with a persistence of night terrors more than sleep-walking. Four subjects reported control of their symptoms with treatment of their sleep-related breathing disorder. The rest of the population was helped by medication intake that included carbamazepine, phenytoin or benzodiazepine, but the medication intake was variable and reports from subjects indicate that relapses occurred with termination of drug intake.

COMMENTS

We could not detect many differences between the violent and nonviolent groups, with two exceptions: i) only the violent group had subjects with temporal lobe epileptic foci (although they represented only 7% of the group), and ii) there was a predominance of men in the violent group compared with the nonviolent group. Otherwise, sleep-disordered breathing, NREM and REM sleep onset of nocturnal wanderings and the different onset times during the night were reported in both populations. Increased nocturnal wanderings were associated in both groups with periods of increased daytime stress.

Temporal lobe epileptic foci are reported in association with nocturnal wanderings in less than 1% of subjects with nocturnal wandering (9). There was an obvious overrepresentation of these subjects in our population. Despite its rarity, an epileptic focus must be eliminated. The predominance of men in the violent group may, in part, reflect the fact that young male subjects have a greater physical strength that may make them more susceptible to physical injuries or more likely to injure others when confused and disoriented, or it might reflect a genetic, constitutional predisposition for violent behavior.

Nocturnal wanderings can be triggered by many factors. Organic diseases such as obstructive sleep apnea or abnormal upper airway resistance during sleep may be involved in the onset of wandering. It must be emphasized, however, that many subjects who have obstructive sleep apnea syndrome will never have nocturnal wanderings and "violent" behavior. A possible explanation is that a confused "arousal" is triggered by the other illness. The overall personality traits and the level of anxiety of the subject on a daily basis will also be factors associated with the abnormal behavior. These findings are important when therapeutic solutions are considered.

Another conclusion is that nocturnal polysomnography alone was not very helpful in defining the nocturnal wandering. In one case, the polygraphic evidence would have suggested a different sleep state onset than what was actually observed with ambulatory monitoring. As nocturnal wandering with nocturnal violence may involve medicolegal issues, it is important to perform an appropriate and full investigation. Polysomnography will often limit and perhaps inhibit

nocturnal wandering, but it will show the associated sleep pathology (with the caveat that the appropriate montage, including monitoring of esophageal pressure if needed, is performed). Repeated ambulatory monitoring, in the home environment if possible, is a very helpful diagnostic tool.

One may question the importance of dissociating the NREM sleep parasomnia from REM sleep behavior syndrome and the need to perform such a succession of neurophysiologic tests. The onset of nocturnal wandering from stages 1–2 NREM sleep (not only stages 3–4 NREM sleep) was previously reported by Fisher et al. in 1974 (10), and was re-emphasized by Guilleminault and Silvestri in 1982 (9) and by Schenck et al. in 1989 (11). Although the recognition of the NREM sleep stage onset of the nocturnal wandering may be trivial, it is valuable to recognize the prior sleep state, because treatment recommendations and efficacy of the prescribed medications may be different in NREM and REM onset wandering, as may be other factors such as etiology, attack phenomenology, etc. In REM sleep behavior disorder, the subject is still in REM sleep, acting out a dream. In abnormal behavior from NREM sleep, the features of NREM are seen sometimes during the first minute, but less commonly than usually reported. These features are associated with the abrupt appearance of hypersynchronic high-amplitude slow wave (noted in four of 41 subjects with the beginning of movement). Subsequently, the tracing is obscured by movement artifacts recorded on all channels. Ambulatory monitoring always confirmed the abrupt appearance of the nocturnal wandering from sleep and identified the sleep state immediately preceding the wandering, an important diagnostic point. It may over time help in better understanding the different types of nocturnal wanderings and the relationship of a specific mentation (and perhaps psychopathology) to a specific sleep state.

Most obviously, however, subjects in our study with "violent" nocturnal wanderings always had many previous nonviolent episodes, in some cases occurring for years. There was a very large tolerance from the family and even the medical community to these episodes. It seems that the potential life-threatening risks associated with nocturnal wanderings are not well understood.

Treatment appears to be helpful and, particularly when violence has occurred, medications may be useful to reduce the risk of occurrence. We often selected carbamazepine in these cases, although the positive response observed with this medication is not, for us, an etiologic argument, as carbamazepine has several positive indications and is used in disorders ranging from depressive illness to epilepsy. In our population, only two subjects, both in the violent group, had nocturnal wanderings as an indication of a partial, complex seizure. The arguments in favor of this diagnosis are the presence of interictal, unilateral, sharp transients and sharp wave complexes, and the observation once again of these sharp transients prior to wandering during Medilog® recording. We believe, however, that this etiology is rare, even in association with violent behavior, and that violence during nocturnal wandering has many different etiologies.

In spite of the efficacy of pharmacologic treatment, however, prevention is better. This means early recognition of nocturnal wanderings, an increased awareness by the medical community of the need for appropriate diagnostic treatments and efforts to help subjects to cope with the daytime stressors that often lead to increased nocturnal wanderings. These different efforts may reduce the frequency of nocturnal wanderings and the associated violent behavior.

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