

## **Sexsomnia: A Specialized Non-REM Parasomnia?**

Anne-Laure Dubessy AL, MD, PhD,<sup>1</sup> Smaranda Leu-Semenescu, MD,<sup>1</sup> Valérie Attali, MD, PhD,<sup>1</sup> Jean-Baptiste Maranci,<sup>1,2</sup> Isabelle Arnulf, MD, PhD<sup>1,3</sup>

<sup>1</sup> *Sleep Disorders Unit and Hospital-University, Pitié-Salpêtrière Hospital (APHP),* <sup>2</sup> *Champagne-Ardenne University, Reims, France;* <sup>3</sup> *Institute of Neuroscience, Pierre and Marie Curie University, Paris, France*

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**Corresponding author:** Isabelle Arnulf, Service des pathologies du sommeil, Hôpital Pitié Salpêtrière, 47-83 boulevard de l'Hôpital, 75651 Paris Cedex 13.

Phone: 33 (0) 1 42167702; Fax: 33 (0) 1 42167700

E-mail: isabelle.arnulf@aphp.fr

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## ABSTRACT

**Objective:** To describe patients with sexsomnia and to contrast their clinical and sleep measures with those of healthy controls and sleepwalkers.

**Methods:** Subjects referred for sexsomnia and for sleepwalking/night terror were interviewed, completed the Paris Arousal Disorder Severity Scale (PADSS) and were monitored one to two nights with video-polysomnography.

**Results:** Seventeen patients (70.6% male, aged 17 to 76 years) had sexsomnia, with amnestic fondling of the bed partner (n=11), complete sexual intercourse (n=8), masturbation (n=8) and spontaneous orgasm (n=1). The sexual behaviors were more direct during sleep than during wakefulness (n=12), leading to 6 sexual assaults, including intra-conjugal rape (n=3), assault of a family member (n=2), rape of a friend (n=1) and forensic consequences (n=2). In 47% of sexsomnia patients, there was a history or current occurrences of sleepwalking/night terrors. Patients with sexsomnia had more N3 awakenings than healthy matched controls and the same amount as regular sleepwalkers. Half of them presented evidence of cortico-cortical dissociation, including concomitant slow (mostly frontal) and rapid (mostly temporal and occipital) EEG rhythms, with concomitant N3 penile erection in one case. Of 89 sleepwalkers, 10% had previous episodes of amnestic sexual behaviors, with a higher PADSS-A score and a trend of a higher total PADSS score than the 80 sleepwalkers without sexsomnia.

**Conclusion:** In this single-center series, we confirmed the male predominance of sexsomnia and its potential for severe clinical and forensic consequences. The results suggest a continuum of regular sleepwalking, sleepwalking with occasional sexsomnia and quasi-exclusive sexsomnia.

**Keywords:** Non-REM parasomnia, sleepwalking, sexual behavior, sexsomnia, forensic

## **Significance**

Sexsomnia is recently identified amnesic sexual behavior during sleep. Case reports and series are limited and not contrasted with normal controls or with sleepwalkers. In a series of 17 patients, we found that most patients were male, displayed more direct sexual behaviors asleep than awake, and faced severe personal and interpersonal consequences, including suicidal ideation, assault, rapes of family members and friends, and loss of child custody. In addition, 9/89 adult, regular sleepwalkers reported occasional sexual amnesic behaviors. Concomitant rapid and slow EEG activities during N3 awakenings in half of the patients with sexsomnia could be developed to support the diagnosis.

## INTRODUCTION

Various sleep-related abnormal sexual behaviors have been recently identified, including sexual behavior that is mostly linked to confusional arousals (coined here as “sexsomnia”,<sup>1</sup> i.e., a sexual parasomnia)<sup>2</sup> and more rarely linked to REM sleep behavior disorder<sup>3</sup> and sexual epileptic seizures.<sup>2</sup> Clinical descriptions of sexsomnia are based on case reports and small series, totaling 95 published cases to date. A first extensive review of the literature in 2007 identified 31 published cases,<sup>2</sup> a recent review in 2015 identified 22 additional cases,<sup>4</sup> and an abstract of 41 consecutive cases of sexsomnia evaluated at a single UK sleep center was recently published,<sup>5</sup> leading to a homogenous description of the disorder. Affected patients display sexual vocalizations, masturbation, fondling, or intercourse/attempted intercourse during sleep—followed by morning amnesia. The disorder has a strong (67-81%) male predominance, with a mean disease onset between 26 and 33 years.<sup>2,4</sup> Sexsomnia may cause major interpersonal, clinical, and criminal consequences. Many patients have also been diagnosed with an NREM sleep parasomnia (confusional arousals, sleepwalking, sleep-related driving, sleep-related eating disorder). Because the sexsomnias typically occur without any behaviors outside of bed and are associated with amnesia of the behavior, the disorder is primarily classified as confusional arousals, an NREM parasomnia in the International Classification of Sleep Disorders-III, and has been termed as “Sleep related abnormal sexual behaviors”.<sup>6</sup> Some sexual behaviors (masturbation, coital-like pelvis movements without a partner) have occasionally been monitored during REM sleep as part of the numerous behaviors observed during REM sleep behavior disorder.<sup>3</sup> Obstructive sleep apnea (OSA) is a recognized precipitant of sleep-related abnormal sexual behaviors, and it disappeared in 4/4 reported cases when the apnea was treated.<sup>4</sup> As in other recently described specialized parasomnias,<sup>7</sup> there is a clinical need for sharing series and performing controlled measures. In addition, non-forensic sexsomnias can provide unbiased scientific information useful for evaluating forensic cases with alleged sexsomnia. Eventually, the frequency of sexsomnia

in regular sleepwalkers was systematically evaluated in a single series at our center<sup>8</sup> but not contrasted with sleepwalkers without amnestic sexual behavior. We collected all cases referred for amnestic sexual behaviors during sleep in our center and contrasted this series with healthy controls as well as with regular sleepwalkers with and without occasional sexsomnia.

## **METHODS**

### **Participants**

Three groups of participants were selected for this study, including patients with sexsomnia, regular sleepwalkers and healthy controls. The patients with sexsomnia were recruited among all patients referred to our sleep disorders unit (a university-hospital sleep disorder center that focuses mostly on neurological and respiratory sleep disorders and receives exclusively adults and adolescents older than 15 years, with approximately 2,000 hospitalized new patients per year) from 2008 to May 2016. The main motive of their referral had to be suspicion of amnestic sexual behavior during sleep. Two sleep neurologists (SLS and IA) experienced in parasomnias performed the eventual diagnosis of sexsomnia after a medical interview with the patients (and their bed sharers, if available) and a video-polysomnography for one night or two consecutive nights. All patients had had at least once a bed sharer, 16 of them on a regular (more than 4 nights/week) basis. A single patient (a teenager) did not have any bed sharer except for the night of the rape of her cousin. Eight bed sharers were available for the interview. In addition, all patients diagnosed with sleepwalking and sleep terrors within the prior 2 years were collected from our medical database. The diagnosis of sleepwalking/sleep terrors was performed using ICSD-3 criteria.<sup>6</sup> Patients were grouped into a single category because both are

disorders of arousal and are frequently concomitant in adults. Among the 124 patients in the database, only those (n=89) who had completed the Paris Arousal Disorders Severity Scale (PADSS)<sup>8</sup> and had answered the PADSS question about amnestic sexual behavior were selected for the analysis. No other selection criteria were in place. Healthy controls were selected among normal subjects who had participated as paid volunteers in another study, during which they had undergone video and sleep monitoring. They were selected to match for age and sex with the sexsomnia group. Healthy controls signed an agreement to take part in the study. The patients were informed of the study and did not oppose the use of their measures in a scientific study, as requested by the ethical committee, which waived written consent when collecting non-interventional clinical routine measures, following the French law on biological research.

### **Clinical evaluations**

Patients' sex, age at parasomnia onset, age at polysomnography, personal and familial history of sleep talking, sleep walking, and sleep terrors, and descriptions of parasomniac episodes were collected. Participants completed the PADSS,<sup>8</sup> an auto-questionnaire aimed at evaluating the severity of disorders of arousal. In the PADSS-A, the question "During the past year, did you ever exhibit one of the following behaviors during the night, while you were still asleep?" was followed by a list of 17 parasomniac behaviors, each one scored as never=0, sometimes=1 and frequently=2, leading to a subtotal score ranging from 0 to 34. In PADSS-B, patients assessed the frequency of parasomnias, i.e., from never to twice or more per night (with a subtotal score ranging from 0 to 6, transformed into monthly frequency as previously described)<sup>8</sup>, and in PADSS-C, they evaluated the consequences of the disorder (disturbed sleep, injuries to oneself and others, fatigue, and psychological consequences, leading to a subtotal score ranging from 0 to 10). Linked with sexsomnia, Item 17 of PADSS-A stipulates: "I unwillingly

performed a sexual act”, coded as never=0, sometimes=1 and often=2. Linked with sleep-related eating disorder, Item 16 of PADSS-A stipulates: “I prepared or ate some food or a drink”.

### **Sleep study**

Subjects underwent a video-polysomnography for one night or two consecutive nights, depending on their availability. Electroencephalography included eight bipolar channels for sexsomnia and sleepwalkers (Fp1-C3, C3-O1, C3-T3, T3-O1, Fp2-C4, C4-O2, C4-T4, T4-O2) to exclude nocturnal frontal lobe epilepsy and three bipolar channels for the healthy controls (Fp1-A2, C3-A2, C3-O1). Sleep stages were scored on the same montage (Fp1-A2, C3-A2, C3-O1) in all three groups. Monitoring also included a right and left electrooculogram, levator menti and right and left tibialis anterior muscle electromyograms, nasal pressure measurement through a cannula, tracheal sound recording through a microphone placed on the surface of the trachea, thoracic and abdominal belts to assess respiratory efforts, electrocardiography, pulse oximetry, EEG-synchronized infrared video-monitoring and sound recording in the room. Sleep stages, EEG arousals, respiratory events, periodic leg movements, and muscle activity were scored by IA, SLS and ALD after visual inspection of the recordings, using standard criteria.<sup>9</sup> Special attention was paid to counting “sudden awakenings from slow wave sleep” (events frequently associated with arousal disorders), which occurred in NREM sleep N3.



## **Statistical analysis**

Data are presented as the mean  $\pm$  SD unless otherwise specified. The comparisons between the patients with sexsomnia and the control subjects and between the patients with sexsomnia and sleepwalkers were performed separately using Student's t-test for quantitative data and the exact Fisher test for qualitative data.

## **RESULTS**

### **Ruling out sexsomnia in two cases**

Since 2008, 19 subjects were referred to the sleep-disorder unit for evaluation of abnormal sexual behaviors at night. We ruled out the diagnosis in two male cases who had sexually assaulted a female minor and had faced forensic consequences. A fascicle of evidence was obtained after a long interview with the subjects, a reading of the victims' declaratives, the time and conditions of the perpetration and video-polysomnography, as during any diagnosis process. The absence of personal and familial evidence of previous and current confusional arousals or disorders of arousal, the intake of alcohol/cannabis before the assaults, and the absence of signs of sleep disorders (including N3 awakenings) during the two consecutive nights with video-polysomnography were essential in this process.

### History of sexsomnia in 17 patients

Eventually, 17 patients were diagnosed with sexsomnia, including 12 (70.6%) men and 5 (29.4%) women, aged 17 to 76 years at the time of the study (Table 1). Five patients (29.4%) had a history of sleepwalking during childhood but no current sleepwalking, two (11.8%) patients had current occasional sleepwalking, 10 (58.8%) had a history of sleep talking, and 6 (35.3%) patients had no evidence of previous or current sleepwalking, sleep terrors or sleep talking. There was no history of sexual abuse in the patients. All but one (who was a virgin until having the sexsomnia) had one to several heterosexual (n=15) or homosexual (n=1) regular partners in their awake, conscious life and had a happy sexual life. The frequency of the sexsomnia episodes was daily or almost daily (n=7), once to five times per week (n=2), monthly (n=4), more than once per year but less than once per month (n=3), and only once or twice during the lifetime (n=1). This last patient was extremely ashamed of having had this sexsomnia, even so infrequently, and was seeking information to avoid this problem in the future. Most patients usually experienced a single episode per day (n=9), mostly in the first third of the night, but four patients reported two or more episodes within a single night, including during morning hours. For two women with severe non-conscious masturbation and a man with interpersonal sexsomnia, the episodes also occurred on some occasions during daytime naps.

Eleven patients identified factors that increased the frequency of the episodes, including sleep deprivation (n=9, linked with shift work in 1 patient), stressful daytime events (n=6), alcohol intake in the evening (n=5, which had been moderate in 3 cases and excessive in 2 cases), insufficient daytime sexual activity, and reuniting with their partner after a trip (n=3), whereas 4 patients did not identify any promoting factor. One patient noticed that he had less frequent episodes when he smoked cannabis in the evening, whereas another mentioned cannabis as a trigger

for sexsomnia. Four patients reported an increased frequency of sexsomnia episodes at the beginning of a new relationship (possibly due to recall bias), 9 denied such an increase, and one described that the sexsomnia developed in intensity in parallel with the development of the relationship with his fiancée.

The sexual behaviors during episodes included amnestic masturbation (n=8, the exclusive sexual behavior in 4/5 women), fondling the bed partner (n=11) and amnesic complete sexual intercourse (n=8). A single, old female patient had almost nightly orgasms awakening her within the first sleep hours, without any motor exteriorization except feeling wet genital areas, and a disagreeable (not pleasurable) feeling. Epileptic ictal orgasms were ruled out in the absence of any current or previous seizures, a normal 24-h EEG and a brain MRI. In 12 cases, partners described the patients as more direct and less inhibited than during “normal” intercourse. They were less gentle, were less concerned by the well-being of their partner or exhibited behaviors (vocalization of insanities, masturbation) that were unusual during their daytime sexual life.

During the episodes, all but three patients remained totally unaware of their behavior, with no recall in the morning. Three patients could on rare occasions progressively regain partial or total consciousness, especially if their bed partner had responded and sexual intercourse was initiated. Most patients did not recall any sleep-associated mentation, three patients sometimes recalled dreams with erotic content in the morning, and three had non-erotic, banal, or even stressful sleep mentations (e.g., passing an exam, speaking in English) at the time they were awakened by their partner because of their sexual behavior.

### **Consequences of sexsomnia**

Usually, patients stopped the sexsomnia and resumed sleep if their bed partner did not respond or pushed them away. Nevertheless, violent episodes that resulted in traumatic injury of the partner occurred in 2 patients. A male patient systematically exhibited a violent behavior and was impossible to wake up (see clinical illustration #2). Another male patient exhibited gentle sexual behaviors during most episodes but was violent once, leading to severe genital injuries in his spouse (who required surgery). Six patients reported at least one episode of involuntary sexual assault, including intra-conjugal rape (n=3, one with a complaint to the police; the wife later divorced her sexsomnia husband and asked for the exclusive custody of their baby daughter, arguing to the judge that the daughter would also be at risk of being raped), assault of a family member (n=2, with the rape of a younger female cousin by a male teenager [she reported the event to a child psychologist, who triggered an inquiry for worrying information, but nothing went to the police] and repeated fondling of a female cousin by another male patient [no complaint, but the female cousin now avoids him]) along with the rape of a female friend (n=1, not his girlfriend). The assaulted subjects were sleeping in the same bed, except for one case (see clinical illustration #2). Two patients faced forensic consequences and a police inquiry. In addition to physical harm, sexsomnia could lead to significant psychological distress. Spouses of the four female patients with recurrent amnesic masturbation complained about the behavior, leading to conjugal difficulties. One of them uttered the name of a man during numerous episodes of amnesic masturbation, a name that was not her husband's (she reported not knowing the named person). A female patient with severe amnesic masturbation considered suicide after having been summoned by her husband for this behavior. She left a suicide letter and went to the river to jump in but renounced. Eleven patients reported feelings of strangeness, guilt, shame, or depression.

The therapy included counseling on how to reduce precipitant factors (sleep deprivation, alcohol, lack of sex during daytime) and to avoid sleeping with children and unlinked persons (e.g., a patient decided to bring his own individual tent when camping and not sleeping in the community chalet during holidays). A drug treatment was suggested either on a regular or as needed basis. The first line of therapy was paroxetine 5 to 10 mg in the evening, with long-lasting benefits in two severe patients, i.e., 7 years without any episode in one case and 1 year without amnesic masturbation in a middle-aged woman. An old woman with nightly amnesic behavior and a mild apnea hypopnea index of 20 tried continuous positive airway pressure as well as paroxetine, clonazepam, gabapentin, carbamazepine and pramipexole, without any benefit. Another 64 years-old woman was adequately treated for severe sleep apnea syndrome when she started to present nightly amnesic masturbation episodes. She tried clonazepam 1 mg without any benefit. The other patients were offered a drug therapy but declined it and did not take any drug on a regular basis.

### **Video-polysomnography in patients with sexsomnia**

The patients with sexsomnia underwent a video-polysomnography for a single night (n=6 patients) or two consecutive (n=11) nights. All sexsomnia patients but one had at least one episode of awakening from N3 sleep, with a mean 4.5 (range 0-11) N3 awakenings during the first night and 4.8 (range 0-9) N3 awakenings during the second night. Eight (47%) of the patients had abnormal, partial awakenings, with dissociated activities on EEG channels during at least one N3 awakening. These abnormal activities included: (i) a continuous slow delta rhythm on the frontal left and right channels contrasting with rapid alpha rhythm on posterior channels (Figure 1); (ii) concomitant, superimposed slow

(theta/delta) and rapid (alpha) rhythms on all channels; or (iii) diffuse slow (delta or theta) rhythm contrasting with sustained motor activity. No epileptic activity was found in the patients, during a quiet waking state or during sleep. No abnormal sexual behavior was monitored on video, except for one patient who placed his right hand into his pants in 3 of 4 partial N3 awakenings, with a visible erection during N3 awakening (Supplemental data, for reviewers only). The motor behaviors associated with the N3 awakenings included mostly quiet, self-centered usual behaviors (repositioning in bed, touching the nasal cannula or the oximeter), or brief exploratory behavior (opening of eyes, looking around with a surprised gaze) suggestive of confusional arousals. There were no enhanced chin muscle tone and no behavior during REM sleep.

### **Sexsomnia in patients with regular sleepwalking**

Among 89 patients who had regular sleepwalking/sleep terror and completed the PADSS, nine (10.1%) reported occasional (n=7) or frequent (n=2) amnestic sexual behavior, in addition to their usual parasomniac behaviors. The 9 regular sleepwalkers with occasional sexsomnia had a higher PADSS-A score and tended to have a higher total PADSS score (but  $p=0.054$ ) than the 80 regular sleepwalkers without any sexsomnia (Table 1).

### **Clinical and sleep measures in patients with sexsomnia, patients with regular sleepwalking/sleep terrors and healthy controls**

Compared with the 89 patients with regular sleepwalking, the 17 patients with sexsomnia more frequently were men, more frequently were older at the disease onset (but not at the time of diagnosis), less frequently had a history or current occurrences of SW/ST, more frequently had sexsomnia (by definition), and had a lower PADSS-A inventory score and total PADSS score, whereas the frequency and consequences of episodes were not different between groups (Table 1). The sleep measures were compared between groups during the first recording night. Compared with healthy controls, patients with sexsomnia had a longer total sleep time, more frequent awakenings from N3, a higher arousal index and a higher periodic leg movements index but no other differences in sleep measures. Compared with regular sleepwalkers, patients with sexsomnia had lower sleep efficiencies and a higher periodic leg movement index but no other differences in sleep measures, including a non-different mean number of awakenings from N3.

## **DISCUSSION**

### **Main findings**

This controlled series included 17 patients with regular sexsomnia and revealed a male predominance, various behaviors (sexual vocalizations, orgasm, masturbation, fondling, vaginal and anal penetration, full sexual intercourse) occurring in heterosexual and homosexual patients, with a wide age range (17-74 years) at sexsomnia onset. The behaviors led to sexual assaults of someone else (wife, n=3, complaint to the police, n=1, female cousin, n=2) and an unrelated female (n=1, complaint to the police) in 43% of patients. In addition, 9 (10%) of regular sleepwalkers also had amnesic sexual behaviors. They had a more severe clinical form of sleepwalking. Patients with sexsomnia had the same abnormally high number of N3 awakenings as regular sleepwalkers, and half of them presented evidence of cortico-cortical dissociation, including concomitant slow (mostly frontal) and rapid (mostly temporal and occipital) EEG rhythms.

### **Confirmation of sexsomnia characteristics found in reviews and series**

The first characteristic of sexsomnia here is its rarity, at least when it is estimated through referrals and published cases. Our specialized, tertiary university hospital could collect only 17 patients with sexsomnia over 8 years and 16,000 new monitored patients, despite being located in the country's capital, with a local population of 10 million inhabitants. This suggests that patients with sexsomnia are rarely referred. One may imagine that the condition is exceptional or under-recognized. However, the relatively high frequency (10% here and 15% in our previous other series)<sup>8</sup> of amnesic sexual behaviors reported by regular sleepwalkers is in favor of the under-recognition of sexsomnia rather than the rarity of



it because patients would not have signaled it until they were specifically interviewed on this topic. In a population-based survey in Norway, 7.1%, of 1000 adults had performed sexual acts during sleep during their lifetime, 2.7% had done it during the prior three months, and 0.4% did it currently at least once a week, with no gender differences in the prevalence.<sup>10</sup> In contrast, the first extensive review of the literature, in 2007, contained 31 published cases;<sup>2</sup> the second, a recent review in 2015, included 22 additional cases;<sup>4</sup> and a UK center reported the largest series to date, with 41 consecutive patients.<sup>5</sup> Another review collected 40 cases, most overlapping with the previously reported cases.<sup>11</sup> In keeping with these series, men were more affected than women in our center. Patients' mean age and age range were also similar and notably wide, with onset as early as age 17 years and as late as age 73 years. The absence of daytime sexual or psychiatric problems was the rule here, as in many, but not all,<sup>12, 13</sup> previous cases. Spontaneous nocturnal orgasms noted here in an old woman have already been mentioned in two women from Turkey (see review<sup>4</sup>). The triggers noted by some but not all patients were classical in the case of NREM parasomnia, including sleep deprivation, stress in the preceding day and alcohol intake. Specific to sexsomnia was the report that a lack of sexual activity in the previous days was a precipitant of amnestic sexual behaviors in 3 patients.

### **Sexsomnia is a NREM parasomnia**

There is strong evidence here to support the concept of sexsomnia as a NREM arousal disorder. In 47.6% of sexsomnia patients, there was a history or current occurrences sleepwalking/night terrors, mostly in their childhood. However, these patients had lower severity scores regarding the range of amnestic behaviors (PADSS-A), showing that apart from sexual behavior, they rarely left the bed and walked. In parallel, as many as 10% of regular sleepwalkers occasionally displayed amnestic sexual behavior in addition to the numerous behaviors of sleepwalkers. This suggests a continuum between sleepwalking without sexsomnia, sleepwalking with occasional sexsomnia, and exclusively sexual behaviors during sleep. The observation of frequent N3 awakenings in patients with sexsomnia (more frequently than controls and as frequently as regular sleepwalkers), as well as concomitant rapid and slow EEG activities, suggesting partial awakenings in half of them, are indirect evidence of NREM parasomnia. However, there is the limitation that no sexual behavior was observed during these arousals, except for a patient who placed his hand in his pants and had an obvious penile erection during several N3 partial awakenings. Direct observations of sexual behaviors during NREM sleep are exceptional and recent. A 60-year-old Italian woman had an episode of masturbation emerging from N3, which was preceded by a hypersynchronous delta pattern.<sup>14</sup> A young Korean soldier had visible, prolonged masturbation during stable N2 and N3 sleep.<sup>15</sup> A man removed the pajamas of his partner, probably during arousal from N3.<sup>13</sup> Although sexsomnia was an NREM parasomnia in all cases in our series, ambulation before sexual behavior was exceptional, except in an isolated case. A man was able to walk back from the sofa to his bedroom during an episode and to assault his wife once, whereas all other episodes always occurred in the same bed. In a previous forensic case report, a man slept on the sofa after a late party and politely loaned his own bed to a female friend, but he walked back to his bedroom during the night and

raped her.<sup>16</sup> At least in these two cases, the findings suggest that amnestic ambulation back to the usual bedroom is possible, which limits the possibility of avoiding sexual assault by sleeping in another room. However, this seems to be the exception rather than the rule in this and in other series.

We incidentally monitored sexual behaviors (masturbation, coital-like pelvis thrusting) during REM sleep in two patients with RBD (one with narcolepsy and one with RBD in association with Parkinson's disease) in a previous study,<sup>3</sup> but they were not the motive of referral and were not reported at home, at least as a problem. In two patients with sexsomnia, a parasomnia overlap disorder was diagnosed by the concomitant presence of repeated N3 sudden awakenings and enhanced REM sleep without atonia, but a defined sexual behavior was only found during N3 awakening in one of them.<sup>14</sup> In other cases, the link between reported sexsomnia episodes and REM sleep was suggested by enhanced muscle tone during REM sleep, which is an indirect and weak link, in the absence of defined sexual behaviors in REM sleep.<sup>13</sup> In addition, patients with RBD have their eyes closed and are usually clumsy in using their environment without purpose. As a consequence, we think that they have a lower risk of penetrating their bed partner during REM sleep, even if a penile erection is physiological in REM sleep, than patients with NREM sexsomnia, who are able to open doors and windows and have their eyes open. All in all, the findings suggest that problematic sexsomnia mostly emerge from NREM sleep.

## New findings

This study produced several new findings. The group of regular adult sleepwalkers (10% of a large group here, 15% in a previous sample from our group) with occasional or frequent sexsomnia was singled out and contained individuals with a generally more severe form of sleepwalking, in terms of the variety and frequency of behaviors other than sexual behaviors. This suggests systematically interviewing sleepwalkers about amnestic sexual behaviors, as mentioned in the PADSS, to prevent sexual assault. We could not confirm the benefit of CPAP mentioned in 4 previous cases with sexsomnia plus obstructive sleep apnea,<sup>4</sup> Similarly, clonazepam but not CPAP treated the sexsomnia of a patient with parasomnia overlap disorder associated with sleep apnea.<sup>17</sup> These results suggest that the presence of apneas may be incidental and not causative in some patients with sexsomnia. We observed a clear penile erection during an episode of partial arousal from N3. Previous cases of sexsomnia were also associated with reported penile erection (otherwise, complete sexual intercourse would not be possible), but no direct evidence was seen until this case and the obvious masturbation of the Taiwanese soldier. This suggests that penile erection is not restricted to REM sleep or that, in cases of parasomnia, the general autonomous arousal (tachycardia, vasoconstriction, mydriasis) during N3 partial awakenings extends in some cases to penile erection, even in the absence of a partner, as here. Eventually, we found evidence of EEG dissociations (slow frontal EEG activity contrasting with rapid posterior EEG activity or simultaneous slow and rapid EEG activities on the same leads) in half of the patients during N3 arousals, which are typical of what we see in regular sleepwalkers. In our clinical scoring experiences, these patterns are not observed in adult patients without parasomnia, suggesting a cortico-cortical dissociation during an N3 arousal would be of value in forensic cases, as one of the fascicle sources of evidence for NREM parasomnia. However, this suggestion is based on clinical experience only. To determine the

sensitivity (here 50% in a sexsomnia group) and, more importantly, the specificity of the cortico-cortical EEG dissociation, one should extend the observation via a controlled, blind study of the EEG patterns during awakenings from N3 in a large number of patients with NREM parasomnia, healthy controls and patients with other sleep disorders (e.g., patients with sleep apnea) before it can be used in forensic cases. Currently, a videopolysomnography is not a mandatory criterion among the ICSD-3 criteria to confirm the diagnosis of arousal disorders. The interest of videopolysomnography for ruling out differential diagnoses such as REM sleep behavior disorder and epilepsy, or to identify whether some N3 arousals are triggered by curable respiratory events or periodic leg movements is however mentioned.<sup>6</sup> Consequently, there is still a debate among sleep experts about the pro and con of videopolysomnographies performed several months after the criminal act, and about the sensitivity and specificity of various markers, including high-amplitude hypersynchronous delta waves, frequent N3 arousals, documentation of confusional arousals, as well as provocative studies using sleep deprivation, acoustic stimuli, and alcohol intake.<sup>18-21</sup> The advantage here is that all but two cases did not go to the police or the justice system, making the interview, examination and videopolysomnographies less biased than if they were performed in the context of a judiciary charge.

Another surprising, new finding was the occurrence of an amnesic complete sexual rape performed by a previously virgin teenager. Eventually, we found a benefit of paroxetine, which increases slow wave sleep, decreases awakenings and may decrease erection. Clonazepam has been to date the most widely used drug in NREM parasomnias, including sexsomnia, with reported success. However, clonazepam is now a scheduled drug, with a first and then annual prescription limited to epilepsy and to neurologists and pediatricians in France, which has restricted its use.

Plus, it may increase sleep-disordered breathing and induce sedation the next day, which may be reasons for alternative treatment ~~it~~ in ~~young~~ patients.

### **Limitations**

An obvious limitation of this study is the small size of the sexsomnia sample (as well as the sample of regular sleepwalkers with sexsomnia), which also seems to be the case in other sleep disorder centers, given the paucity of published series. This limits the power of revealing differences between this group and other groups. We tried to circumscribe this bias by using a control healthy group matched for sex and age with the sexsomnia group and by studying a large group of adults with sleepwalking/night terrors. Furthermore, the patients were studied in a single center by the same sleep neurologists and via the same interview and monitoring procedures, which provides some homogeneity for the study.

### **Conclusion**

This controlled series of 17 patients with sexsomnia studied in a single center confirmed the male predominance of sexsomnia and its close link with NREM parasomnias and with some violent behaviors. It showed some evidence of dissociated EEG during N3 arousals, and it revealed that penile erection was visible during N3 arousal in a sexsomnia patient. The major impact of sexsomnia on the lives of these men and women (leading some of them to consider suicide and bringing others to the police) justifies the collection of more information on this disabling condition.

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**Table 1.** Demographical and clinical characteristics in patients with regular sexsomnia and patients with regular sleepwalking, with and without occasional sexsomnia

	Patients with sexsomnia	Patients with sleepwalking/sleep terrors	Sleepwalkers without sexsomnia	Sleepwalkers with sexsomnia
No. of patients	17	89	80	9
Age, y	37.2 ± 18.4	32.5 ± 10.1	32.8 ± 10.4	29.2 ± 7.1
Age at disease onset, y	31.9 ± 18.6 <sup>a</sup>	15.1 ± 12.4	15.5 ± 12.7	11.7 ± 9.8
Sex, % male	70.6 <sup>a</sup>	41.6	38.8	66.7
Epworth Sleepiness Score, 0-24	7.5 ± 3.9	9.0 ± 5.4	9.1 ± 5.2	7.8 ± 6.6
Current SW/ST, %	11.8 <sup>a</sup>	100	100	100
Past SW/ST, %	35.3 <sup>a</sup>	100	100	100
Current or past SW/ST, %	47 <sup>a</sup>	100	100	100
Sleep terrors, % with	11.8 <sup>a</sup>	58.4	60	44.4
Sexsomnia (1 or more), %	100 <sup>a</sup>	10.1	0	100
PADSS total score, 0-50	10.5 ± 4 <sup>a</sup>	17.2 ± 5.5	18.6 ± 5.3	21.3 ± 6
PADSS-A score, 0-34	3 ± 1.9 <sup>a</sup>	9.2 ± 4.4	8.9 ± 4.3	12.4 ± 4.4 <sup>b</sup>

PADSS-B score (n				
episodes/month)	16.6 ± 21	16.8 ± 21.4	15.2 ± 20.6	30.7 ± 25.1
More than once a night, %	11.8	15.7	13.8	33.3
Nightly or almost nightly, %	23.5	18	16.3	33.3
More than once a week, %	11.8	39.3	42.5	11.1
More than once a month, %	23.5	23.6	23.8	22.2
Less than once a month, %	11.8	3.4	3.8	0
Exceptionally, %	11.8	0	0	0
PADSS-C score, 0-10	3.8 ± 1.9	3.9 ± 1.3	3.9 ± 1.2	4.1 ± 2.1

<sup>a</sup>p<0.05 for a difference with the 89 regular sleepwalkers, <sup>b</sup>p<0.05 for a difference with the regular sleepwalkers without sexsomnia

**Table 2.** Sleep measures in patients with sexsomnia, regular sleepwalkers (with and without occasional sexsomnia), and healthy controls (matched for age and sex with patients with sexsomnia)

	Patients with sexsomnia	Healthy controls	Sleepwalkers with sexsomnia	Sleepwalkers without sexsomnia	Regular sleepwalkers
Number	17	15	9	80	89
Total sleep time, min	467.2 ± 92.9 <sup>c</sup>	384 ± 55.2	518.9 ± 80.6	473.9 ± 90.5	478.4 ± 90.2
Sleep efficiency, %	80.7 ± 9.2 <sup>a,b</sup>	84.2 ± 6.2	89.3 ± 4.6	86.6 ± 8.3	86.9 ± 8
Latency to, min					
Sleep onset	24.7 ± 16.5	41.2 ± 27.1	42 ± 37.1	33.7 ± 30.6	34.6 ± 31.2
N3	56.5 ± 43.6	57.8 ± 22	62.2 ± 39.3	51.3 ± 34.9	52.4 ± 35.3
REM sleep	101.3 ± 54.3	104.3 ± 49	122.6 ± 79.9	130.9 ± 71.6	130.1 ± 72
<b>Sleep stages, % of total sleep</b>					
N1	4.5 ± 2.8	4.9 ± 2.7	4 ± 2	4.1 ± 3.7	4.1 ± 3.6
N2	48.4 ± 9.7	49.1 ± 7.1	51 ± 8.6	50.8 ± 8.5	50.8 ± 8.5
N3	27 ± 15.1	26.8 ± 6.3	22.4 ± 9.3	25.4 ± 8.4	25.1 ± 8.5

REM Sleep	23.3 ± 5.8	19 ± 6.6	23.2 ± 5.7	20.2 ± 9.1	20.5 ± 8.8
N3 awakenings, n	4.5 ± 2.4 <sup>c</sup>	1.5 ± 1.1	5.1 ± 3.2	5.7 ± 3.5	5.7 ± 3.5
<b>Sleep fragmentation, events/h</b>					
Periodic leg movements	5.2 ± 6.2 <sup>a,b,c</sup>	1.3 ± 1.3	0.4 ± 0.9	1.2 ± 5.2	1.1 ± 4.9
Apnea-hypopnea	3.7 ± 5.5	3.7 ± 2.7	4.8 ± 10	3.9 ± 9.1	4 ± 9.2
Arousals	9.4 ± 4.7 <sup>c</sup>	18.3 ± 7.6	10 ± 3.9	10.5 ± 6.3	10.4 ± 6.1

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<sup>a</sup>p<0.05 for a difference with the 89 regular sleepwalkers, <sup>b</sup>p<0.05 for a difference with the regular sleepwalkers without  
sexsomnia, <sup>c</sup>p<0.05 for a difference with healthy controls

### Legend of the figures

**Figure 1:** 30 s epoch with N3 followed by a partial arousal (A and vertical arrow) that contains a dissociated EEG (slow delta EEG activity in left and right frontal cortices contrasts with rapid, alpha EEG activity in the more posterior cortex) as well as a concomitant quiet motor activity (opens his eyes, scratches his nose). The x axis, from top to bottom, displays the eye movements (LOC/A2, ROC/A2, in pink color), the left and right bipolar EEG (Fp1 and Fp2, frontopolar electrodes, C3 and C4, central electrodes, T3 and T4, temporal electrodes, O1 and O2, occipital electrodes, A2, right mastoid) and the chin (*levator menti* muscle) electromyogram.

