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CASE REPORTS

Night Stepping: Fitbit Cracks the Case

Thapanee Somboon, MD[1,2]; Madeleine M. Grigg-Damberger, MD[3]; Nancy Foldvary-Schaefer, DO, MS[1]

[1]Cleveland Clinic Sleep Disorders Center, Cleveland, Ohio; [2]Epilepsy Unit, Neurological Department, Prasat Neurological Institute, Bangkok, Thailand; [3]Department of Neurology, University of New Mexico, Albuquerque, New Mexico

The most common sleep disorders that can result in injurious or violent behaviors include REM sleep behavioral disorder, sleepwalking, comorbid parasomnias, sleep-related dissociative disorder, and obstructive sleep apnea. Video polysomnography is usually indicated to evaluate recurring sleep-related injury in adults. Only one-third of patients with complex paroxysmal nocturnal events will have one of their habitual events on a single night of in-laboratory video polysomnography, most often those who have prominent, high-frequency motor features. We report evidence of sleep walking induced by sodium oxybate identified by steps recorded on a consumer wearable device coinciding with clinical history and evidence of injury.

Keywords: sodium oxybate, sleep walking, narcolepsy, parasomnias

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INTRODUCTION

Violent behaviors during sleep were reported in a phone survey by 1.6% of a random stratified sample of 19,961 participants (15 years or older) from multiple European Union countries.[1] Patients with violent behaviors during sleep were more likely to also report a history of associated parasomnias, especially sleep walking and sleep terrors (odds ratio of 2.0 and 4.2 respectively). Violent behaviors during sleep were more likely to occur in those younger than 35 years and only 12.3% had consulted a physician for them. In another study, among 100 consecutive adults who came to a sleep disorders center complaining of repeated nocturnal injury, video polysomnography identified five sleep disorders: sleep walking/sleep terrors in 54%, REM sleep behavior disorder in 36%, sleep related dissociative disorders in 7%, nocturnal seizures in 2%, and obstructive sleep apnea in 1%.[2] Sleep-related injuries reported were bruising in 95%, lacerations in 30%, and fractures in 9%. Clonazepam controlled the sleep-related behaviors and injury in 51 of 61 patients in whom it was prescribed.

Sleep walking in adults is most likely to occur when priming factors (such as sleep deprivation or situational stress) are coupled with provoking triggers (such as noise, light, touch, sound) in individuals who have a familial or genetic predisposition for it.[3] Priming factors include conditions and substances that increase stage N3 sleep or make awakening from sleep more difficult: sleep deprivation/restriction, sedative-hypnotic medications, situational or emotional stress. Provoking triggers include noise, touch, forced attempted awakenings, periodic limb movements, and obstructvie sleep apnea-induced arousals from non-rapid eye movement sleep that can also precipitate sleep walking in predisposed adults.[4]

REPORT OF CASE

A 35-year-old right-handed female with narcolepsy type 2 beginning 4 years after an infectious mononucleosis infection presented with excessive daytime sleepiness, irresistible daytime napping, recurrent nocturnal awakenings and hypnagogic hallucinations. She denied cataplexy, sleep paralysis, restless legs, sleep walking, or other parasomnias. Her physical examination was normal with a body mass index of 24.6 kg/m^2 and Friedman tongue position of 2.

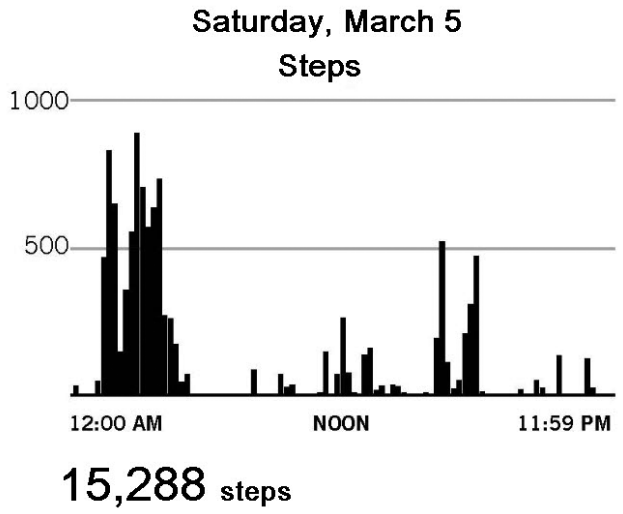
When first diagnosed with narcolepsy type 2 , her Epworth Sleepiness Scale score was 15 of 24. An overnight video polysomnography showed a REM sleep latency of 31.5 minutes, sleep latency of 22 minutes, sleep efficiency of 91%, apnea-hypopnea index of 1 event/h and periodic limb movement index of 5.8 events/h (**Table 1**). Multiple Sleep Latency Test showed a mean sleep latency of 3.8 minutes and 4 sleep onset REM periods. Of note, a lumbar puncture was performed (for possible central sarcoidosis due to narcolepsy and unexplained lymphadenopathy) and cerebrospinal fluid hypocretin level also measured was normal (374.1 pg/mL). Her serum HLADQB1*0602 normally associated with narcolepsy type 1 was negative.

She was prescribed various wake-promoting agents (eg, modafinil, armodafinil, methylphenidate, amphetamine/dextroamphetamine, atomoxetine) without sufficient improvement in sleepiness to permit her to continue teaching elementary school. Unable to work, the patient felt socially isolated and subsequently became depressed. Her depression was effectively treated with venlafaxine-extended release 75 mg daily.

To treat her sleepiness, we prescribed sodium oxybate 4.5 g/night titrated over 6 weeks to 9 g/night. The patient reported a moderate improvement in daytime sleepiness when taking sodium oxybate combined with modafinil 200 mg.

However, 3 months after starting sodium oxybate, the patient woke from sleep with a bruised leg and a cut on her ankle. She continued to experience bruising in sleep several times per week without recall and had no bed partner to provide observations. Coincidentally, she purchased a consumer wearable device (Fitbit Charge, Fitbit, San Francisco, California, United States), concerned that her lifestyle had become increasingly sedentary. During the first week of use, she awoke one morning bruised to find that 15,288 steps had registered, many of which were between 1:00 AM and 5:00 AM (**Figure 1**).

Figure 1—Fitbit data shows several thousand steps between 1:00 AM and 5:00 AM.



A second overnight in-laboratory level 1 video polysomnography was performed with the patient taking sodium oxybate the night of the study (**Table 1**). It showed a markedly elevated percent time in stage N3 sleep of 53% (compared to 12% on her diagnostic polysomnography before sodium oxybate) (**Figure 2**). No significant sleep-disordered breathing, REM sleep without atonia, periodic limb movements, or parasomnias were observed. We recommended the patient secure the safety of her sleep environment, set up a motion-detected video camera in her bedroom, and stop sodium oxybate. No episodes of sleep walking recurred off sodium oxybate for 1 month, but her daytime sleepiness and nocturnal awakenings markedly worsened.

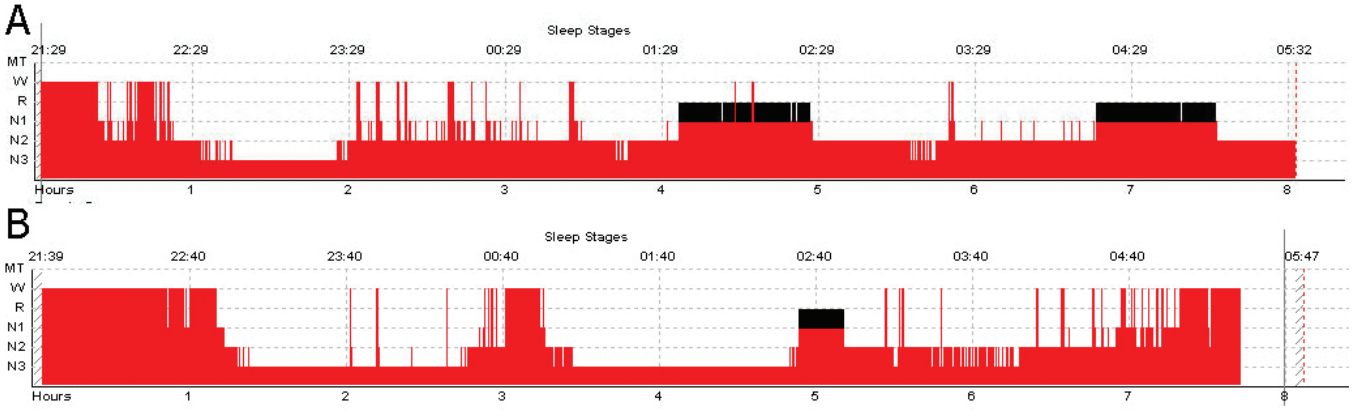
Sodium oxybate was reintroduced after setting up a home video system and 1 month later there were recurring episodes of sleep walking. On at least 8 occasions she awoke from sleep

Table 1—Polysomnography parameters of diagnostic test, with sodium oxybate, and after sodium oxybate discontinuation.

Parameters	Diagnostic	With Sodium Oxybate	Without Sodium Oxybate
TST, minutes	453.0	339.0	350.0
Sleep efficiency, %	91.0	70.7	81.4
Sleep onset latency, minutes	22.0	48.0	53.0
REM sleep latency, minutes	31.5	242.0	215.0
Arousal index, events/h	13.0	16.4	24.7
Stage N1 sleep, %TST	10.0	6.9	7.0
Stage N2 sleep, %TST	45.0	35.1	57.5
Stage N3 sleep, %TST	12.0	52.9	21.9
Stage R sleep, %TST	33.0	5.2	13.4
Apnea-hypopnea index, events/h	1.0	1.4	3.1
Periodic limb movement index, events/h	5.8	9.2	13.0
Periodic limb movement arousal index, events/h	0.9	0.0	3.9

TST = total sleep time.

Figure 2—Hypnograms show sleep stage without sodium oxybate **(A)** and with sodium oxybate **(B)**.



finding herself bruised or sleeping elsewhere in her home. Her Fitbit showed 4,242 steps during that night. She was unable to retrieve the video recordings associated with these events. Living alone, she feared injury and decided to stop sodium oxybate. Her excessive sleepiness remains moderately controlled with armodafinil and methylphenidate coupled with timed daytime naps. No further episodes of sleep walking have been captured on her Fitbit for years after stopping sodium oxybate.

DISCUSSION

We report a case of emergent sleep walking detected by a consumer wearable device and minor sleep-related injuries after the introduction of sodium oxybate in a patient with narcolepsy type 2 without a prior history of parasomnias. Sleep walking and sleep-related injuries resolved after discontinuation of sodium oxybate and re-emerged after re-introduction of sodium oxybate, again documented by the wearable device. Safety of the patient and others in the environment, at times potentially life-threatening, is the primary concern in the management of sleep walking.[2,5] In general, sleep walking in adults is more likely to occur when priming factors are coupled with provoking triggers in susceptible individuals.[2–4]

A recent systematic review of medication-related sleep walking identified 29 drugs which have been reported in small case series or case reports as priming factors for sleep walking.[6] The strongest evidence for medication-induced sleep walking was for zolpidem and sodium oxybate.[6]

Sodium oxybate is the sodium salt of gamma-hydroxybutyrate and approved by Federal Drug Administration for treatment of cataplexy and excessive daytime sleepiness in patients with narcolepsy.[7] Sodium oxybate is rapidly absorbed and eliminated with a mean elimination half-life of 30–60 minutes and requires twice nightly dosing.[8] Sleep walking has been reported in 6% of 781 patients with narcolepsy treated with sodium oxybate in controlled and long-term open-label studies with less than 1% of patients discontinuing it for this reason.[7] Sleep walking in patients with treated with sodium oxybate typically occurs when taking higher doses (eg, 8 to 9 g/night). Sodium oxybate has been shown to increase stage N3 sleep duration and delta power during sleep.[9–11] Mamelak et al. found the duration of stage N3 sleep increased in a dose-related manner during each half of the night in 25 patients with narcolepsy type 1 treated with sodium oxybate.[11] This increase became significant during the second half of the night at 7.5 g and 9 g doses and for the entire night at 9 g doses. Delta power increased in both halves of the night and for the night as a whole with subsequent increases in doses as was the case in our patient. Delayed appearance of sleep walking in patients treated with sodium oxybate is attributed to its appearance after titrating to higher doses. As was the case in our patient, recurrence of sleep walking upon restarting sodium oxybate again suggests sodium oxybate was an important priming factor. Sodium oxybate can also provoke or worsen sleep-disordered breathing, but was not present in our case.

How reliable are timing and number of steps reported by the patient's FitBit? Accuracy of consumer physical activity monitors such as FitBit depend upon the particular model, walking speed, and device placement. Step count accuracy increases at higher walking speeds, linear walking, and wearing the device at the waist rather than wrist.[12] Data from wearable devices may enhance the clinical history in monitoring patients at risk for sleep walking and other parasomnias.

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Address correspondence to: Nancy Foldvary-Schaefer, DO, MS, Cleveland Clinic Neurological Institute, 9500 Euclid Avenue, S73, Cleveland, OH 44195; Tel: (216) 445-2990; Fax: (216) 636-0090; Email: foldvan@ccf.org

DISCLOSURE STATEMENT

All authors have seen and approved the manuscript. The authors report no conflicts of interest.