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COMMENTARY

Eyes wide open minds shut best identify disorders of arousal in adult sleepwalkers

Commentary on Barros A, Uguccioni G, Salkin-Goux V, Leu-Semenescu S, Dodet P, Arnulf I. Simple behavioral criteria for the diagnosis of arousal disorders. *J Clin Sleep Med*. 2020;16(1):121–128.

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Disorders of arousal (DOA) are incomplete awakenings typically from non-rapid eye movement (NREM) sleep—stage N3 sleep—characterized by confusion, disorientation, difficult to fully arouse, nonstereotyped automatic behaviors, and partial/complete amnesia of the event. DOA are sometimes triggered by sound, touch or other stimuli (especially sleep deprivation or biophysiological stressors). Inappropriate/absent responses to intervention/redirection during episodes can lead to violent behaviors and injury to self or others especially in older adolescents or adults. DOA vary in intensity, sympathetic activation and duration from confusional arousals, sleepwalking (SW) to sleep terrors (ST).[1]

A 2016 meta-analysis estimated the lifetime prevalence of SW is 6.9%, and the current prevalence within the last year is 5% in children and 1.5% in adults.[2] DOA in adults that are non-injurious, infrequent, and began in childhood can usually be diagnosed by clinical evaluation and do not warrant polysomnography (PSG). However, video PSG is warranted to evaluate parasomnias that are frequent (> 2–3 per week) or potentially injurious or have caused injury.

The goals of video PSG are to: (1) capture typical events confirming these are incomplete awakenings from stage N3 sleep accompanied by abnormal behaviors; (2) identify if another sleep disorder (sleep apnea or periodic limb movements) is contributing to DOA; and (3) exclude events that are sleep-related hypermotor epilepsy (SHE), REM sleep behavior disorder, sleep-related panic, or dissociation disorders.

Unfortunately, full-blown episodes of SW/ST are rarely captured in a single night of video PSG. Most often, we observe blunted arousals from stage N3 sleep in which we search for behaviors that support a diagnosis of DOA. Until recently, we had little validation of which paroxysmal behaviors best identify DOA in adult sleepwalkers.

In this issue of the *Journal of Clinical Sleep Medicine*, Barros et al retrospectively analyzed 172 overnight in-laboratory video PSG of 1,335 arousals and awakenings from stage N3 sleep (calling them N3 interruptions) in 52 adults with DOA and 52 controls without DOA (healthy controls and patients with sleep apnea, idiopathic hypersomnia and insomnia).[3] Their goal was to identify simple video-based behavioral criteria to distinguish patients with DOA from healthy controls and patients with other sleep disorders. Two scorers identified N3 interruptions by changes in the electroencephalogram (EEG; usually theta and/or alpha activity, sometimes high amplitude hypersynchronous delta activity).[4] They then reviewed and categorized behaviors accompanying events, measured motor activity duration, whether abrupt or slow in onset, and presence/absence of a trigger.

They found eye opening (EO) was the most frequent behavior heralding 69% of 953 N3 interruptions in DOA patients. EO events averaged 3.4 events/h in N3 sleep in the DOA group and 0.5 events/h in controls. A single episode of EO occurred in 15% of 382 N3 interruptions in controls. Two or more N3 interruptions containing EO predicted the DOA diagnosis with a sensitivity of 94% and a specificity of 77%; ≥ 2 EO combined with ≥ 6 N3 interruptions increased the specificity to 94%. They validated these findings on a second set of video PSG data.

They further found a facial expression of fear/surprise, screaming, sitting, or standing were observed only in those with DOA. Head raising, visually exploring the environment, speaking, trunk elevation, and interacting with the environment was commonly observed in DOA (respectively, 41%, 27%, 18%, 13%) and rarely observed in controls (9%, 1%, 0.3%, 0.3% and 0.5%). Ninety-six percent of N3 interruptions in both DOA and control groups were associated with motor behaviors. Most were comfort movements (repositioning, yawning, stretching, rubbing nose/other body parts), seen in 93% of events in controls and 82% in DOA.

EO as the most common behavior accompanying DOA is not new, reported in 76% and 84% of DOA episodes in two smaller case series.[5, 6] However, Barros et al are the first to provide a cutoff of ≥ 2 or more EO from stage N3 sleep in a single night of video PSG as a marker with a high sensitivity and specificity for DOA. EO from sleep is not specific to DOA, as it is also common in SHE seizures. However, SHE seizures typically emerge from stage N2 sleep and DOA from stage N3 sleep.[5]

Strengths of the Barros et al study are large sample size, use of controls including patients with other sleep disorders, and validating predictions on a second set of data. Some limitations also exist, namely that scorers were not blinded to the DOA diagnosis, and the lack of semiology sequence, as we must do in epilepsy to identify network activation.

Two recently published studies explored video PSG DOA criteria.[4,6] Loddo et al retrospectively reviewed 184 DOA episodes in 30 adult sleepwalkers and 10 controls.[6] They identified three different motor patterns of increasing complexity, intensity, and duration: simple arousal movements (SAMs), rising arousal movements (RAMs), and complex arousal patterns with ambulatory movements (CAMs). Ninety-three percent of DOA events were SAMs characterized by head flexion/extension with/without limb movements or partial truncal flexion/extension. EO accompanied 71% of SAM events, visual environment exploration (63%), hands to face (54%), and speaking (25%). Thirty-nine percent of DOA were RAMs: trunk flexion followed by sitting with feet in/out of bed accompanied by EO (93%), hands to face (75%), speaking (54%), and screaming (40%). CAMS occurred in only four patients, EO in all. EO was observed only once in one control when changing position during sleep.

Lopez et al analyzed the first 3 seconds of EEG during N3 interruptions in 160 DOA patients and 50 controls.[4] They identified and classified three EEG arousal patterns: *fast arousal* (predominantly alpha and beta with < 20% theta and delta activity); *slow arousal* (diffuse synchronous delta with < 20% of alpha, beta, or theta); and *mixed* (slow and fast EEG frequencies). They tallied all the slow wave sleep (SWS) events/h in stage N3 sleep, calculating a SWS Fragmentation Index (SWSFI). They found a SWSFI ≥ 6.8 events/h in stage N3 sleep distinguished patients with DOA from controls with a specificity 82% and sensitivity of 79%. Combining EEG patterns and video behaviors increased correct classification of adult sleepwalkers versus controls to 91%.

The SWSFI calculation, while elegant, is time consuming to score and requires considerable expertise in EEG. Whereas, opening of the eyes accompanying two or more N3 arousals/awakenings is satisfyingly simple to employ and shown by Barros et al to be sensitive, specific and reproducible for identifying patients with DOA from sleep laboratory controls.

Multiple pathophysiological processes appear to predispose to DOA: sleep state instability (propensity for arousals from NREM sleep), sleep inertia (incomplete awakening from NREM sleep), state dissociation (ability to simultaneously straddle both NREM sleep and wakefulness), and/or activation of central pattern generators (permitting expression of subcortical determined motor behaviors without conscious higher cortical input).[7] Which of these is operant appears to vary between individuals, and warrants precision medicine to best treat DOA.[8] We need prospective multicenter studies to confirm objective video PSG criteria for DOA and evidence-based clinical practice guidelines for the most common and puzzling parasomnia.

CITATION

Grigg-Damberger M, Foldvary-Schaefer N. Eyes wide open minds shut best identify disorders of arousal in adult sleepwalkers. *J Clin Sleep Med*. 2020;16(1):7–8.

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DISCLOSURE STATEMENT

The authors report no conflicts of interest.