



Rapid eye movement sleep behavior disorder or epileptic seizure during sleep? A video analysis of motor events



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ABSTRACT

Purpose: To compare the motor semiology of sleep behavior disorder (RBD) during rapid eye movement (REM) with epileptic seizures in non-REM and REM sleep.

Methods: We analyzed the types and frequency of motor events from videos of patients with RBD (n = 15, mean age 64.8 years, 179 motor episodes) and patients with epilepsy (n = 15, mean age 34.4 years, 87 sleep-related epileptic seizures including 34 during REM sleep).

Results: Patients with sleep-related epileptic seizures more often woke up abruptly (28% vs. 0.3%), raised head/trunk (31% vs. 1.6%), opened their eyes (89% vs. 5%), had whole body movements (74% vs. 14%) or dystonic posturing (29% vs. 1.3%), manipulated objects in their environment (44% vs. 3.9%), as if emerging from sleep with ictal automatisms, and sniffed, coughed, or breathed differently during motor events. In contrast, RBD patients more often remained lying down with closed eyes (99% vs. 78%) as if still asleep, with non-stereotyped jerky movements (42% vs. 8%) and outward-directed behaviors (14% vs. 2%) than patients with epilepsy. There were no differences in violent behaviors and vocalizations between groups. Comparison with subgroups of REM or non-REM sleep seizures yielded many similar findings.

Conclusion: These different motor patterns discriminate between RBD events and sleep-associated seizures, and could be used as an aid to differential diagnosis.

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1. Introduction

During rapid eye movement (REM) sleep behavior disorder (RBD), patients display vocalization and/or complex motor non-stereotyped behaviors (mostly acting out dreams) in association with excess muscle tone during REM sleep (American Academy of Sleep Medicine (AASM), 2014) [1]. The disorder mostly affects people older than 50 years, and those with neurodegenerative diseases [2]. RBD events must be differentiated from nighttime

epileptic seizures as other paroxysmal behaviors during sleep [3–5]. While this differentiation may not be difficult, both epileptic seizures and RBD are prevalent in aged people and may exceptionally be concomitant [4]. More over, symptoms during RBD can mimic focal epileptic seizures, namely of frontal and temporal lobe epilepsy [3]. Indeed, temporal or other extra-frontal lobe epilepsies may cause sleep-related hypermotor symptoms [6]. Recall of dreams on waking is a strong evidence for RBD, but it occurs often or always in only 59% of parkinsonian patients with RBD [7], and 44% of patients with idiopathic RBD are unaware of their dream-enactment behaviors [8].

Thus, when patients report abnormal paroxysmal events during sleep with a history poorly suggestive of a specific diagnosis, general physicians may have difficulties in referring them for an appropriate investigation. Video-EEG (v-EEG) monitoring and video-polysomnography (v-PSG) are standard investigative

Abbreviations: REM, rapid eye movement; NREM, non-rapid eye movement; RBD, rapid eye movement sleep behavior disorder.

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procedures for epilepsy and RBD respectively, but are not always easily available.

We therefore aim here to compare clinical manifestations of RBD episodes and epileptic seizures during non-REM (NREM) and REM sleep. We used video data to extract features that best could discriminate motor events in these disorders. There is little comparative data on motor semiology in RBD and epileptic seizures [4,9,10]. REM sleep-associated seizures are extremely rare [11–14]. Thus, little is known about the semiology of seizures during REM sleep and how they differentiate from the RBD episodes.

2. Methods

2.1. Patient selection and sleep monitoring in the sleep disorder unit

Over 10 months in 2015, we selected 15 consecutive patients diagnosed with RBD and referred to the Sleep Disorders Unit of Pitié-Salpêtrière university hospital. They all met ICSD-3 criteria for RBD: (i) repeated episodes of sleep related vocalization and/or complex motor behaviors; (ii) these behaviors were documented by polysomnography to occur during REM sleep or were presumed to occur during REM sleep based on clinical histories of dream enactment; (iii) polysomnographic recording demonstrated REM sleep without atonia; (iv) disturbances were not better explained by another sleep disorder, mental disorder, medication, or substance use [1].

Video-PSG performed during one night included electroencephalography (EEG) with electrodes Fp1, C3, T3, O1, Fp2, C4, T4, O2, electrooculogram, chin and left and right leg electromyography, nasal pressure, oropharyngeal sounds via a tracheal microphone, chest and abdominal efforts via belts, pulse oximetry, electrocardiogram, and synchronized video and audio monitoring performed under infrared lights. Tonic muscle activity was considered enhanced when 50% of a REM sleep epoch contained a chin muscle activity twice greater than the minimum activity during NREM sleep. The number of epochs with enhanced tonic chin muscle activity was divided by the total number of REM sleep epochs to derive the percentage of REM sleep without atonia. Sleep stages, arousals, motor and respiratory events and chin tonic activities (after excluding snoring artifacts) were scored according to criteria of the AASM, 2014 [15]. The video recordings were carefully examined by the Sleep Unit team (SLS, APJ, IA) in order to confirm the diagnosis, and by VHNM to identify any movements, behaviors and vocalizations during REM sleep, and were reported on the scoring of the v-PSG.

We noted all RBD minor, major and motor or verbal events during the recording time. We selected the events which were assumed to be easily noticeable, and were readily objectively observed by video-polysomnography reviewers, i.e., fulfilling at least one of the following criteria: (i) jerks which move limb(s) away from the body; (ii) prolonged or strong movements sufficient to awaken the patients or their bed-partners; and (iii) presence of gestures, behaviors, breathing changes, facial expressions, oral manifestations, eye opening, vocalizations or dystonic posturing. Behaviors vocalizations or movements occurring during arousal or linked to respiratory event (apnea, hypopnea) were not analyzed.

2.2. Patient selection and video-EEG monitoring in the epileptology unit

We retrospectively selected patients with at least one seizure occurring during REM sleep from those referred for v-EEG monitoring in the Epileptology Unit of the Pitié-Salpêtrière university hospital between 2004 and 2015. Fifteen (1.9%) of

785 referred patients fulfilled this criterion. They suffered from different types of refractory epilepsy, diagnosed on multimodal criteria including clinical symptoms, structural and nuclear brain imaging, scalp EEG, and intra-cranial v-EEG in three patients. Continuous scalp v-EEG recording was performed for 12.1 ± 11.8 (mean \pm SD) nights on average, using the international 10/20 system for electrode placement (Fp1, Fp2, F3, F4, F7, F8, C3, C4, P3, P4, T3, T4, T5, T6, O1, O2, Fpz, Fz, Cz, Pz, Oz) plus supplementary inferior temporal electrodes (FT9, T9, TP9, FT10, T10, TP10) and a single-channel ECG (BMSI system, Nicolet, Madison, Wis., U.S.A.; SystemPlus Evolution, Micromed, Mogliano Veneto, Italy). Antiepileptic drugs were, when needed, partially or totally withdrawn during video-EEG records in a progressive manner, in an attempt to provoke habitual seizures while avoiding secondary generalization. All recorded seizures were analyzed routinely by the Epilepsy Unit team (VHNM, OS, VN, CA, SD), to confirm diagnosis, the seizure types and semiology features. Video data were later reviewed (VHNM and IA) for this study.

Sleep stages have previously been recognized from 21-electrode-EEG signals [9]. We distinguished different sleep stages, from 27-electrode-EEG recording, according to EEG criteria of AASM 2014 [15]. NREM stages were defined from the presence of vertex spikes, spindles, K complexes, and slow EEG activities. REM sleep periods were recognized as abrupt changes in EEG records: from slow NREM sleep activities to desynchronized-low voltage activities of mixed frequencies with no spindles or K complexes, often associated with saw tooth waves or twitching artifacts visible on EEG; presence of rapid eye movements (captured by right and left polar frontal channels), and “quiet” muscle artifacts on EEG compared to wakefulness. Video records provided further aid in confirmation of sleep state.

All epileptic seizures occurring during sleep (NREM or REM) were selected. Ictal EEG discharges, temporally and spatially organized, accompanying the clinical symptoms were captured in all patients except for one where they were obscured by muscular artifacts but the clinical symptoms recorded and the whole features were consistent with the epileptic nature of behaviors. Aiming to study behaviors easily noticeable by a non-medical observer, we included all movements, behaviors or vocalizations over a period gathering both ictal and post-ictal manifestations.

2.3. Ethical approval

The study was part of a systematic medical assessment and healthcare program for patients referred to the Sleep Disorder Unit and the Epileptology Unit. All participants received spoken and written information on sleep assessment and v-EEG monitoring procedures. They were informed that data would be anonymized and stored for research unless they were formally opposed. On the basis of this program, the Institutional Review Board of the French Sleep Society considered the full research study as part of routine care procedures. According to the French laws, the ethical committee waived written consent for this routine procedure (because of oral consent and non-opposition to re-use clinical data for research purpose, provided that anonymity is warranted).

2.4. Statistical analysis

We compared the duration and timing of events, the type and frequency of gestures, movements, behaviors, and vocalizations in RBD patients and patients with epilepsy during sleep, NREM and REM sleep seizures. Statistical analyses were performed using chi-square test, exact Fisher test, and nonparametric Mann-Whitney rank sum test as appropriate. Multiple comparisons were corrected by Benjamini and Hochberg method.

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