Sleep Medicine 12 (2011) S59–S63

Contents lists available at SciVerse ScienceDirect

Sleep Medicine

journal homepage: www.elsevier.com/locate/sleep

Original Article

Motor events during REM sleep in patients with narcolepsy–cataplexy: A video-polysomnographic pilot study

Christian Franceschini [a,b,*], Raffaele Ferri [c], Fabio Pizza [a], Lara Ricotta [a], Stefano Vandi [a], Stefania Detto [a], Francesca Poli [a], Carlo Pruneti [b], Michela Mazzetti [d], Carlo Cipolli [d], Elio Lugaresi [a], Giuseppe Plazzi [a]

[a] Department of Neurological Sciences, University of Bologna, Bologna, Italy
[b] Department of Psychology, University of Parma, Parma, Italy
[c] Department of Neurology, Oasi Institute IRCCS, Troina, Italy
[d] Department of Psychology, University of Bologna, Bologna, Italy

ARTICLE INFO

Article history:
Received 27 September 2011
Received in revised form 11 October 2011
Accepted 12 October 2011

Keywords:
REM sleep behavior disorder
Narcolepsy–cataplexy
Video-PSG recording
Simple and complex motor events
REM sleep
Vocalizations
Dream enactment

ABSTRACT

Objective: We carried out a systematic video-polysomnographic analysis of the number and type of motor events during REM sleep in narcolepsy–cataplexy patients with REM sleep behavior disorder (NC + RBD) but not clinical RBD (NC – RBD).
Methods: Twelve NC + RBD and 10 NC – RBD male patients underwent video-polysomnography (video-PSG). Motor events of different type and complexity (i.e., elementary and complex movements and vocalizations) occurring during REM sleep were visually assessed, and indices of their frequency per hour of REM sleep were calculated. Subsequently, the index values were compared in NC + RBD versus NC – RBD patients.
Results: Typical RBD behaviors observed in five NC + RBD patients were not included in any type of motor events. No objective conventional sleep parameter, including visual analysis of chin electromyographic (EMG) activity, significantly differed between the two groups of NC patients. NC + RBD patients showed higher occurrence of elementary movements ($p = 0.034$) during REM sleep compared with NC – RBD patients, but the occurrence of complex movements did not differ significantly.
Conclusions: Video-analysis of motor events during REM sleep may improve the diagnosis of RBD in NC. RBD in NC patients is mainly characterized by elementary rather than complex movements, consistent with the view that RBD with NC patients displays a distinct phenotype with respect to other RBD patients.

1. Introduction

REM sleep behavior disorder (RBD), first described in 1986 by Schenck et al. [1], is an REM sleep parasomnia characterized by the lack of physiological muscle atonia during REM sleep (REM without atonia – RWA) at polysomnography (PSG), and by an intense motor activity leading to potentially harmful dream-enacting behaviors [1]. These motor manifestations seem to reflect the concomitant dream, by translating some of its contents into motor behaviors: patients scream, kick and punch, assault their bed partner, fall out of bed, and may cause sleep-related injuries [2]. RBD episodes may occur in otherwise healthy people (idiopathic RBD), but also arise or even herald the first signs of disease in a variety of progressive neurodegenerative conditions (mainly synucleinopathies, i.e. Parkinson Disease, Multiple System Atrophy, Levy Body Dementia) [3–6], and in patients with narcolepsy [7–12].

An early description of the PSG features of RBD in narcoleptic patients was reported in the 1970s as a "dissociated" sleep state, characterized by the coexistence of electroencephalographic (EEG) features of REM sleep and the persistence of elevated tonic chin EMG activity intermingled with bursts of phasic activations [13]. After the first documented association of RBD and narcolepsy by Schenck and Mahowald in 1992 [12], several studies confirmed a fairly high prevalence of RBD in narcoleptic patients [7–12]. The variations in prevalence rates in these studies seem to depend on the tools used to assess RBD; in fact, studies based on history taking or questionnaires detected an association widely ranging from 36% to 61%, whereas studies based on video-PSG disclosed that 43.2% of patients with narcolepsy–cataplexy (NC) displayed RBD [7]. Video-PSG studies have also shown that RBD is not an every-night phenomenon in NC patients [7,14].

An increased chin EMG activity during REM sleep has been previously reported as a common trait in NC since the 1970s [13]. Studies on NC patients using visual scoring techniques

* Corresponding author. Address: Department of Neurological Sciences, University of Bologna, Via Ugo Foscolo 7, 40123 Bologna, Italy. Tel.: +39 051 2092926; fax: +39 051 2092963.
E-mail address: christian.franceschini@unibo.it (C. Franceschini).

1389-9457/$ - see front matter © 2011 Elsevier B.V. All rights reserved.
doi:10.1016/j.sleep.2011.10.013

[11,10,15,16] or computerized analysis tools [17,18] have confirmed an elevated EMG activation during REM sleep, which is also, albeit slightly, higher in NC patients with RBD [19].

Some other items of evidence suggest that NC patients present specific clinical and pathophysiological features in control. Indeed, narcolepsy patients and RBD patients share common polysomnographic abnormalities indicative of impaired motor control during REM sleep: in particular, they share an increased number of periodic limb movements during sleep (PLMS), especially in REM sleep [20,8]), and an absence or reduction of physiologic REM sleep muscle atonia [17,11]. Moreover, narcolepsy patients show rhythmic movements intermingled over a plateau of muscle atonia during sleep paralysis, and inappropriate occurrence of muscle atonia and jerking activities accompanying cataplexy attacks during wakefulness [7]. To account for these features, it has been suggested that they may be due to the underlying hypocretin-1 (hcrt-1) defect, resulting not only in sleep state instability, but also in unwanted postural atonia during wakefulness and in increased muscular activity during REM sleep [21,22].

To substantiate this view, a careful and complete classification and quantification of motor events during REM sleep in narcoleptic patients is needed. This classification could also lead to the identification of behavioral and PSG indices of motor events capable of distinguishing NC patients with RBD from those without, even in the absence of clear RBD episodes. Indeed, RBD occurrence is not an every-night phenomenon and, therefore, the usual one-night video-PSG recording made to confirm the clinical diagnosis [7,14] may not capture it.

In this pilot study we therefore examined the PSG and behavioral characteristics of motor events during REM sleep in NC patients with (NC + RBD) and without clinically-documented RBD (NC − RBD). To characterize the behavioral patterns of all the visually detectable motor events, a detailed and comprehensive video-PSG analysis was carried out using a slightly modified version of the Frauscher and coworkers' scoring system [23].

2. Materials and methods

2.1. Patients

In the series of NC patients first diagnosed from January to August 2011 at the Sleep Disorders Center, Department of Neurological Sciences, University of Bologna, it was planned that only men would be selected for the present study. This decision, which was due to the exploratory aims of the study (and, thus, the need to exclude possible gender-related confounding factors), was based on the prevalence of men in the population (and also presumable in our series) of NC patients.

The diagnosis of NC was made in 22 men according to the clinical (i.e., daytime sleepiness, cataplexy) and polysomnographic (i.e., a 48 h continuous PSG followed by a five nap opportunity multiple sleep latency test, MSLT) international criteria [2]. Moreover, human leukocyte antigen (HLA) DQB1*0602 typing, and, whenever possible, cerebrospinal fluid (CSF) hcrt-1 measurement were performed. Subjective sleepiness at the time of the study was assessed by means of the Italian version of the Epworth Sleepiness Scale (ESS) [24,25].

Among the 22 first-diagnosed patients, a clinical diagnosis of RBD was posed in 12 patients (NC + RBD) on the basis of the responses to a specific semi-structured questionnaire [26], which was framed according to the International Classification of Sleep Disorders 2nd Edition (ICSD-2) [2], and aimed at establishing the diagnosis of RBD by examining its clinical features over the past 12 months. The questionnaire was focused on the following RBD characteristics: (i) clinical features: vocalizations, movements of limbs and body, spontaneous report of dream experience, and report of any specific content of mental experience during sleep; (ii) duration and overnight distribution of RBD; (iii) frequency of episodes, and (iv) occurrence of sleep-related injuries.

In addition, NC duration was systematically investigated together with clinical history of the following sleep disorders: non-REM parasomnias (i.e., confusional arousals, sleepwalking, sleep terrors), sleep-talking, sleep-related bruxism, sleep-enuresis, and sleep-related eating syndrome [2].

At the time of the study, all NC patients were drug-naïve. The clinical features of the two subgroups of NC + RBD ($n = 12$) and NC − RBD patients ($n = 10$) are reported in Table 1.

The institutional review board of the Department of Neurological Sciences, University of Bologna approved the study project. All patients signed a written informed consent before the study entry.

2.2. Video-polysomnography

After an adaptation night without video-recording, NC patients underwent a full night of sleep in – laboratory with video-PSG recording.

Patients were allowed to be asleep and awake spontaneously, without any time restriction. The parameters considered for the PSG recording were: EEG (C3-A2, C4-A1, O2-A1), bilateral electro-oculogram (EOG), chin EMG, and electrocardiogram (ECG). The breathing pattern was monitored through an oro-nasal thermistor, thoraco-abdominal bands, and a finger pulse oximeter [27]. Patients with an apnea/hypopnea index (AHI) $\geqslant 15$ were excluded [27,2]. PLMS were scored according to the current international criteria [28], and the PLMS index (PLMI) was computed [28].

The video recording, time-synchronized with the PSG track, was obtained from an infrared camera (video resolution of 1280×960 pixels). PSG tracks were scored by a sleep expert according to the criteria of Rechtshaffen and Kales [29]. All the percentages of the time spent in each sleep stage referred to the total sleep time (TST), whereas the sleep efficiency referred to the time in bed (TIB).

Moreover, the activation of the chin EMG signal in REM sleep was evaluated according to the criteria proposed by Lapierre and Montplaisir in 1992 [30], and Consens et al. [15], in order to obtain the percentage of the total REM epochs scored as tonic (Tonic REM 30-s epochs%) and to obtain the phasic EMG density (Phasic REM 3-s miniepochs%).

2.3. Definition of motor events

The video classification of motor events in REM sleep was performed according to the classification proposed by Frauscher and colleagues in 2007 [23]. Accordingly, motor events were classified considering their complexity (and also considering the parts of the body involved) as follows:

(a) Elementary:
  (i) myoclonic events: events defined as sudden, brief, and involuntary, and involving the limbs, face or trunk,
  (ii) simple events: the single twitch of the fingers, or more important, a "body jerk".
(b) Complex:
  (i) complex events: events that involve multiple muscle groups at the same time,
  (ii) acting out events (i.e., clear-cut RBD episodes),
  (iii) aggressive and/or violent movements: motor behaviors in which the patient can potentially hurt or injure himself and/or the bed partner (e.g., kicking or punching).
(c) Vocalization:
  (i) not associated with visible motor events,
  (ii) associated with visible motor events.