Sleep Medicine 63 (2019) 38–40

Contents lists available at ScienceDirect

Sleep Medicine

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

Video-Clinical Corners

Overt replay during REM sleep of the UPDRS finger taps sequence in a patient with REM sleep behavior disorder

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ARTICLE INFO

Article history:
Received 2 April 2019
Received in revised form
26 May 2019
Accepted 30 May 2019
Available online 8 June 2019

Keywords:
REM sleep
REM sleep behavior disorder
Replay
Procedural memory

1. Introduction

Animal studies have shown that sequenced patterns of neuronal activity may be replayed during sleep [1]. However, in humans the existence of such temporally-structured replay of a recently learned behavior has only been demonstrated during non-rapid eye movement (NREM) sleep, in a single patient sleepwalking [2]. Here, we observed a patient with idiopathic rapid eye movement (REM) sleep behavior disorder (RBD) who replayed during REM sleep a motor task used to evaluate bradykinesia during wakefulness.

2. Case report

A physician referred a 74-year-old male patient to the sleep center because for the past three years he talked in his sleep, kicked and occasionally fell from bed. Except for antiplatelet medication he took no treatment. As RBD was suspected (and could be associated with parkinsonism or dementia), the patient was examined at admission (around 4 PM). The neurologist performed the motor part of the Movement Disorder Society - Unified Parkinson's Disease Rating Scale (MDS-UPDRS [3]), including muscle rigidity, fingers, hands and legs motor agility, as well as axial motor scoring. His motor score was 0/132, and he had no neurological disorder. It was the first time that the patient underwent this examination.

He underwent a video-polysomnography during the next night and a second, consecutive night. The sleep macro-structure was normal (except for an increased [24.1/h] periodic leg movement index) and there were no sleep apnea. The percentage of REM sleep without atonia was 82% (tonic chin muscle tone, normal values are below 18%). Complex motor behaviors in REM sleep included sleep talking, shouting, laughing, applauding, eating, and pointing invisible characters. Consequently, the patient met the criteria of idiopathic RBD.

During the fourth REM sleep episode of the second night, the patient performed a curious 45-s long motor sequence (Fig. 1). He raised the forearm in pronation, attempted to tap the right thumb with index finger in rapid succession (small amplitude movements), then raised the head and tapped right thumb with index finger twice (Fig. 2) and almost synchronously tapped the left thumb with index finger (small amplitude movements). Soon after, he briefly repeated the right finger taps while uttering indistinguishable vocalizations and smiling (Video-clip). This motor pattern, performed with closed eyes, was consistent with the finger taps test (item 3.4) of the MDS-UPDRS, performed at admission. The patient had no dream recall the next morning.

Supplementary video related to this article can be found at https://doi.org/10.1016/j.sleep.2019.05.018.

3. Discussion

Tapping the thumb with the index finger in rapid succession, right and then left, does not correspond to any purposeful behavior or co-speech gesture. Rather, it mimics the motions first shown by the neurologist and copied, upon request, by the awake patient approximately 36 h before. This is, to the best of our knowledge, the first direct and unambiguous demonstration of overt behavioral replay during human REM sleep of a recently learned procedural task. We previously reported on a sleepwalker having partially

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https://doi.org/10.1016/j.sleep.2019.05.018

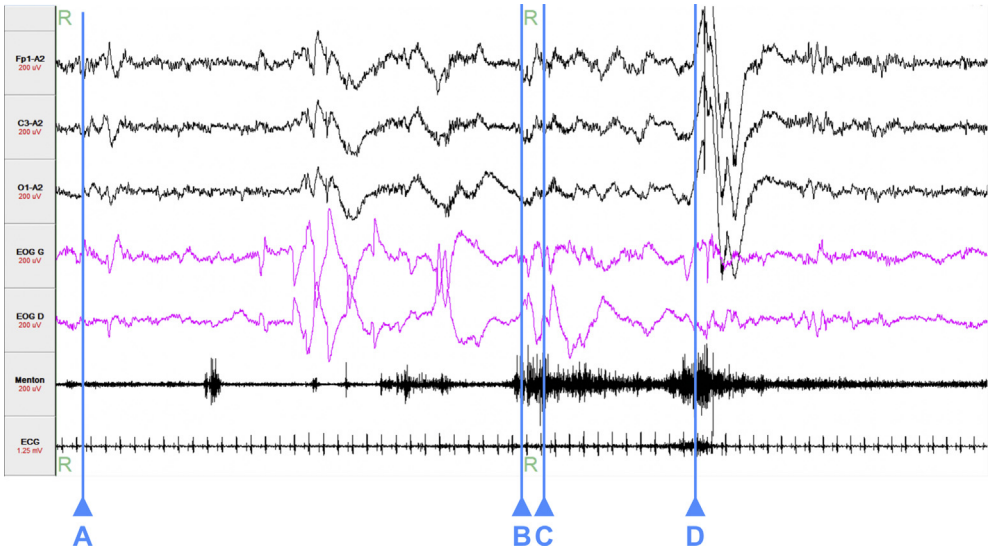

Fig. 1. Polysomnography of the full RBD sequence. This 60 s polysomnography extract includes, from top to bottom, the Fp1/A2, C3/A2 and O1/A2 EEG channels (black lines), the right and left electro-oculograms (red), the mentalis (black) EMG and electrocardiography (black), with the successive right (A), right (B), left (C) and right (D) finger taps.

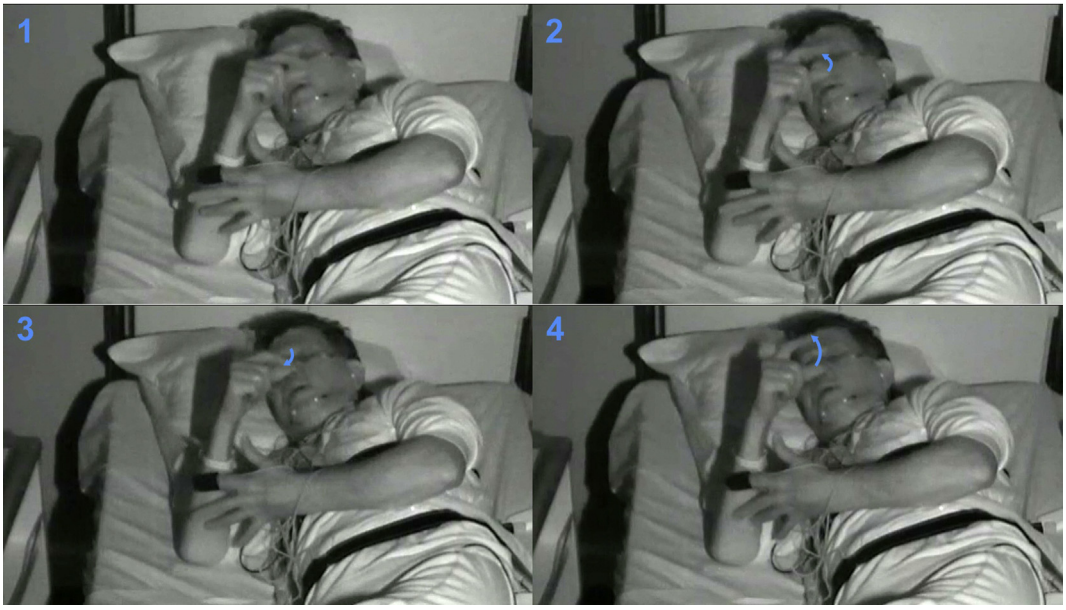

Fig. 2. Finger taps sequences during an RBD episode. The successive (1–4) screenshots illustrate how the patient, who is in REM sleep and has REM sleep behavior disorder (RBD), taps the right thumb with index finger twice (as during wakefulness, item 3.4 of the MDS-UPDRS testing).

replayed a complex, recently learned motor sequence during a NREM parasomnia episode [2]. This observation can now be extended to REM sleep. Of note, both this sleepwalker and the patient with RBD performed the sequence during the second (and not the first) night after the training, in accordance with models which state that early memory incorporation during sleep takes place during the first two nights [4]. Here, the movements were clumsier during REM sleep than during wakefulness, in keeping with the "rough" motor signature of RBD movements that we previously described [5], as if RBD movements, driven by premotor or motor cortex, would bypass the basal ganglia [6]. This early hypothesis has been recently supported by functional brain imaging and deep brain monitoring during RBD [7,8].

The motor patterns required by the MDS-UPDRS motor testing are simple, and do not require any extensive training over day and night to be learned (unlike more complex sequences [9]). They may have been already consolidated via the striatum connections during the previous waking time. Replaying this motor pattern (using cortical memories) may rather be part of a new scenario. The patient smiled when replaying the finger taps test asleep, whereas he did not when he first executed the test awake. He may have judged this test as ridiculous, or integrated it into a new, funny or unrelated dreaming scenario. In the same direction, we found that verbal declarative memories was integrated at a semantic (rather than literal) level in sleep talking during REM sleep in a patient with RBD [10].

This serendipitous observation supports the concept that newly learned procedural memories are integrated into the mental content of subsequent REM sleep, and replayed through activation of large-scale, distributed brain networks.

Conflict of interest

The ICMJE Uniform Disclosure Form for Potential Conflicts of Interest associated with this article can be viewed by clicking on the following link: https://doi.org/10.1016/j.sleep.2019.05.018.

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