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Original article

The occurrence of respiratory events in young subjects with a frequent rhythmic masticatory muscle activity: a pilot study

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ABSTRACT

Purpose: Concomitant occurrence of respiratory events can be often overlooked in the clinical practice of SB. This study assessed physiological characteristics of rhythmic masticatory muscle activity (RMMA) and concomitant respiratory events in young SB subjects asymptomatic to obstructive sleep apnea (OSA).
Methods: Twenty-two subjects (age: 24.1 ± 1.9 years; F 8: M 14; BMI: 20.2 ± 1.9 kg/m^2) were polysomnographically diagnosed as moderate-severe SB. Sleep architecture, oromotor (RMMA and non-specific masseter activity [NSMA]) and apnea/hypopnea events were scored.
Results: All subjects showed normal sleep architecture whereas 6 exhibited respiratory events at a mild level of OSA. In all subjects, RMMA predominantly occurred in Stage N1 + N2 while NSMA occurred in Stage N1 + N2 (approximately 60 %) and in Stage R (up to 30 %). Up to 50% of respiratory events were scored in Stage R. RMMA occurred more frequently in close association (e.g., within 10 s) with respiratory events in 6 subjects with OSA than those without. The percentage of RMMA occurring closely to respiratory events was positively correlated with apnea–hypopnea index (AHI) in Stage N1 + N2 only while that of NSMA was positively correlated with AHI in Stage N1 + N2 and Stage R. A sub-analysis in 6 subjects with OSA, RMMA after respiratory events was followed to arousals while those before respiratory events were mostly associated with central apnea.
Conclusions: A subpopulation of young SB subjects can show concomitant respiratory events. Further large sample studies are needed to demonstrate that the occurrence of subclinical respiratory events represents a clinical subtype of SB.

1. Introduction

Sleep bruxism (SB) is a sleep-related movement disorder, characterized by frequent occurrence of rhythmic masticatory muscle activity (RMMA) and teeth grinding noise [1]. The prevalence of SB is about 5–10 % in adults and it decreases with age [2,3]. Age-related decrease of the prevalence is unique for SB since the prevalence of the other common sleep disorders, such as obstructive sleep apnea (OSA), increases with age [1]. Previous polysomnographic studies showed that SB patients less likely had severe OSA but they may have a mild level of OSA [4–6]. Several studies suggested that concomitant occurrence of respiratory events, even though OSA is subclinical or mild, can be a significant clinical issue in management of SB. Such comorbidity can be associated with morning headache, which can be resolved by a use of oral appliance in the SB patients and mild OSA patients [7,8]. Oral splint, commonly used on upper dentition, can increase respiratory events and snoring in mild OSA patients [9,10]. Therefore, the physiological characteristics of RMMA and respiratory events need to be investigated in primary SB patients for the better understandings of the clinical significance of comorbidity.

Previously, physiological associations between RMMA and respiratory events have been usually investigated in middle-aged

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or older patients with moderate to severe OSA. These studies failed to demonstrate direct causal and temporal associations between the two events [11–15]. These patients had compromised sleep processes [16–18] that could influence the occurrence of RMMA [19–21]. In addition, the pathophysiological phenotypes of concomitant OSA [22] would represent the variety of clinical subtypes of primary SB patients in the clinical setting. Therefore, the aim of this study was to investigate the physiological associations between RMMA and respiratory events in relation to the time and sleep states in young SB patients.

2. Materials and methods

2.1. Participants

Sixty-one subjects (age: 24.4 ± 2.6 years old, F: 26, M: 35; BMI: 20.8 ± 1.7 kg/m^2) were first recruited for the ongoing prospective polysomnography (PSG) study for SB at Osaka University. The subjects were recruited from university students, staff, and their friends. They completed a written informed consent form approved by the Research Ethics Committee of Osaka University Graduate School of Dentistry and Osaka University Dental Hospital (H25-E9). Subjects were invited for a two-night PSG examination after they were found not to have the following exclusion criteria. Exclusion criteria were: a history of neurological or psychiatric diseases; medical problems such as pulmonary, cardiac, and renal diseases; pregnancy; a use of medications such as analgesics and hypnotics; presence of shiftwork; presence of severe daytime sleepiness; presence of a report on regular loud snoring; and obesity (BMI > 25 kg/m^2). Among 61 subjects, 19 reported a history of tooth grinding noise during sleep while 42 did not.

2.2. Polysomnographic recordings

Prior to the PSG recording, subjects were instructed to fill the Japanese versions of the Pittsburgh sleep quality index (PSQI), the Japanese version the Epworth sleepiness scale (JESS), and self-administered questionnaires. Subjects were interviewed on the subjective signs and symptoms of SB and OSA, and on sleep quality. Intra- and extra-oral examinations were done to assess clinical signs and symptoms of SB.

PSG recordings were done for two consecutive nights in the sleep research laboratory at Osaka University Graduate School of Dentistry. The first night was used for habituation, and the second night was used for analysis. PSG montages included the following biosignals: electroencephalograms (EEGs; C_3M_2, C_4M_1, O_1M_2, O_2M_1, F_3M_2, and F_4M_1); electro-oculograms (EOGs); electro-cardiograms (ECGs); EMGs of the chin/suprahyoid, bilateral masticatory muscles (masseter and temporalis), and bilateral tibialis muscles; snoring sound; nasal pressure and oronasal thermal airflow; chest and abdominal movements; arterial oxygen saturation; body position; and laryngeal movements. Audio and video recordings were made simultaneously. All signals and audio video were recorded and fed into a personal computer using commercial software (Embla N7000, Natus Medical Incorporated, Pleasanton, CA, USA). Sleep recording started between 22:30 and 23:00, and ended between 06:30 and 07:30 or when subjects awoke.

2.3. Scoring sleep and oromotor variables

According to the AASM manual version 2.1 of the AASM criteria [23], sleep stages, arousals, and respiratory events were scored by a registered PSG technologist using commercial software (REMbrandt, Natus Medical Incorporated). RMMA, including phasic, mixed and tonic types, and non-specific masseter activity (NSMA) unrelated to RMMA were scored by the investigators (TK and SH) according to the previous publications [13,24,25].

Respiratory events were scored as follows: apnea was defined as a cessation of airflow measured using oronasal thermal airflow lasting 10 s or more; hypopnea was defined as a decrease in nasal pressure airflow greater than 30 % and a decline in SpO_2 greater than 3 %, or as a decrease in nasal pressure airflow greater than 30 % associated with arousal. The frequency of the respiratory events per hour of sleep was quantified as apnea–hypopnea index (AHI).

Among 61 subjects, 4 were excluded due to a lack of data sets and technical errors. Then, 22 subjects (male: 14, female: 8, mean age: 24.09 ± 1.9 [19,20,22–28], BMI: 20.22 ± 1.87 kg/m^2) were diagnosed as severe SB according to the polysomnographic research diagnostic criteria (RMMA index ≧ 4 times/h) [25]. They were divided into two groups; the SB-group (AHI < 5/h) and the SB + OSA group (AHI ≧ 5/h): sixteen subjects (male: 9, female: 7, mean age: 23.6 ± 1.9 [19,20,22–28] years, BMI: 20.1 ± 1.8 kg/m^2 AHI: 1.7 ± 1.5/h) were assigned to the SB group and 6 subjects (male: 5, female: 1, mean age: 25.5 ± 1.2 [24–27] years, BMI: 20.1 ± 1.8 kg/m^2, AHI: 8.7 ± 2.8/h) to the SB + OSA group.

2.4. Data analysis

The sleep-stage distributions were assessed for oromotor and respiratory events. AHI for each sleep stage was also calculated. To assess temporal relationships between oromotor and respiratory events, the following oromotor events were analyzed (13, 14). Oromotor events after respiratory events were scored when they occurred within 10 s after the end of the respiratory events, in relation to the recovery of respiration with or without respiratory-event related arousals (Fig. 1A). Oromotor events before the respiratory events were scored when they were followed by the cessation or the decrease of respiration within 10 s after the end of oromotor events (Fig. 1B). Then the percentages of these events in RMMA and NSMA were calculated. The correlation between the percentage of oromotor events close to the respiratory events and AHI for sleep stages was also assessed. In the SB + OSA group, the oromotor events with or without arousals were scored in relation to respiratory events.

2.5. Statistics

Statistical analysis was made using SYSTAT 13 (HULINKS Inc., San Jose, CA, USA). Data are presented as mean ± SD or median (range). Mann–Whitney *U* tests and *t* tests were made to compare demographic data, sleep, and oromotor variables between the groups. Wilcoxon rank sum tests were used for within-subject comparison of the incidence of oromotor events related to respiratory events. Two-way repeated measure ANOVAs were used to compare sleep stage incidence of oromotor and respiratory events between the two groups. Pearson's correlation was used for assessing the correlation between AHI and the percentage of oromotor events close to respiratory events. Friedman tests were used to compare response of oromotor events to respiratory and arousal events. Statistical significance was set at $\alpha = 0.05$.

3. Results

3.1. Demographic and sleep variables

Demographic data, scores of PSQI and ESS, and presence of signs and symptoms of SB and OSA did not differ between the SB + OSA and the SB groups except for age ($p = 0.03$, Table 1). Sleep architecture and oromotor variables did not differ between the two groups except for the AHI (Table 2).

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