Sleep Science 9 (2016) 84–88

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Contents lists available at ScienceDirect

Sleep Science

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

Full length article

Sleep architecture alterations in patients with periodic limb movements disorder during sleep and sleep breathing disorders

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ARTICLE INFO

Article history:
Received 10 February 2016
Received in revised form
5 April 2016
Accepted 22 June 2016
Available online 7 July 2016

Keywords:
Periodic limb movements disorder
Obstructive sleep apnea-hypopnea syndrome
Sleep architecture
Polysomnography

ABSTRACT

Introduction: Sleep movement disorders includes mainly periodic limb movement and others. The more frequent breathing disorders are: obstructive sleep apnea-hypopnea syndrome and primary snoring.
Objective: To compare sleep architecture in periodic limb movements and breathing disorders of different severity, and weight their interactions.
Methods: We compared sleep architecture in 160 patients, divided in six groups: periodic limb movements (n=25), obstructive apnea only (n=30), periodic limb movements/snoring (n=30), periodic limb movements/mild apnea (n=25), periodic limb movements/moderate apnea (n=25), periodic limb movements/severe apnea (n=26). Polysomnographic variables were compared by analysis of variance and Tukey test.
Results: We observed an increase of percentage of awakenings in the group with periodic limb movements/severe apnea. We found an increase of percentage of light sleep in the group with obstructive apnea only with respect to periodic limb movements group. The group with obstructive apnea only presented less rapid eye movements sleep in relation with group with periodic limb movements. We found an increase of awakenings in the group with periodic limb movements/severe apnea to the group with periodic limb movements only. Oxygen saturation showed a decrease in the group with periodic limb movements/severe apnea and obstructive apnea only group to periodic limb movements only group.
Conclusions: Periodic limb movements and breathing disorders, resulted in more additive changes in sleep architecture alterations, than as separately disorders, in a complex interaction. Research in these relations deserve more investigations.

1. Introduction

Sleep disorders are divided in six groups according to the new Third International Classification of Sleep Disorders [1]. Sleep breathing disorders (SBD) are in the second group, and Sleep movement disorders (SMD) are in the fifth group of this classification.

SMD are characterized by burst of repetitive, involuntary, and stereotyped movements of toe, and partial flexion of ankle, knee, and hip during sleep [2]. Periodic limb movement disorder during sleep (PLMs) is the more frequent alteration in this group. Alterations could be due to abnormal inhibition of motor system during sleep. SMD has a reported prevalence of 7.6% in adult patients [3].

In the SBD group, we can found more frequently, the Obstructive sleep apnea-hypopnea syndrome (OSAHS), and Primary snoring (PS). OSAHS main characteristics are: repetitive and intermittent events of obstruction of the Superior air pathway (SAP), which results in complete (apnea) or partial (hypopnea) events $\geq$ 10 s (sec) of interruption of air flux, with a decrease of blood oxygen saturation and an increase of body, and breathing movements, and snoring [4]. Obstruction is secondary to abnormal narrowing or collapse of SAP during sleep, and tone loss of pharyngeal muscles [5]. Higher frequency of SBD was present in males than females. In one study carried-out in Latinamerica [6], authors reported OSAHS prevalence of 3.2%, and 54.8% for PS.

PLMs and OSAHS can be associated to cortical awakening or autonomic activation. However, some body movements can be found during, or behind to an apnea event, and can difficult their identification to clinicians. Moreover, in the upper airway resistance syndrome (UARS), the component event could be a respiratory effort

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Peer review under responsibility of Brazilian Association of Sleep.

http://dx.doi.org/10.1016/j.slsci.2016.06.002

related arousal (RERA), and PLMs, the component event cold be a repetitive, stereotyped extremity movements occurring in a periodic fashion, associated in certain patients, by this reason is very important to be differentiated between the disorders [7]. PLMs and OSAHS can result in sleep architecture (SA) alteration, and could be detected by means of Polysomnographic (PSG) recordings.

Researchers found a frequency of PLMs of 24–48% of patients with OSAHS [8]. Co-existence of both disorders has been recognized long-ago, but there is a wide controversy on their interaction. Thus, the objective of this research was to compare SA alteration in a group of patients with PLMs, and SBD, and both alterations, studied by means of PSG recordings, and to weight their interaction.

2. Method

2.1. Subjects

We performed a descriptive, and comparative study at the Clinic of Sleep Disorders at the National University of Mexico. Patients with PLMs were diagnosed when fulfilling the American Sleep Medicine Association criteria, while patients with SBD: OSAHS and PS were identified after complete fulfilling criteria in the same way. Inclusion, exclusion, and elimination criteria for each group are presented in Table 1. The sample was constructed as follows: 160 patients (51% females, and 49% males), with a mean age ($\pm$ Standard deviation) of 53.9 ± 14.9 years, with age range of 19–83 years. Sample was divided in six groups: PLMs (n=25), OSAHS only (n=30), PLMs/PS (n=30), PLMs/mild OSAHS (n=25), PLMs/moderate OSAHS (n=24), and PLMs/severe OSAHS (n=26), demographic features of each group are show in Table 2. Protocol of the study was approved by the Research and Ethics Committee of the institution. Informed consent was obtained in every subject after a wide explanation of the research and importance of their participation. Patients and control subjects signed informed consent according to Declaration of Helsinki.

Table 1
Inclusion, exclusion, and elimination criteria of subjects of each group of the sample.

Group	PLMs	OSAHS	PLMs/PS	PLMs/OSAHS		
				mild	moderate	severe
Inclusion						
Age > 18 years	✓	✓	✓	✓		
Complete PSG (8 h)	✓	✓	✓	✓		
Meets PSG criteria for	✓	✗	✓	✓		
PLMs*	✗	✓	✗	✓		
Meets PSG criteria for	✗	NA	✓	NA		
OSAHS**	✓	✓	✓	✓		
Meets PSG criteria for PS						
Under medical control for heart, metabolic, and kidney diseases						
Exclusion						
PSG by splint night	✓	✓	✓	✓		
PLMs index < 15 movements/h	✓	NA	✓	✓		
Elimination						
To develop other neurological diseases	✓	✓	✓	✓		

OSAHS=obstructive sleep apnea-hypopnea syndrome. PLMs=periodic limb movements during sleep disorder. PS=primary snoring. PSG=polisomnography. NA=not apply. ✓=present, ✗=absent.

2.2. Polysomnography (PSG)

All night Polysomnographic (PGS) recordings were performed with digital Polysomographic devices Alice, with Sleepware version 2.8.78 (Respironics Inc. EUA). For electroencephalographic (EEG) recording, we set five silver plate surface electrodes in F4, C4, O2, Cz and A1 according to the International 10–20 System [9]. Electromyographic (EMG) recordings were obtained by means of skin plate electrodes located on chin and over tibialis muscles of both legs. Electro-oculographic (EOG) recordings were obtained from skin electrodes placed in lateral canthi of each eye. For Electrocardiogram (EKG) recordings, we placed disposable surface electrodes over second intercostal space and mid-clavicular line. Respiratory flow was measured by means of a thermistor in nostrils, and pletismographic belts in thorax and abdomen (Pro-Tech, Velcro Strap). Oxygen saturation was measured with a pulse oxymeter (Masimo Set), and snoring with a microphone (Pro-Tech).

Interpretation of the PSG recording was carried-out by qualified technicians following standards of the American Association of Sleep Medicine for sleep scoring and associated events [10]. Compared variables included as follows: Total sleep time (TST), Sleep latency (SL), SL to Rapid eye movements sleep (REMs) (SL-REMs), Sleep efficiency (SE), Awake percentage (A%), Percentage of light sleep in N1-N2 stages (N1%), and in deep sleep in N3 stage (N3%), and in REMs (REM%), Awakenings (A), and Snoring (S).

In patients with PLMs we measured number of movements/hour of sleep, or index of severity of PLMs, as follows: mild (15–25 movements (mov)/hour (h); moderate (26–50 mov/h), and severe ($\geq$ 51 mov/h). In patients with OSAHS we calculated Apnea-hypopnea index (AHÍ), classified as follows: mild (6–15 events/hour), moderate (16–30 events/h), and severe degree ($\geq$ 31 events/h).

2.3. Epworth sleepiness scale (ESS)

We utilized the Epworth sleepiness scale (ESS). The instrument measures sleep propensity in awake state, in order to identify individuals with daytime excessive sleepiness (DES). The EES is a simple self-administrated questionnaire (eight questions), that asks the subject to rate on a scale of 0–3, the chances of sleep in eight different situations commonly met in daily life (sum of eight questions can vary from 0 to 24). Scores > 10 are considered as abnormal sleepiness. The EES has been validated in México [11].

2.4. Statistical analysis

We calculated mean (x), and Standard deviation (SD) of quantitative variables. For qualitative variables we calculated percentages (%). We used one-way Analysis of variance (ANOVA) to compare means across groups, and the Tukey honest differences test *post-hoc* to found location of significant differences. We chose an *alpha* value of $p \leq 0.05$ to select differences as significant.

3. Results

PSG variables in the six studied groups are presented in Table 3. We found high values of awake percentage to reference standards in all groups, however, group of patients with PLMs/severe OSAHS showed a significant increase of this percentage compared to PLMs/mild OSAHS ($F=2.31$, $gl=5154$; $p=0.04$). We observed an increase in percentage of light sleep (N1-N2) in all groups, however, group with OSAHS only, has a significant increase, to PLMs group ($F=3.00$; $gl=5, 153$; $p=0.01$). Although percentage of REMs was decreased in all groups, we found that group with OSAHS only, had a significant decrease to group with PLMs ($F=2.83$; $gl=5154$; $p=0.01$). We observed an increase of awakenings in all