Study of Differences on Heart Rate in Patients with Apnea and Insomnia Syndromes

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Abstract

A high percentage of patients with obstructive sleep apnea-hypopnea syndrome (OSAHS) also have chronic insomnia, particularly elderly people. Additionally, these patients usually show high levels of depression, stress and other sleep disorders. In order to quantify the potential negative impact that insomnia produces in patients with OSAHS, some studies have analyzed the usual parameters in the polysomnographic reports, although the results are inconclusive.

The aim of this paper is to study the possible effect that the combination of these pathologies might produce in heart rate (HR). We analyzed 85 polysomnograms (PSG) from two groups of patients with OSAHS, for cases without insomnia (G1, N=55, 53.4 +- 13.1 years) and with insomnia (G2, N=30, 49.1 +- 10.0 years). For each sleep stage (aWake, 1, 2, 3, REM), epochs were grouped with the presence of obstructive apnea/hypopnea (G#A) or without apneic events (G#). The obtained values (mean +- standard deviation; beats per minute) are:

- W: (G1: 71.7 ± 11.9 bpm; G2: 69.4 ± 9.9 bpm).

- 1: (G1: 70.2 ± 13.0 bpm; G2: 67.8 ± 10.0 bpm), (G1A: 70.6 ± 3.0 bpm; G2A: 70.6 ± 18.5 bpm).

- 2: (G1: 67.2 ±± 12.0 bpm; G2: 64.7 ± 11.0 bpm), (G1A: 69.2 ± 12.1 bpm; G2A: 66.7 ± 17.5 bpm).

- 3: (G1: 67.1 ± 12.4 bpm; G2: 64.9± 10.8 bpm), (G1A: 70.9 ± 8.4 bpm; G2A: 67.5 ± 19.8 bpm).

- REM: (G1: 67.0 ± 11.2 bpm; G2: 65.9± 10.9 bpm), (G1A: 67.1 ± 9.7 bpm; G2A: 68.4 ± 17.2 bpm).

Although not statistically significant, the results show that the HR in the studied PSG show higher values for G1 in all sleep stages for periods without apnea. In case of apnea, HR is also greater for G1 except for REM sleep stage.

1. Introduction

Various disorders and diseases are associated with the presence of obstructive sleep apnea-hypopnea syndrome (OSAHS), such as daytime sleepiness, decreased cognitive function, hypertension, and increased risk of cardiovascular or cerebrovascular accidents [1].

Because daytime sleepiness is a typical feature of OSAHS, it is paradoxical the coexistence of this disorder with insomnia. However, a high percentage of patients with OSAHS present chronic insomnia, especially elderly people. Additionally, these patients present depression, stress and other sleep disorders, having more problems to get adapted to Continuous Positive Air Pressure (CPAP) therapy [2].

There are few references about this topic. Gilleminault et al. already published an article in 1973 pointing to described OSAHS problems [3]. In 2001, Krakow et al. [4] introduced the term "Sleep-Disordered Breathing plus" (SDB-plus) for patients showing both pathologies. They estimated that 50% of OSAHS patients also presented insomnia. Later studies obtained similar values between 42% and 55% [2].

In order to measure the negative impact that insomnia produces in an OSAHS patient, some studies analyzed typical parameters in polysomnogram, but no concluding remarks were obtained. For those patients with SDB-plus, three main characteristics were identified: disturbances in nocturnal sleep, significant presence of psychological disorders such as depression, and association with other sleep disorders like restless leg syndrome (RLS). Moreover, recent hypotheses also propose a relationship between metabolic syndrome and the presence of insomnia together with OSAHS due to the sympathetic and hypothalamic-pituitary axis-adrenal (HPA) activation [2].

The aim of this paper is to study the possible effect that the combination of conditions has on heart rate (HR) during sleep, and test if HR is a parameter that could lead to distinguish between single OSAHS and SDB-plus patients.

2. Methods

This study was made in 85 OSAHS patients, from which 55 were classified without insomnia (G1, N=55, 53.4±13.1 year old) and 30 with insomnia (G2, N=30, 49.1±10.0 year old). All patients were attended at the Sleep Unit in Hospital La Fe (Valencia, Spain). Each patient fulfilled a survey related to sleep disorders using the Epworth scale. Later, an standard nightly polysomnogram (PSG) was recorded using a digital polygraph (NT A/108-7910 Deltamed Coherent 3), recording electroencephalogram (EEG, C4-A1, C3-A2, C4-C3), electrooculogram, submental electromyogram and both anterior tibial muscles, electrocardiogram, and respiration by thermistor (naso airflow) and piezoelectric sensors (thoracic and abdominal respiratory effort) [5].

Obstructive apnea was defined as cessation of airflow for at least 10 seconds and hypopnea as a decrease in amplitude of airflow of at least 50%, accompanied by a 2-3 % decrease in arterial oxygen saturation (SaO2) with or without associated arousal [5]. OSAHS was classified when the apnea-hypopnea index (AHI) is greater or equal to 5, and somnolence if the value in the Epworth scale is greater or equal to 9.

All records were revised and annotated by, at least, one expert who labeled all sleep phases in 30 second epochs and marked all apnea/hypopnea events, sleep stages and other annotations. The records were processed, obtaining the following information:

- Hypnogram calculation, obtained from the sleep phases pointed by the expert.
- Heart rate (HR) series. A QRS detector Proposed by Pan and Tompkins [6] and modified by Laguna [7] was used. The detector is based on an adaptive threshold in the ECG amplitude that has been previously filtered with a band-pass filter (12-22 Hz).
- Mean value calculation for the HR series in 30-second epochs.

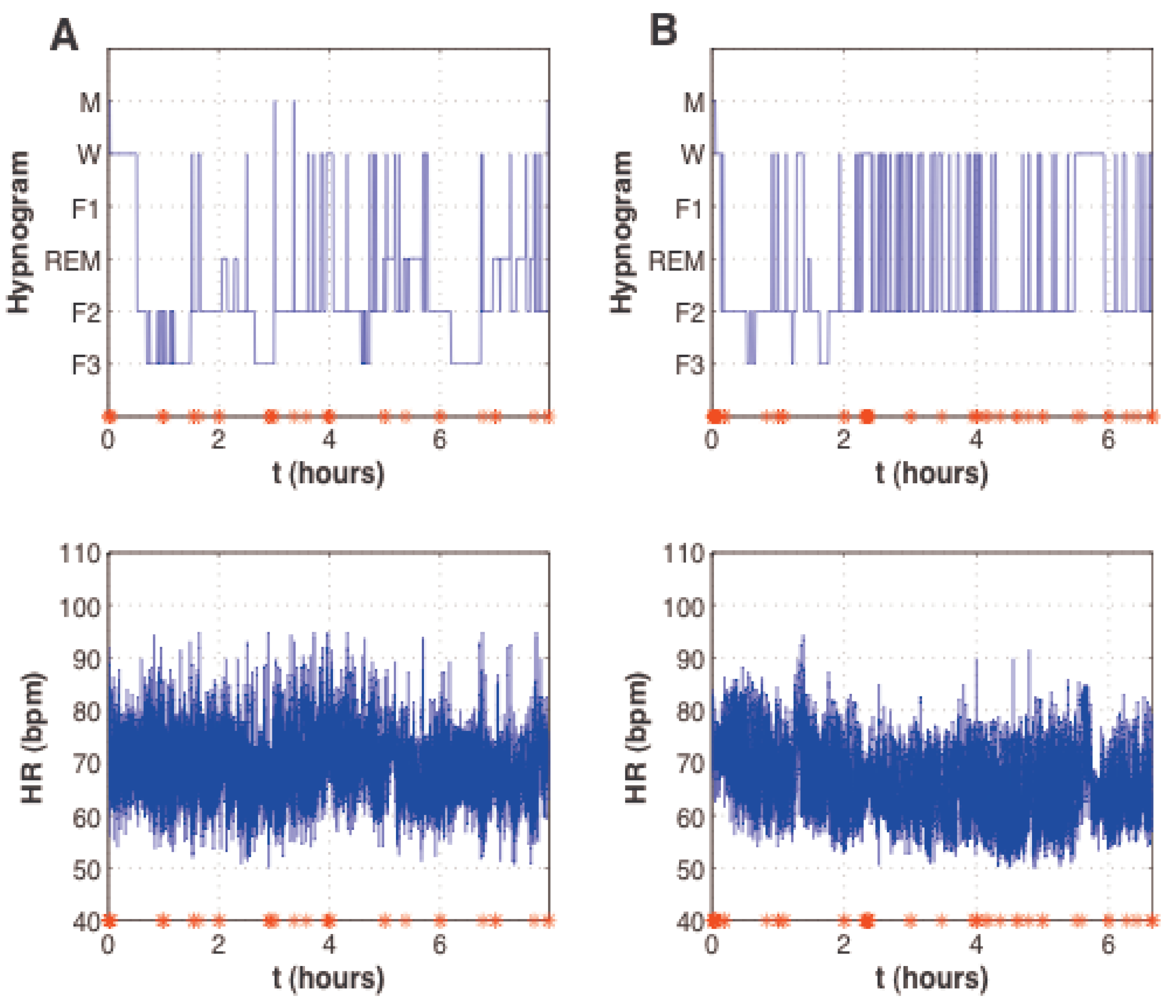

Figure 1. Example of hipnograma, HR series and marks invalid time for a patient without insomnia (A: G1) and insomnia (B: G2).

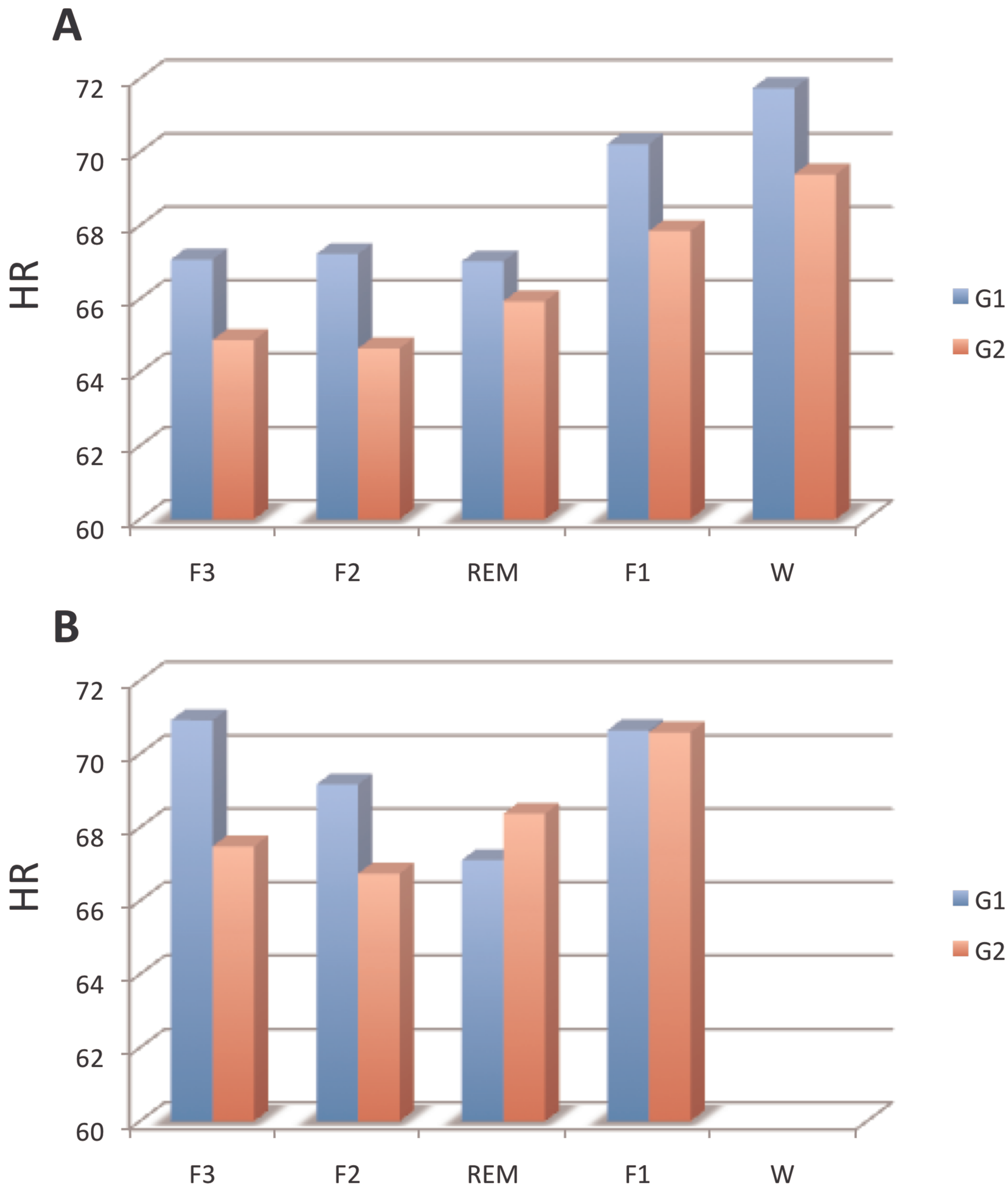

Figure 2. Average heart rate (bpm) for the two patient groups G1 and G2 separated by the sleep phase and epoch (A: apneic event; B: no apneic event).

• Epochs that met any of the following conditions were marked as invalid: a) records of movement (M label) or polygraph test; b) ECG channel with no signal, saturated or without detection of QRS; c) HR out of valid range (valid values must be between 25 and 130 bpm).

• For each sleep stage (awake, 1, 2, 3, REM), epochs were grouped in those with obstructive apnea / hypopnea presence (G1A, G2a) and those without any apnea event (G1, G2).

For statistical analysis, the test of Kolmogorov-Smirnov for normality, Levene test for equality of variances were applied. Student's t-test was used to compare the groups.

3. Results

Figure 1 shows an example of an hypnogram and the HR series for two patients, one for each group. Red marks show non-valid epochs. In case of the patient without insomnia (A), less awakening time and more “deep sleep” time is observed. The patient showing insomnia (B) shows more transitions to awakening phase and less time in “deep sleep” phase; additionally, lower HR is observed.

Obtained results for HR (mean ± std; values in beats per minute -bpm-) are presented in Table 1 and Figure 2. These results are not statistically significant, however, it can be observed that higher HR mean values are obtained for non-insomnia patients (G1 group), for all phases and epochs without apnea. In case of epochs with apnea, again, the HR value is higher for group G1 except for the REM phase

Concerning the influence of the apneic events, it can be observed higher HR in case of apneic epochs. This increment is greater in those “deep sleep” phases (F3, F2), and lower in light sleep phases such as REM and F1

Table 1. Mean values and standard deviations for HR (bpm) in G1 and G2 groups, grouped by sleep phase and epoch with or without apneic events.

Sleep phase	G1	G2	G1A	G2A
F3	67.1 ± 12.4	64.9 ± 10.8	70.9 ± 8.4	67.5 ± 19.8
F2	67.2 ± 12.0	64.7 ± 11.0	69.2 ± 12.1	66.7 ± 17.5
REM	67.0 ± 11.2	65.9 ± 10.9	67.1 ± 9.7	68.4 ± 17.2
F1	70.2 ± 13.0	67.8 ± 10.0	70.6 ± 3.0	70.6 ± 18.5
W	71.7 ± 11.9	69.4 ± 9.9		

4. Conclusions

The association of OSASH and insomnia is very common in case of OSAHS patients. Thus, it is important to study the negative impact that this combination might generate. This work proposes the study of Heart Rate (HR) as an additional parameter to those traditionally used in this field.

Although results are not definitive, some differences can be observed. It becomes necessary to continue with the study, analyzing other effects as the sympathic-vagal balance effect, and the relation that could exist with other parameters obtained from other physiological variables such as EEG

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