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Original Article

Insomnia symptoms and CPAP compliance in OSAS patients: A descriptive study using Data Mining methods

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ABSTRACT

Background: Obstructive Sleep Apnoea Syndrome (OSAS) and insomnia are common pathologies sharing a high comorbidity. CPAP is a cumbersome treatment. Yet, CPAP compliance must remain optimal in order to reverse excessive daytime sleepiness and prevent the cardiovascular consequences of OSAS. But chronic insomnia could negatively affect CPAP compliance.
Objective: To assess the consequences of insomnia symptoms on long-term CPAP use.
Methods: A prospective study was conducted on 148 OSAS patients (RDI = 39.0 ± 21.3/h), age = 54.8 ± 11.8 years, BMI = 29.1 ± 6.3 kg/m^2, Epworth Score = 12.2 ± 5.4, on CPAP. Using the Insomnia Severity Index (ISI) as an indicator of insomnia (ISI ⩾ 14 = moderate to severe insomnia) and baseline data (anthropometric data, sleeping medication intakes, CPAP compliance, Epworth, Pittsburgh Sleep Quality and ISI scores, polygraphic recording data), Data Mining analysis identified the major rules explaining the features "High" or "Low ISI" and "High" or "Low Use" in the groups defined, according to the median values of the ISI and the 6th month-compliance, respectively.
Results: Median ISI was 15 and median 6th month-compliance was 4.38 h/night. Moderate to severe insomnia complaint was found in 50% of patients. In the "High" and "Low ISI," the 6th month-compliance was not significantly different (3.7 ± 2.3 vs 4.2 ± 2.3 h/night). In the classification models of compliance, the ISI was not a predictor of CPAP rejection or of long-term use, the predictor for explaining CPAP abandonment being the RDI, and the predictor of the 6th month-compliance being the one month-compliance.
Conclusion: Insomnia symptoms were highly prevalent in OSAS patients, but had no impact on CPAP rejection or on long-term compliance.

1. Introduction

Obstructive Sleep Apnoea Syndrome (OSAS) and insomnia are two prevalent and public health pathologies sharing a high comorbidity [1–5]. The activation of the wakefulness drive involved in the physiopathology of insomnia [6,7] could become reinforced by repeated micro-arousals, the consequences of intermittent pharyngeal occlusions in the OSAS patient; this phenomenon could lead to a complaint of sleep maintenance insomnia or early morning awakenings and exacerbate a pre-existing insomnia complaint.

Continuous positive airway pressure ventilation (CPAP) [8], the first-line therapy for OSAS, is able not only to reduce daytime sleepiness and improve daily functioning [9], but also to improve cardiovascular outcomes [10,11]. Continued adherent use of CPAP must be optimal in order to maintain treatment effects [12]. But, despite technological progress, nasal CPAP remains a cumbersome treatment that some patients reject from the start (the primary acceptance rate is typically only 85–90%) or decide to give up after some use (the withdrawal rate varies between 15% and 35%) [13–15].

Pre-existing insomnia could explain part of the early abandonment of nasal CPAP and poor compliance due to the sleep difficulties induced by the mechanical constraints of nasal CPAP. The challenge facing clinicians consists of increasing acceptance and adherence to CPAP; thus every effort should be made in order to maintain or facilitate compliance. In this context, screening for insomnia symptoms in patients recommended for CPAP therapy and starting systematic cognitive behavioural therapy in case of associated insomnia has been deservedly proposed [16]. However, to our knowledge, there are no data in the literature that establish the adverse impact of insomnia symptoms on CPAP compliance. If, in fact, comorbid insomnia does not affect CPAP compliance, screening for and treatment of the insomnia would unnecessarily delay OSAS treatment and lead to increasing public health costs.

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The objective of this study was to determine the potential influence of insomnia symptoms on CPAP compliance in a sample of patients whose severity of the sleep apnea syndrome indicated the need for treatment.

2. Methods

2.1. Patients

Subjects in this study were 166 consecutive OSAS patients fitted with the device for continuous positive airway pressure (CPAP) between November 2005 and March 2007.

The study was approved by the Institutional Review Board of the Société de Pneumologie de Langue Française.

2.2. Procedures

2.2.1. Diagnostic procedure

Sleep-disordered breathing was diagnosed in 166 consecutive patients with an apnea–hypopnea index $\geqslant$10/h on the basis of ambulatory cardiorespiratory monitoring according to the recommendations of the ATS/ACCP/AASM Taskforce Steering Committee [17,18]. The portable monitor (CID 102, CIDELEC, Gemmes sur Loire, France) analyzes snoring, oxyhaemoglobin saturation, nasal airflow by a nasal cannula and monitors respiratory effort with thoracic and abdominal strain gauges and a substernal pressure captor [19].

Abnormal breathing events and the time spent in a SaO2 less than 90% were quantified per hour of monitoring time, as a Respiratory Disturbance Index (RDI) and "SaO2 < 90%."

2.2.2. Assessing baseline sleep quality

The insomnia complaint was assessed by the score on the Insomnia Severity Index (ISI) questionnaire, containing seven items, scored from 0 to 4, respectively:

1. Difficulty falling asleep.
2. Difficulty staying asleep.
3. Problem waking up too early.
4. Dissatisfaction with the current sleep pattern.
5. Interference with daily functioning.
6. Importance of the sleeping problem according to others.
7. Distress about the sleep problem.

The maximum ISI score is 28, 8 being the threshold for subclinical insomnia and 14 the threshold for a moderate to severe insomnia complaint [20].

2.2.2.1. Definition of $ISI_{1,2,3}$. We defined $ISI_{1,2,3}$ as the index made of the sum of the first 3 items of the ISI, more specific for insomnia symptoms.

- The subjective quality of sleep was assessed by the Pittsburgh questionnaire (PSQI) [21], for which the maximum score is 21, and a value of $\geqslant$5 indicates poor sleep quality. The components of the PSQI score are Subjective Sleep Quality, Sleep Latency, Sleep Duration, Habitual Sleep Efficiency, Sleep Disturbances, Use of Sleep Medications, and Daytime Dysfunction. Each of these components is scored 0–3 (0 designating the absence of difficulty and 3 severe difficulties).
- Somnolence was assessed by the Epworth Sleepiness Scale [22], for which a value above 11 is an indicator of an excessive daytime somnolence [23].

2.2.3. Installing the CPAP device

Patients were fitted with the CPAP masks on the day after the announcement of the positive diagnosis of sleep apnea, on a scheduled visit at the hospital; the procedure was identical for all patients. During this visit, the patient could benefit from a training session explaining the pathology and treatment. A nasal mask was applied, unless the patient could confirm he was not able to breathe nasally; in this case a full-face mask was chosen. Finally the patient was given a 30 min-practice session with the CPAP before starting home treatment with the best-fitting equipment.

The positive airway pressure device was an auto-adjusting positive airway pressure (APAP) device initially with minimum and maximum pressures empirically set at 6 and 12 cm H_2O, respectively.

Home treatment was carried out by a technician specialized in home-care medical appliances contracted from the service-provider. Following a routine procedure, patients were systematically visited by a technician on days 8, 15 and at the end of the first month. On each visit, CPAP memory recordings (compliance, leaks) were collected. The mask was changed in cases of leakage or discomfort, and a heated humidifier was provided in cases of nasobuccal dryness. A full-face mask was proposed in case of persisting symptoms of oronasal dryness despite the use of a humidifier.

Overnight oximetry recording (PalmSAT® 2500, NONIN Medical, Inc., Plymouth, Minnesota, USA) was performed on two consecutive nights after verifying that the patient was sufficiently comfortable. Mechanical efficacy was defined by an ODI < 10/h; in case of an ODI $\geqslant$ 10/h, the range of positive pressures was modified and additional visits were made in order to control treatment efficacy [24,25].

Epworth Sleepiness scores were systematically collected during the scheduled visits on the 1st and on the 6th month.

2.2.4. CPAP compliance

CPAP use M1 (month 1) and M6 (month 6) extracted from the CPAP device memory recordings, represented the mean efficient use, measured in hours, at 1 month and 6 months.

3. Statistical analyses and modeling on the study sample

The design of the study was prospective.

We chose to apply Data Mining (DM) methods (Clementine Software, SPSS Inc., USA) on our data. Since the study's objective was to assess the influence of the insomnia complaint on long-term CPAP compliance, we conducted the analysis, using successively the ISI and the 6th month CPAP use as the target variables.

Data Mining [26,27] involves information extraction, the goal of which is to discover hidden or a priori unknown facts contained in databases. Using a combination of machine learning, statistical analysis, modelling techniques and database technology, Data Mining automates the process of finding patterns and subtle relationships in data and infers rules for predicting trends and behaviours.

The first step in the DM process was to arbitrarily define *"High ISI"* subjects (whose ISI was $\geqslant$ median ISI in the study sample) and *"Low ISI"* subjects (whose ISI was < median ISI), *"High use"* subjects (whose CPAP use was $\geqslant$ median CPAP use M6) and *"Low use"* subjects (whose CPAP use was < median CPAP use M6). The following step was to identify from the database, the major rules explaining the feature "*High*" or "*Low ISI*" and "*High*" or "*Low Use*." The database contained each of the following variables: age, sex, BMI, baseline RDI, percentage of time spent at SaO2 < 90%, baseline Epworth Score, ISI and PSQI scores, as well as the details of their different components, consumption of psychotropic, hypnotic, anxiolytic