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Original Study

Usefulness of Oximetry for Sleep Apnea Screening in Frail Hospitalized Elderly

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ABSTRACT

Background: Sleep Apnea Syndrome (SAS) prevalence increases with age. In the elderly, symptoms are less specific (falls, cognitive or functional decline, polymedication). Polysomnography, the gold standard technique to diagnose SAS, is challenged by sleep laboratories' waiting lists and high associated costs. Nocturnal oximetry is an easy-to-use tool widely available outside the sleep medicine field identifying intermittent hypoxia, the landmark of SAS. It might be an interesting and easy way to screen for SAS in the functionally and cognitively impaired elderly living in long-term care settings.
Objectives: The primary goal of this study was to assess the accuracy of the variability index of nocturnal pulse oximetry to detect moderate to severe SAS in patients older than 75 hospitalized in stable condition. The secondary goals were to assess the accuracy of the other indices of pulse oximetry (oxygen desaturation index [ODI]), and to determine the prevalence of moderate to severe SAS in our population.
Methods: In-hospital sleep studies with simultaneous respiratory polygraphy and nocturnal pulse oximetry were performed. Comorbidities were assessed by the Cumulative Illness Rating Scale for Geriatrics (CIRS-G) in association with a comprehensive geriatric assessment.
Results: Eighty patients (mean age 85.3 ± 5.3 years) were included. Seventy-two percent of the patients exhibited moderate to severe SAS (95% CI 58.9–82.9), including 59.5% of severe SAS (apnea + hypopnea index >30/hour). SaO2 variability index using a threshold of 0.51, the sensitivity and negative predictive value (NPV) were 100%. With a value above 0.88, positive predictive value and specificity were high (respectively 96.6% and 93.8%). ODI of 3% or higher and 4% or higher were highly specific but less sensitive.
Conclusion: Prevalence of moderate to severe SAS in multimorbid hospitalized elderly patients is high. Automatic analysis of the variability of nocturnal SaO2 is a reliable tool for geriatricians to screen and rule out moderate to severe SAS. Our study suggests an important role of pulse oximetry as the first step in the diagnostic strategy for moderate to severe SAS in this population.

Sleep apnea syndrome is common in middle-aged community-dwelling adults, but its prevalence increases up to 20% in those older than 70.[1] Patients are usually referred for diagnosis owing to classical symptoms associated with sleep apnea syndrome (SAS) (ie, snoring and excessive daytime sleepiness). These complaints become less sensitive with increase in age[1–4] and in the elderly population specific conditions are more specifically associated with sleep apnea (falls, cognitive or functional decline, polypharmacy).[4–6]

Sleep apnea is underdiagnosed in the elderly population mainly as appropriate screening/diagnosis tools are lacking or have not been validated in patients older than 75 years. Geriatricians have recently validated a clinical score (Observation-Based Nocturnal Sleep

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Inventory [ONSI]) to detect SAS in the elderly. This score is interesting and specific but needs close nocturnal supervision.[7] On the other hand, the American Academy of Sleep Medicine's (AASM) guidelines strongly recommend treatment to be proposed for the moderate to severe SAS,[8] even in mild to moderately cognitively impaired older patients.[9] Polysomnography (PSG) remains the "gold standard" to diagnose SAS, but is challenged by waiting lists of sleep laboratories and high associated costs.[8,10] An easy-to-use, widely available, and inexpensive tool to screen for SAS in the functionally impaired elderly would be helpful, especially in long-term care settings. Pulse oximetry measures intermittent hypoxia, the landmark consequence of sleep apnea,[11] and seems to be an interesting alternative. The use of pulse oximetry to detect moderate to severe SAS has been clinically validated in the middle-aged population by using different indices of oxygen desaturation. Our group has specifically demonstrated the interest of an SaO2 variability index reflecting the repetitive occurrence of the desaturation-reoxygenation sequence typical of sleep apnea.[12] The validity of oximetry and particularly the interest of the variability index has not been evaluated in multimorbid elderly patients.

The primary goal of this study was to assess the accuracy of the variability index of nocturnal pulse oximetry to detect moderate to severe SAS in patients older than 75 hospitalized in stable condition. The secondary goals were to assess the accuracy of the other index of the pulse oximetry, the oxygen desaturation index (ODI), and to determine the prevalence of moderate to severe SAS in our population. This validation has been done against cardiopulmonary polygraphy, which is now considered as acceptable for sleep apnea diagnosis.[8]

Methods

Study Participants

Patients older than 75 years, hospitalized in a geriatric ward in the Grenoble University Hospital in France between March 2011 and October 2012, were prospectively included. Patients who had current oxygen therapy, a known diagnosis of SAS, or were referred for an acute event were excluded. As previous studies have demonstrated that continuous positive airway pressure (CPAP), the first-line therapy of sleep apnea, is feasible in the elderly only when the MMSE (Mini Mental State Examination[13]) is more than 18 of 30,[9] patients with an MMSE less than 18 of 30 were also excluded. The institutional review board of Grenoble University Hospital approved the study (2010-A01305-34) and patients signed informed consent. The study was registered on clinical trials.gov (NCT01294137).

Measurements

The reference method for sleep apnea diagnosis was attended in-hospital respiratory polygraphy. The validity of such a technique has been demonstrated when in-laboratory PSG is difficult to implement, as this is particularly the case in the elderly population.[14–16] A nocturnal pulse oximetry was recorded concurrently to respiratory polygraphy with a dedicated device.

Pulse oximetry was recorded with Rad-8 by Masimo (Irvine, CA) using a 3-Hz sampling rate. Automatic analysis of nocturnal SaO2 variability was conducted using the Bluenight software (SleepInnov, Moirans, France). Variability index measures the variations between successive oxygen saturation data at constant time intervals. The nocturnal SaO2 profile in SAS is due to repetitive sequences of apneas ended by resumption in ventilation. This leads to SaO2 oscillations and SaO2 variability is then significant for most sampling intervals. This logically leads to high variability index values. The other usual oxygen desaturation indices (ODI ≥2%, 3%, and 4%) were also automatically calculated (number of desaturations ≥2%, 3%, and 4% divided per the recording time).

Respiratory polygraphy (Embla Titanium by Micromed SPA, Treviso, Italy) included oximetry, nasal pressure airflow sensor, nasal and oral thermistors, thoraco-abdominal movements, cardiac recording with electrocardiogram, and a leg sensor for tibial electromyography. Manual scoring done by an expert sleep specialist was conducted using the Somnologica version 1.1 software (Embla, Broomfield, CO). According to the AASM guidelines, moderate SAS was defined as an apnea hypopnea index (AHI) ranging from 15 to 30, and severe SAS when AHI was 30 or higher.[8]

We collected sociodemographic data and medical history, especially cardiac, pulmonary, metabolic, and neurologic diseases. Comorbidities were assessed by the Cumulative Illness Rating Scale for Geriatrics (CIRS-G).[17] A comprehensive geriatric assessment was performed, using functional activities of daily living (ADLs)[18] 15 days before admission, at admission, and at discharge; instrumental ADLs (IADLs)[19] 15 days before admission; and nutritional (body mass index [BMI]) and cognitive (MMSE)[13] evaluations. A sleep questionnaire addressing snoring, headaches, nocturia, and daytime sleepiness as measured by the Epworth Sleepiness Scale (ESS)[20] was also systematically performed. Biological data also were recorded. All data were prospectively collected by a physician and then analyzed anonymously.

Statistical Analysis

Descriptive statistics were used to depict patients' characteristics. Quantitative variables were expressed by means (±SD) or by medians (interquartile range) depending on validation of normality distribution. Normality was assessed using tests of Skewness and Kurtosis. Qualitative variables were expressed as count and percent. For some percents, a confidence interval of 95% was calculated by Wilson's method with correction for continuity.

Comparisons between the 58 patients who had concurrent recordings of sufficient quality to be analyzed and the 22 with recording failures were made using *t* test (or Mann-Whitney test, depending on normality of distribution), for quantitative variables. Qualitative variables were compared with the chi-square test (or the Fisher exact test, depending on the expected counts).

Because the clinical goal of the study was to detect apneic patients who require sleep apnea treatment, nocturnal oximetry was used as the test, and respiratory polygraphy as the gold standard for the correct classification of moderate to severe sleep apnea (AHI ≥15) versus non and mild sleep apnea (AHI <15). Receiver operating characteristic (ROC) curves[21] were built to assess the respective evolution of sensitivity versus 1-specificity at different thresholds for each of the pulse oximetry indices studied. Area under the curve (AUC), negative and positive predictive values (respectively NPV and PPV) were also calculated, with a confidence interval of 95%.

Statistical significance was set at *P* less than .05. All data collected were statistically analyzed using NCSS version 2007 (Kaysville, UT).

Results

Eighty patients were prospectively included; 58 patients (72.5%) had concurrent recordings of sufficient quality to be analyzed. Sixteen of the 22 recording failures were related to technical problems. The rate of failures directly related to patients' acceptance was 7.5%. There were no differences in terms of anthropometrics and clinical history between the patients with or without double sleep recordings available (data not shown).

The patients' characteristics are depicted in Table 1. The mean age of the population was 85.3 ± 5.3 years (range 75 to 98), with 26.0% males, and 94.8% being community living. The median length of stay