

LETTER



High prevalence of sleep apnea syndrome in patients admitted to ICU for acute hypercapnic respiratory failure: a preliminary study

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Introduction

Noninvasive ventilation (NIV) using bi-level or continuous positive airway pressure (CPAP) at home may improve outcomes in patients with obstructive sleep apneas [1] or chronic obstructive pulmonary disease (COPD) [2]. However, numerous patients admitted to ICU for acute-on-chronic respiratory failure have never undergone sleep studies or pulmonary function tests. We decided to assess the prevalence of sleep apnea and to identify the underlying chronic lung disease among patients admitted to ICU for acute hypercapnic respiratory failure.

Methods

We conducted a prospective single-center cohort study in a French teaching hospital. We included patients admitted to ICU for acute hypercapnic respiratory failure ($pH < 7.35$ and $PaCO_2 > 45$ mmHg) and treated with invasive mechanical ventilation or NIV. The study was approved by the institutional review board. All patients gave written informed consent. Complete polysomnography and pulmonary function tests were performed 3 months after ICU discharge (after at least 3 days of NIV withdrawal at home). Sleep apnea syndrome was defined according to the 2012 American Academy of Sleep Medicine [3].

Results

Over a 15-month period, 35 patients were included in the study (Table 1). Among them, only 16 (46%) came back for a complete exploration 3 months later while five patients died within the 3 first months after ICU discharge, and 14 patients refused to participate despite initial agreement (40% of enrolled patients). Patients who underwent polysomnography were younger than those who refused to participate [66 years (61–71) vs. 74 (70–75), $p = 0.008$].

Among the 16 patients studied, all had sleep apnea syndrome with a median apnea–hypopnea index of 33 events per hour of sleep. The prevalence of severe sleep apnea (≥ 30 events/h) was 56% in the whole population (nine out of 16 patients), 50% in obstructive and 71% in restrictive patients. Eleven of the 16 patients studied (69%) were discharged with home NIV.

Discussion

In our study all ICU patients who accepted polysomnography after an acute hypercapnic respiratory failure episode had sleep apnea and more than half of them had severe sleep apnea syndrome. However, this prevalence has not been evaluated on the whole population and our preliminary report needs to be confirmed by more large studies.

To our knowledge, only one other study performed in a single center in Switzerland assessed the prevalence of sleep apnea after ICU discharge in hypercapnic patients [4]. In keeping with our results, the prevalence of severe sleep apnea was 51% in COPD patients and 81%

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Table 1 Characteristics of the 35 patients included in the study

Characteristics of the patients and results of pulmonary and sleep tests	Median values [25th–75th percentiles] and number (percentages)
Age, years	70 [65–75]
Male gender, <i>n</i> (%)	19 (54%)
Body mass index, Kg/m ²	34 [29–43]
Obesity, <i>n</i> (%)	22 (63%)
History of smoking, <i>n</i> (%)	18 (51%)
Previously studied by pulmonary function tests or polysomnography, <i>n</i> (%)	13 (37%)
Previous pulmonary function tests, <i>n</i> (%)	11 (31%)
Previous polysomnography, <i>n</i> (%)	7 (20%)
Known underlying COPD, <i>n</i> (%)	10 (29%)
Known underlying OSA, <i>n</i> (%)	7 (20%)
Already treated at home by noninvasive ventilation, <i>n</i> (%)	6 (17%)
pH at admission, units	7.30 [7.25–7.33]
PaCO ₂ at admission, mm Hg	70 [62–82]
pH at ICU discharge, units	7.42 [7.39–7.44]
PaCO ₂ at ICU discharge, mm Hg	52 [48–60]
Length of ICU stay, days	7 [6–12]
Intubation before admission or after NIV failure in the ICU, <i>n</i> (%)	7 (20%)
ICU discharge with home noninvasive ventilation, <i>n</i> (%)	17 (49%)
Death with the first 3 months after ICU discharge, <i>n</i> (%)	5 (14%)
Pulmonary function tests and polysomnography at 3 months (<i>n</i> = 16)	
6-min walking test, m	368 [258–421]
6-min walking test, % of theoretical value	57 [34–60]
Obstructive spirometric pattern, <i>n</i> (%)	8 (50%)
Restrictive spirometric pattern, <i>n</i> (%)	7 (44%)
Normal spirometric pattern, <i>n</i> (%)	1 (6%)
Obesity-hypoventilation syndrome, <i>n</i> (%)	5 (31%)
Apnea-hypopnea index, events per hour of sleep	33 [16–65]
Moderate or severe sleep apnea, <i>n</i> (%)	14 (88%)
Severe sleep apnea, <i>n</i> (%)	9 (56%)
Severe sleep apnea in obstructive patients, <i>n</i> (%)	4/8 (50%)
Severe sleep apnea in restrictive patients, <i>n</i> (%)	5/7 (71%)
Left ventricular systolic dysfunction (ejection fraction < 45%), <i>n</i> (%)	3/12 (25%)

COPD Chronic obstructive pulmonary disease, OSA obstructive sleep apnea, ICU intensive care unit, NIV noninvasive ventilation

in non-COPD patients [4]. In this study, only 47% of the patients who were planned for sleep exploration actually underwent polysomnography. Similarly, we found that 40% of the included patients (14 out of 35 patients) declined their participation despite initial agreement, highlighting the difficulty for follow-up of these patients.

In conclusion, we found a high prevalence of sleep apnea in patients with acute hypercapnic respiratory failure. As many patients were reluctant to come back for sleep explorations after hospital discharge, sleep could be explored by polysomnography while the patient is still hospitalized or by in-home devices using limited-channel sleep studies [5].

Electronic supplementary material

The online version of this article (<https://doi.org/10.1007/s00134-017-4998-3>) contains supplementary material, which is available to authorized users.

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Compliance with ethical standards

Conflicts of interest

The authors declare that they have no competing interest.

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References

1. Marin JM, Soriano JB, Carrizo SJ, Boldova A, Celli BR (2010) Outcomes in patients with chronic obstructive pulmonary disease and obstructive sleep apnea: the overlap syndrome. *Am J Respir Crit Care Med* 182:325–331
2. Murphy PB, Rehal S, Arbane G, Bourke S, Calverley PMA, Crook AM, Dowson L, Duffy N, Gibson GJ, Hughes PD, Hurst JR, Lewis KE, Mukherjee R, Nickol A, Oscroft N, Patout M, Pepperell J, Smith I, Stradling JR, Wedzicha JA, Polkey MI, Elliott MW, Hart N (2017) Effect of home noninvasive ventilation with oxygen therapy vs oxygen therapy alone on hospital readmission or death after an acute COPD exacerbation: a randomized clinical trial. *JAMA* 317:2177–2186
3. Berry RB, Budhiraja R, Gottlieb DJ, Gozal D, Iber C, Kapur VK, Marcus CL, Mehra R, Parthasarathy S, Quan SF, Redline S, Strohl KP, Davidson Ward SL, Tangredi MM (2012) Rules for scoring respiratory events in sleep: update of the 2007 AASM manual for the scoring of sleep and associated events. deliberations of the sleep apnea definitions task force of the American Academy of Sleep Medicine. *J Clin Sleep Med* 8:597–619
4. Adler D, Pepin JL, Dupuis-Lozeron E, Espa-Cervena K, Merlet-Violet R, Muller H, Janssens JP, Brochard L (2017) Comorbidities and subgroups of patients surviving severe acute hypercapnic respiratory failure in the intensive care unit. *Am J Respir Crit Care Med* 196:200–207
5. Chai-Coetzer CL, Antic NA, Hamilton GS, McArdle N, Wong K, Yee BJ, Yeo A, Ratnavadivel R, Naughton MT, Roebuck T, Woodman R, McEvoy RD (2017) Physician decision making and clinical outcomes with laboratory polysomnography or limited-channel sleep studies for obstructive sleep apnea: a randomized trial. *Ann Intern Med* 166:332–340