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Obstructive sleep apnea, cardiac arrhythmias and continuous positive airway pressure therapy: one-year follow-up

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Abstract

English:

Background: *Cardiac arrhythmias represent one of the consequences of obstructive sleep apnea (OSA). The gold standard of moderate–severe symptomatic OSA treatment is positive pressure therapy [continuous positive airway pressure (CPAP)]. The use of CPAP in patients with cardiac arrhythmias and OSA may contribute to the maintenance of sinus rhythm.*
Aim: *To assess the effects of the CPAP therapy in addition to pharmacological and/or ablative interventions in maintaining the sinus rhythm in patients with cardiac arrhythmias and moderate–severe OSA.*
Materials and methods: *Patients diagnosed with cardiac arrhythmias [atrial fibrillation (AF)/flutter] and high pretest OSA suspicion (at least two items out of the following: snoring, witnessed apneas, obesity and excessive daytime sleepiness), performed a cardiorespiratory polygraphy (nasal flowmetry, pulse oximetry, thoracoabdominal movements, snoring and body position) for positive diagnosis and OSA severity assessment. Patients with moderate–severe OSA underwent CPAP titration with consecutive therapy indication (CPAP therapy plus pharmacological and/or ablative intervention). At 1 year, patients who used CPAP (group A) and those without CPAP (group B) were re-evaluated for the presence or absence of cardiac arrhythmias.*
Results: *Sixty-three patients with AF/flutter and high pretest suspicion of OSA performed cardiorespiratory polygraphy. Sixty patients (39 men) were diagnosed with OSA, out of which 40 (26 men) had moderate–severe OSA (apnea–hypopnea index, AHI ≥ 15/h) and underwent CPAP titration. At 1 year of follow-up, 17 patients (42.5%) were found adherent to the CPAP therapy (group A) and 23 (57.5%) did not use CPAP (group B). The two groups were similar in terms of age, body mass index, daytime sleepiness (assessed by Epworth Sleepiness Scale) and oxygen desaturation index, and statistically significant differences were recorded for the values of AHI and the time spent below SaO2 <90% (t90%), statistically significant higher ($p < 0.01$, respectively $p < 0.04$) in group A compared to group B. At 1 year, in group A, more patients had sinus rhythm compared to those with AF/flutter (13, respectively 4). In group B, 8 patients were in sinus rhythm and 15 with AF/flutter.*
Conclusions: *The CPAP therapy added to standard therapy (pharmacological therapy and/or ablative procedures) in patients with moderate–severe OSA and installed cardiovascular disease (arrhythmias) has a favourable effect on maintaining the sinus rhythm at 1 year of follow-up.*

Keywords

obstructive sleep apnea • cardiac arrhythmias • CPAP therapy

Apneea in somn de tip obstructiv, aritmiile cardiace si efectul la un an al terapiei cu presiune pozitiva

Rezumat

Romanian:

Premize: *Tulburarile de ritm cardiac reprezinta una din consecintele apneei in somn de tip obstructiv (ASO). Standardul de aur al tratamentului ASO moderat/sever simptomatic este reprezentat de terapia cu presiune pozitiva de tip CPAP. Utilizarea CPAP la pacienti cu tulburari de ritm cardiac si ASO poate contribui la mentinerea ritmului sinusal.*

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Scop: *Evaluarea efectului terapiei CPAP adaugata tratamenului medicamentos sau de tip ablativ in mentinerea ritmului sinusal la pacienti cu tulburari de ritm cardiac si ASO moderat-severa.*
Material si metoda: *Pacienti diagnosticati cu tulburari de ritm cardiac (Fibrilatie/Fluter atrial), cu suspiciune inalta de ASO (minim doua din: sforait, apnei semnalte de anturaj, obezitate, somnolenta diurna), au efectuat poligrafie cardio-respiratorie (fluxmetrie nazala, pulsoximetrie, miscari toraco-abdominale, sforait, pozitia corpului) pentru diagostic pozitiv si evaluare severitate ASO. Pacientilor cu ASO moderata/severa li s-a efectuat titrare CPAP si prescriptie terapeutica. La un an, atat pacientii care utilizat CPAP cat si cei care au avut doar tratament standard (medicamentos si/sau ablativ), au fost reevaluati in ceea ce priveste existenta sau absenta tulburarilor de ritm cardiac.*
Rezultate: *63 pacienti cu FiA/fluter si suspiciune inalta de ASO au efectuat poligrafie cardio-respiratorie. 60 pacienti (39 barbati) au fost diagnosticati cu ASO, din care 40 (26 barbati) au avut ASO moderat/sever (IAH ≥ 15/ora) si au efectuat titrare CPAP. La evaluarea de la un an, 17 pacienti (42.5%) au utilizat CPAP (grup A) si 23 (57.5%) nu au utilizat CPAP (grup B). Cele doua grupuri au fost similare in ceea ce priveste varsta, Indexul de Masa Corporala (IMC), somnolenta diurna (evaluata cu scala Epworth) si Indexul de Desaturare; diferente semnificativ statistic fiind inregistrate pentru valoarea IAH (Index de Apnei Hipopnei) si a timpului petrecut sub SaO2 <90% (t90%), mai mari semnificativ statistic ($p < 0.01$ respectiv $p < 0.04$) in grupul A fata de grupul B. La un an, in grupul A, mai multi pacienti au fost in ritm sinusal comparativ cu cei cu FiA/fluter (13, respectiv 4). In grupul B, 8 pacienti au fost in ritm sinusal si 15 cu FiA/fluter.*
Concluzii: *Terapia CPAP adaugata terapiei standard (medicatie si/sau ablatie) la pacienti cu apnee in somn de tip obstructiv moderat-severa si boala cardiovasculara manifesta (aritmii cardiace) are efect favorabil in mentinerea ritmului sinusal la un an de urmarire.*

Cuvinte-cheie

apnea in somn de tip obstructiv • aritmii cardiace • terapie cu presiune pozitiva continua

Introduction

Obstructive sleep apnea (OSA) is a common and multifactorial disease characterised by intermittent and repetitive total (apnea) or partial (hypopnea) pharyngeal collapse during sleep, in the presence of thoracoabdominal movements and snoring, leading to intermittent hypoxaemia and sleep fragmentation (1). The severity of the disease is estimated using the apnea–hypopnea index (AHI), meaning the number of apneas and hypopneas recorded per hour of sleep. OSA is defined by an AHI ≥ 5/h. The presence of an AHI ≥ 5/h, excessive daytime sleepiness and/or cardiometabolic comorbidities define OSA syndrome (2). The prevalence of OSA is high and related to age, gender and obesity.

The prevalence of OSA has increased in epidemiological studies over time. In a meta-analysis of 11 epidemiological studies, published between 1993 and 2013, the prevalence of OSA (defined by an AHI ≥ 5/h) was estimated at 22% (range: 9–37%) in men and 17% (range: 4–50%) in women and OSA syndrome occurred in 6% (range: 3–18%) of men and in 4% (range: 1–17%) of women (3).

There is a close association between OSA and cardiovascular diseases (resistant systemic arterial hypertension, cardiac arrhythmias, heart failure, coronary artery disease and stroke). OSA has been associated with increased cardiovascular morbidity and mortality and seems to be an independent risk factor in the development of these diseases (4–6). Atrial fibrillation (AF) is the most common arrhythmia with significant consequences on mortality and morbidity in general population. There is a close connection between OSA and AF, OSA being identified as an independent risk factor in the onset and recurrence of AF (7). Apnea is accompanied by blood gas changes (intermittent hypoxaemia and hypercapnia) and increased sympathetic activity (8,9). Intermittent hypoxaemia that increases the oxidative stress plays a major role in inflammation (10,11). Repeated oxidative stress leads to cardiac remodelling and systemic and endothelial inflammation. Otherwise, the prevalence of OSA is high in patients with AF (12).

The gold standard treatment of OSA is continuous positive airway pressure (CPAP) that reduces diurnal somnolence and improves the quality of life (13). Some studies have shown that OSA reduces the efficacy of heart rate control strategies based on pharmacological treatment and ablative procedures, while treatment with CPAP decreases the rate of AF recurrence after electrical cardioversion and improves catheter ablation outcomes (14–17).

This article aimed to evaluate the effects of the CPAP therapy added to pharmacological and/or ablative interventions in maintaining sinus rhythm in patients with moderate-to-severe OSA and cardiac arrhythmias who used or not CPAP therapy at 1 year of follow-up.

Materials and methods

A prospective, interventional study on patients with paroxistic/persistent AF or flutter and high suspicion of OSA performed a six-channel (nasal flowmetry, thoracic movements, abdominal movements, pulse-oxymetry, body position and snoring)

cardiorespiratory polygraphy (Porti 7, DeVilbis®) for positive diagnosis and OSA severity assessment.

The inclusion criteria are: age between 18 and 80 years, paroxistic/persistent AF/flutter, patients with high pretest suspicion of OSA (at least two items out of: snoring, apnea, obesity, excessive daytime sleepiness) and signed informed consent.

The exclusion criteria are: age under 18 years, patients with uncontrolled neuropsychiatric disorders or thyroid disorders, patients with cranio-facial abnormalities or who did not sign the informed consent.

All patients underwent anamnesis, clinical examination [including weight, height and body mass index (BMI)] and completed the Epworth Sleepiness Scale (ESS) at study initiation.

Patients with moderate–severe OSA underwent the CPAP titration with consecutive therapy indication (CPAP therapy plus pharmacological and/or ablative intervention). At 1 year, patients who used CPAP (group A) and those without CPAP (group B) were re-evaluated for the presence or absence of cardiac arrhythmias. The average residual AHI was downloaded from the CPAP memory card, and number of hours of use was noted. Patients performed also a resting EKG and completed the ESS.

Informed consent was obtained from all the study patients regarding the study procedures and the use of data for research purposes. The research protocol was approved by the Institutional Ethics Committee.

Statistical analysis

The results were expressed as mean ± standard deviation, median values or absolute numbers (percentage). Statistical analysis of the data was performed using SPSS version 20. A nonparametric Spearman rank correlation analysis was used. Mann–Whitney U test was used to compare groups. Results were considered statistically significant for $p < 0.05$. The diagrams are Scatter/Dot plots and pie charts.

Results and discussions

Sixty-three patients with AF/flutter and high suspicion of OSA referred by an arrhytmologist performed the diagnostic cardiorespiratory polygraphy. Out of them, 60 patients (95%, 39 men and 21 women) were diagnosed with OSA (AHI ≥ 5/h). Thus, the presence of at least two items out of the following: obesity, snoring, witnessed apneas and daytime sleepiness (Epworth Sleepinness Scale > 10/24) in adult patients with cardiac arrhythmias could be a valuable tool in recognising OSA in this patients.

Forty patients had moderate and severe OSA (IAH ≥ 15/h). In our patients, the prevalence of OSA among the men was higher than in women (26 men and 14 women), in concordance with the literature data (18). The characteristics of the patients are depicted in Table 1.

All 40 patients underwent the CPAP titration with consecutive therapy indication (CPAP therapy plus pharmacological and/or ablative intervention). The median CPAP pressure level was 7 (7–13) cm H_2O. In 14 patients, an ablative procedure was performed (5 in group A and 9 in group B).

The adherence to the CPAP therapy was assessed by a telephonic interview 4 weeks after the CPAP titration. The utility of using the CPAP therapy was reinforced. Twenty-four (60%) patients used CPAP more than 4 h per night at 1 month without major complaints. The remaining 16 patients renounced the CPAP therapy due to pressure or mask intolerance, financial difficulties (CPAP therapy not yet reimbursed by the health insurance in our country) or inability

Table 1. Characteristics of the patients with moderate/severe OSA

Age (years)	AHI (number/h)	BMI (kg/m²)	ODI (number/h)	Lowest SaO_2 (%)	Average SaO_2 (%)	t90 (%)	Epworth	CPAP pressure (cm H_2O)
62.68 ± 9.68	32.00 (15.70–76.50)	30.50 (25.00–41.00)	34.54 ± 18.46	77.50 (50–88)	93 (77–96)	4.05 (0.20 –55)	5 (0–23)	7 (7–13)

AHI, apnea hipopnea index; BMI, body mass index; CPAP, continuous positive airway pressure; ODI, oxygen desaturation index; OSA, obstructive sleep apnea; SaO_2, oxyhaemoglobin saturation; t90%, time spent with SaO_2 below 90%.

Table 2. Characteristics of Group A

Age (years)	AHI (number/h)	BMI (kg/m²)	ODI (number/h)	Lowest SaO_2 (%)	Average SaO_2 (%)	t90 (%)	Epworth
65 ± 8.68	38.10 (16.10–76.50)	31.00 (26.00–40.80)	36.80 (13.40–78.00)	75 (50–87)	93 (77–95)	10.50 (0.20 –55)	5 (0–23)

AHI, apnea–hipopnoea index; BMI, body mass index; Epworth Sleepiness Scale; ODI, oxygen desaturation index; OSA, obstructive sleep apnea; SaO_2, oxyhaemoglobin saturation; t90%, time spent with SaO_2 below 90%.

Table 3. Characteristics of Group B

Age (years)	AHI (number/h)	BMI (kg/m²)	ODI (number/h)	Lowest SaO_2 (%)	Average SaO_2 (%)	Epworth
60.96 ± 10.21	27.50 (15.70 –74.40)	30.00 (25–40)	26.90 (8.00 –74.40)	79 (50–88)	93 (87–96)	5 (0–17)

OSA, obstructive sleep apnea; AHI, apnea–hipopnoea index; ODI, oxygen desaturation index; SaO_2, oxyhaemoglobin saturation; BMI, body mass index; Epworth Sleepiness Scale.

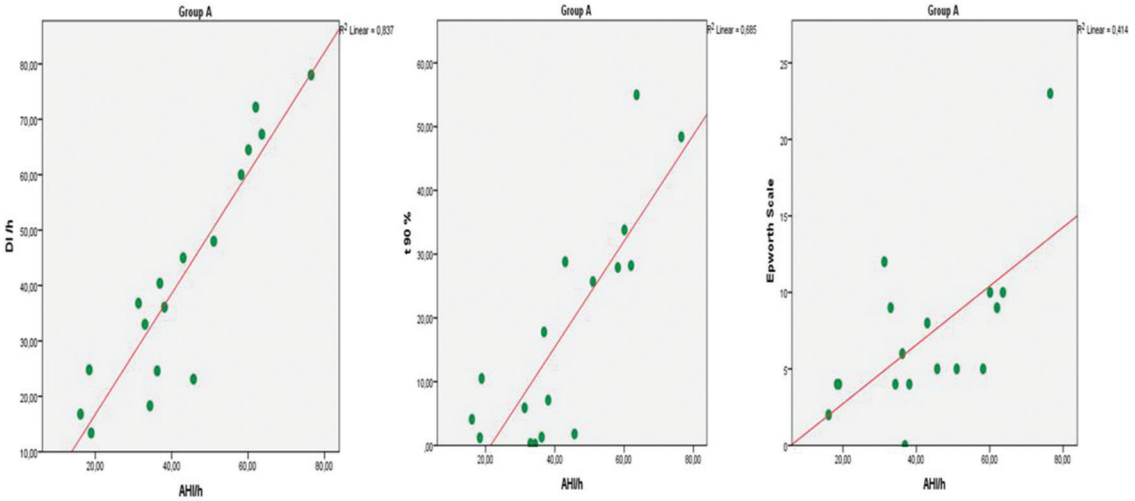

Figure 1. Correlation between Apnea–Hipopnoea index and oxygen desaturation index, t90% (time spent under SaO_2 <90%) and Epworth Sleepiness Scale.

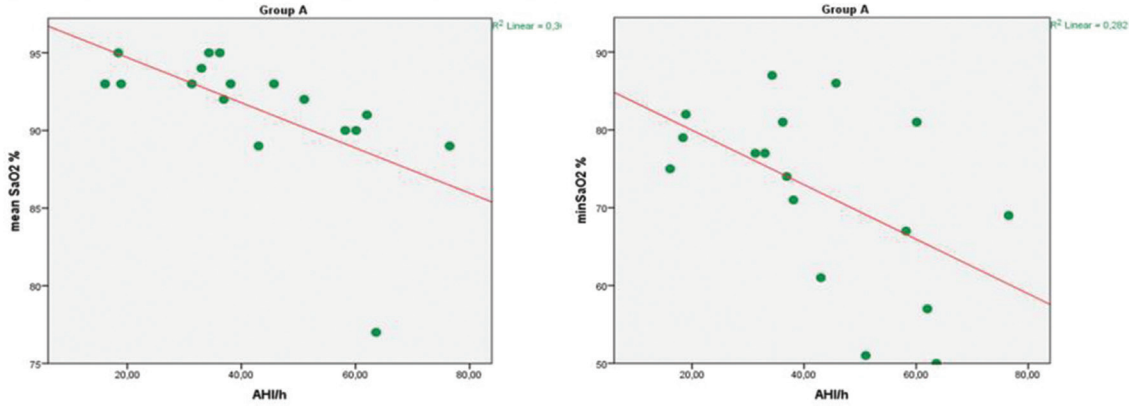

Figure 2. Correlation between Apnea–Hypopnoea index and meanSpO_2% (average SpO_2), minSpO_2% (lowest SpO_2).

to understand the benefits of long-term use of the CPAP therapy.

A total of 17 patients (42.5%) were found adherent to the CPAP therapy (group A) at 1 year of follow-up; the remaining 23 patients (57.5%) did not use CPAP (group B). The characteristics of groups A and B are shown in Tables 2 and 3. The high 42.5% adherence in the CPAP therapy at 1 year could be explained by the fact that the noncompliant patients already renounced the CPAP therapy at 1 month after initial titration (as described below), the remaining CPAP users fulfilling the conditions for a good adherence (pressure and mask tolerance, good sleep quality, education and financial resources). The overall mentioned adherence rates vary between 30 and 60% (19,20).

The two groups were similar in terms of age, BMI, daytime sleepiness (assessed by ESS) and oxygen desaturation index. Statistically significant differences were found for AHI, and the time spent under SaO_2 <90% (t90%), who were

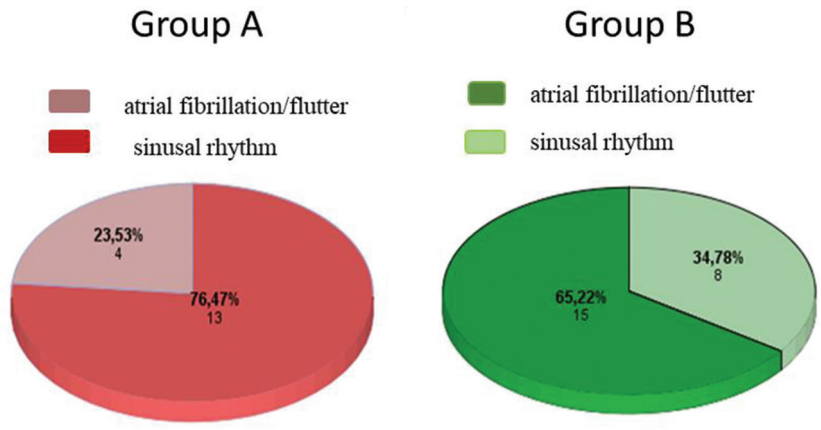

Figure 3. Proportion of sinus rhythm and FIA/flutter in groups A and B.

higher in group A than in group B ($p < 0.01$; respectively $p < 0.04$).

The patients in group A had a more severe OSA and lower nocturnal oxyhaemoglobin levels. A low nocturnal SaO_2 levels are a recognised risk factor for the global cardiovascular risk (21,22), as we found also in our patients.

In group A, AHI positively correlated with oxygen desaturation index ($r = 0.85$; $p < 0.001$), time spent under SpO_2 90% ($r = 0.77$; $p < 0.001$) and ESS ($r = 0.56$; $p = 0.01$) as shown in Figure 1.

A statistically significant negative correlation was found between the nocturnal levels of oxyhaemoglobin saturations (average and lowest) and AHI ($r = -0.78$; $p < 0.01$ respectively $r = -0.55$; $p = 0.02$) in group A, as shown in Figure 2.

At 1 year of follow-up, more patients were in sinus rhythm comparing with those with AF/flutter (13 respectively 4) in group A. In group B, 8 patients were in sinus rhythm and 15 patients with AF/flutter (Figure 3).

The data downloaded from the CPAP memory card revealed that 94.1% of patients used CPAP more than 4 h/night with a median residual AHI/h of 1.90 [0.6–7.10], certifying a good disease control. This may explain our results as the adherence to therapy is an important element in obtaining long-term benefits, with studies showing that with an average CPAP use of less than 4 h/night, the global cardiovascular risk is not significantly decreased (23).

Conclusions

The CPAP therapy added to standard therapy (pharmacological treatment and/or ablative procedures) in patients with moderate–severe OSA and established cardiac arrhythmias has a favourable effect in maintaining the sinus rhythm at 1 year of follow-up.

A proper patient selection (symptomatic moderate–severe OSA) and good adherence to CPAP therapy are important factors in modifying outcomes in established cardiovascular disease.

Conflict of interest

The authors declare that they have no conflicts of interest.

Ethical approval

Inform consent was obtained from the patients in order to participate to the study and write the article.

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