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RESEARCH ARTICLE

Characteristics of Sleep Apnea Assessed Before Discharge in Patients Hospitalized with Acute Heart Failure

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Objectives. Evaluation of the characteristics of sleep apnea (SA) in patients hospitalized with acute heart failure, considering that undiagnosed SA could contribute to early rehospitalization. **Methods**. 56 consecutive patients (13 women, 43 men, mean age 63.12 years) with acute heart failure, in stable condition, underwent nocturnal polygraphy before hospital discharge. The type and severity of SA was determined. Besides descriptive statistics, correlations between the severity of SA and clinical and paraclinical characteristics were also analyzed (t-test, chi-square test, significancy at alpha < 0.05). **Results**. 12 (21.4%) subjects were free of SA (AHI - apnea-hipopnea index <5/h), 15 (26.7%) had mild SA (AHI=5-14/h), 17 (30.3%) had moderate SA (AHI 15-30/h), and 12 (21.4 %) had severe SA (AHI>30/h). The apnea was predominantly obstructive (32 cases vs. 12 with central SA). Comparing the patients with mild or no SA with those with severe SA, we did not find statistically significant correlations (p>0.05) between the severity of SA and the majority of main clinical and paraclinical characteristics – age, sex, BMI, cardiac substrates of heart failure, comorbidities. Paradoxically, arterial hypertension (p=0.028) and atrial fibrillation (p=0.041) were significantly more prevalent in the group with mild or no SA. **Conclusions**. Before discharge, in the majority of patients hospitalized with acute heart failure moderate and severe SA is present, and is not related to the majority of patient related factors. Finding of significant SA in this setting is important, because its therapy could play an important role in preventing readmissions and improving prognosis.

Keywords: acute heart failure, obstructive sleep apnea, central sleep apnea, prognosis

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Introduction

The relationship between sleep disordered breathing (SDB), represented by obstructive and central sleep apnea (SA), and cardiovascular diseases has been demonstrated in numerous studies. SDB confers an increased risk for cardiovascular complications and events, playing role in the pathophysiology of resistant hypertension, arrhythmias (from those benign to sudden cardiac death), myocardial ischemia, pulmonary hypertension and heart failure [1-4].

The prevalence of symptomatic obstructive SA in the general population is about 4% in middle-aged men, and 2% in middle-aged women. SDB is common in heart failure (HF), being present in nearly one half of the patients, impairing both the quality of life and prognosis. The specific manifestation is central SA, which is directly related to the level of congestion and functional status [5-7].

Acute HF is a common cause of hospitalizations in the course of HF, moreover, readmissions represent the most predictive factor for poor prognosis and increased mortality. Rehospitalizations within 30 days post-discharge are high, almost one third of patients being involved. The precipitating factors for these admissions are multiple, including cardiac and noncardiac conditions, like myocardial ischemia, arrhythmias, infections, treatment non-compliance, improper medications, etc., and, also, undiagnosed and/or untreated SDB [8-10] .

Thus, identifying potential factors related to early readmissions is mandatory. In line with this, the aim of our study was to evaluate the characteristics of SDB in patients hospitalized with acute HF, when already compensated, before hospital discharge. Also, the feasibility of this approach was tested: the yield of routine nocturnal poligraphy for identification of those patients who could benefit from specific treatment of SDB, as a possible tool for preventing rehospitalizations.

Methods

Patient population

We enrolled in the study 56 consecutive patients (13 women, 43 men, mean age 63.12 years) hospitalized with acute HF in the Department of Cardiology of Clinical County Hospital Mureș, between 01.01.2015- 01.06.2016. At the admission, all the patients signed the general consent form used in our institution, agreeing with anonymous data collection and usage for scientific purposes. Approval of local ethical committee (3865/01.03.2016) was obtained for confidential data processing and publication.

Patients who had a severe clinical/hemodynamical instability during the admission, those with marked insomnia and those already on treatment with continuous positive airway pressure (CPAP) therapy for obstructive SA were excluded from data collection.

During the hospital stay, all the patients received an usual care, involving common diagnostic (clinical follow-

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up, ECG, chest X-ray, echocardiography, laboratory tests) and therapeutic (oxigen, oral and parenteral medication) procedures. Clinical and paraclinical data were recorded in a custom designed database for further statistical analysis.

In-hospital sleep-study

When in stable clinical condition, as a rule, during the night before discharge, all the patients underwent nocturnal polygraphy (Stardust II®, Phillips Respironics) for assessing the presence and severity of SDB. The device was applied at bedtime by a member of the medical staff, while a trained night shift nurse controlled intermittantly the course of registration during nighttime.

Poligraphy involved continuous registration of the following six parameters: nasal airflow, arterial oxygen saturation, heart rate, thoracic movements, body position and snoring. The recordings were edited and corrected manually. The episodes of apnea and hypopnea were defined according to the criteria of American Academy of Sleep Medicine [11, 12]. The overall SDB of the patient was labelled as central or obstructive depending on the predominance (more than 50 % of all episodes) of the central or obstructive events. The level of severity was expressed using the apnea-hipopnea index (AHI) – number of events/hour. Central events also included Cheyne-Stokes respiration, a specific pattern of SA in HF, which was diagnosed when three consecutive cycles of respiration had a cresscendo-descrescendo pattern in association with central hipopnea or apnea.

Statistics

We applied descriptive statistics for the characterization of the prevalence, type and severity of SA, while the correlations between SDB severity and diverse clinical and paraclinical parameters were analysed using t-test and chi-square test - statistical significance set at alpha < 0.05 (GraphPad InStat 3.0 software).

Results

The occurrence, severity and type of SA found in our patients are presented in Table I. SDB was present on nocturnal poligraphy performed before hospital discharge at the majority of patients. More than a half of the patients presented moderate or severe forms of SA, the obstructive form being more prevalent (about 2/3 of cases).

To study the correlations between the severity of SA and diverse clinical and paraclinical characteristics of the patients, we compared the parameters of two groups – (1) patients with AHI <15/h (mild or no SA), and (2) patients with AHI >30/h (severe SA). The data and results of comparisons are presented in Table II, III and IV.

The two groups were comparable regarding the general characteristics, like age, sex and body mass index (BMI). Also, we did not find statistically significant differences regarding the majority of cardiac substrates, non-cardiac comorbidities and echocardiographic parameters. Paradoxically, two characteristics, the presence of arterial hypertension and atrial fibrillation, proved to be significantly more prevalent in patients with AHI<15/hour. Also, a tendency ($p<0.1$) was observed for older age and higher values of pulmonary artery pressure in the AHI>30/hour group.

Table I The prevalence, severity and type of sleep apnea in the patient population

	AHI <5 nr. of patients (%)	AHI = 5-14 nr. of patients (%)	AHI = 15-30 nr. of patients (%)	AHI>30 nr. of patients (%)
Apnea (total)	12 (21.4%)	15 (26.7%)	17 (30.3%)	12 (21.4%)
Central	-	4 (26.6%)	4 (23.5%)	4 (33.3%)
Obstructiv	-	11 (73.3%)	13 (76.4%)	8 (66.6%)

Table II Comparison of general parameters in the two groups

Parameter	AHI>30 (12 patients)	AHI<15 (27 patients)	p
Age	*60.67 ±2.0	63.22 ±1.9	0.442
Age>65 years	**3 (25%)	15 (18.5%)	0.095
Body mass index	27.87 ± 1.2	28.27 ± 1.2	0.849
Body mass index >30 kg/m2	4 (33.3%)	8 (29.6%)	1.00
Sex (nr. women/men, %)	1/ 11 (8.3%/91.7%)	7/20 (25.9%/74.1%)	0.393

*for all values: mean ± standard deviation, ** for all values: nr. of patients (%)

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Table III Comparison of clinical characteristics in the two groups

Charactersitic (cardiac substrates, comorbidities)	AHI>30 (12 patients)	AHI<15 (27 patients)	p
Dilated cardiomyopathy	*5 (41.6%)	14 (51.8%)	0.731
Hypertension	1 (8.3%)	13 (48.1%)	**0.028
Ischemic heart disease	2 (16.6%)	6 (22.2%)	1.00
Atrial fibrillation	0	8 (29.6%)	**0.041
Significant mitral valve regurgitation	6 (50%)	13 (48.1%)	1.00
Severe aortic regurgitation	2 (16.6%)	7 (25.9%)	0.692
Severe aortic stenosis	3 (25%)	3 (11.1%)	0.348
Severe tricuspid regurgitation	4 (33.3%)	11 (40.7%)	0.734
Severe pulmonary hypertension (>60 mmHg)	7 (58.3%)	7 (25.9%)	0.074
Chronic obstructive pulmonary disease	2 (16.6%)	1 (3.7%)	0.219
Diabetes	2 (16.6%)	6 (22.2%)	1.00
Renal dysfunction during admission (creatinine>1,5 mg%)	4 (33.3%)	8 (29.6%)	1.00

*for all values: nr. of patients (%), **statistically significant

Table IV Comparison of echocardiographic parameters in the two groups

Parameter	AHI>30 (12 patients)	AHI<15 (27 patients)	P
Left ventricular (LV) end-diastolic diameter (mm)	*61.17 ± 2.7	58.00 ± 1.65	0.316
Left ventricle (diastole) >60 mm	**7 (58.3%)	12 (44.4%)	0.487
Left atrial PA diameter (mm)	48.17 ± 1.5	47.83 ± 1.31	0.874
Left atrial PA diameter > 50 mm	6 (50%)	9 (33.3%)	0.4
LV ejection fraction (%)	41.46 ± 4.33	42.79 ± 3.26	0.815
LV ejection fraction <40 %	6 (50%)	14 (51.8%)	1.00
Pulmonary artery systolic pressure (mmHg)	69.09 ± 5.55	55.63 ± 3.95	0.0672

*for all values: mean ± standard deviation, ** for all values: nr. of patients (%)

Discussion

The pathophysiology of harmful effects of SA in HF is complex and involves haemodynamic, mechanical, humoral, neural, metabolic and inflammatory factors. Obstructive SA induces marked intrathoracic pressure changes, which lead to a higher left ventricular transmural pressure-gradient. SA (both central and obstructive) is characterized by repetitive episodes of hypoxemia/hypercapnia (followed by reoxygenation), which induce oxidative stress and hypoxic pulmonary vasoconstriction. The increase of left ventricular afterload combined with hypoxemia, together with an increase in heart rate and blood pressure (both consequences of sympathetic nervous system activation during arousals) could lead to myocardial ischemia and/or arrhythmias and could trigger acute cardiac decompensations too. The high level of inflammatory mediators (e.g., C-reactive protein) and the oxidative stress determines endothelial dysfunction and metabolic disturbances, which have an important role in atherogenesis [1, 3, 10].

Several studies demonstrated that up to 40-50% of patients with HF (both with preserved and reduced ejection fraction) suffer from clinically relevant SA, with AHI greater than 15/hour [6, 10, 13]. This fact was confirmed also by our study, we observed a prevalence of moderate/severe SA in about 50% of the patients, the obstructive form being more frequent.

Many observational studies demonstrated, that the occurrence and severity of SA in HF is correlated with several general and specific factors - e.g., age, gender, body mass index, level of congestion, NYHA class, left ventricular ejection fraction, cardiac and non-cardiac comorbidities [1-3, 10]. Comparing the group of patients with no or mild SA with that with severe SA – with two exceptions - we did not find significant differences between the two groups in this regard. The increased prevalence of hypertension and atrial fibrillation in the mild/no SA group could be explained by chance, by the relatively small number of cases. On the other hand, the tendency of increased pulmonary artery pressure in the severe SA group is in line with the literature [1-3].

The feasibility of our approach is supported by the studies of Khayat et al., which demonstrate the value of in-hospital SA testing in the setting of acute heart failure. These data support, that both central and obstructive SA diagnosed during hospital stay are independently related to postdischarge mortality (multivariable hazard ratio 1.61 and 1,53) and hospital readmissions (adjusted rate ratio 1,53 and 1,49) [14-16].

Finding a marked SA at hospital discharge could have multiple significances: (1) persisting congestion (including subclinical) as a contributing factor, (2) poor prognosis regarding mortality and readmissions, and (3) the need to start specific therapy for improving symptoms, quality of life and prognosis. Regarding the latter aspect, presently there exist supporting data only for treatment with CPAP in HF patients with significant obstructive SA [10, 17]. Suppressing central SA by adaptive servo-ventilation is still debated after the worrying results of SERVE-HF trial – increased mortality in the patients on nocturnal non-invasive ventilation [10, 18].

Conclusion

Our data supports the value of predischarge testing for SA in patients hospitalized for acute heart failure. Initiation of specific therapy in the case of finding moderate or severe forms of SA (obstructive) can be an important part of management, having a definite role in preventing readmissions and improving prognosis.

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Conflict of interest

None to declare.

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