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CARDIOVASCULAR SYSTEM FEATURES IN PATIENTS WITH CHRONIC BRONCHITIS COMBINED WITH ARTERIAL HYPERTENSION AND SLEEP APNEA SYNDROME

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Abstract

Structural and functional changes in the cardiovascular system in patients with chronic obstructive bronxitis (COB) and arterial hypertension (AH) combined with obstructive sleep apnea syndrome (OSAS) were analyzed. The study included 45 patients with CB of moderate severity, mild clinical symptoms, and rare exacerbations, along with AH (I–II stage), comprising 29 men and 16 women aged 36–61 years, with disease durations of 5–15 years. Diagnosis was verified using the GOLD 2014, WHO/ISAH (1999), and OHK-VI classifications. Echocardiography was performed using the Mindray system in M and B modes.

Patients with OSAS demonstrated significant structural-hemodynamic abnormalities of the left ventricle (LV), including increased LV mass. Those with AH and OSAS exhibited marked heart remodeling—concentric hypertrophy of the LV.

Keywords

Chronic obstructive bronchitis, Arterial Hypertension, Obstructive Sleep Apnea Syndrome, Left Ventricular Remodeling.

Relevance

In recent years, significant attention has been given to obstructive sleep apnea syndrome (OSAS) as a condition closely associated with cardiovascular diseases (CVDs). The prevalence of OSAS varies across populations, as indicated by numerous epidemiological studies, though the data remains highly inconsistent [3, 5, 11].

It has been established that the prevalence of sleep-disordered breathing is higher among men than women, and the incidence of OSAS increases with age. According to research [11, 12], the prevalence of OSAS in men ranges from 0.4% to 9.1%, while in women it is 4.0% to 4.4%. In Asian countries, approximately 3–7% of

adult men and 2–5% of adult women have clinically significant OSAS, requiring treatment [4, 6, 7].

Recent evidence has confirmed the relationship between OSAS, chronic obstructive bronxitis (COB), and arterial hypertension (AH), demonstrating the role of sleep-disordered breathing in maintaining primary pathology. According to various authors, 40–90% of COB patients with OSAS are diagnosed with AH. Conversely, 20–30% of patients with CB and AH experience OSAS. However, the mechanisms by which sleep-related pathology contributes to both nocturnal and daytime hypertension remain unclear.

Studies have shown that sleep-disordered breathing is independently associated with higher blood pressure levels [11, 14, 15].

One major challenge in understanding the causal relationships of OSAS and its impact on CVD in COB patients is the issue of comorbidity, particularly the frequent coexistence of OSAS with COPD and AH. The severity of hemodynamic changes in OSAS patients significantly affects the prognosis for cardiovascular complications and target organ conditions. Increased left ventricular (LV) mass is a predictor of a high frequency of cardiovascular complications, including mortality. In OSAS, a dual mechanism for the development of LV hypertrophy (LVH) is possible.

Study Objective

To identify the structural and functional changes in the cardiovascular system in patients with chronic obstructive bronxitis (COB) and arterial hypertension (AH) combined with obstructive sleep apnea syndrome (OSAS).

Materials and Methods

To achieve the stated objective, 45 patients with chronic bronchitis (CB) of moderate severity (with mild clinical symptoms and rare exacerbations) and arterial hypertension (AH) of stages I–II were examined at the Republican Specialized Scientific and Practical Center for Therapy and Medical Rehabilitation. The cohort included 29 men and 16 women aged 36–61 years (mean age 53.4 ± 2.3 years), with disease durations of 5–15 years. Diagnoses were verified based on the GOLD 2014, WHO/ISAH (1999), and OHK-VI classifications.

All patients underwent echocardiography (EchoCG) and overnight monitoring of arterial blood hemoglobin oxygen saturation (to diagnose obstructive sleep apnea syndrome, OSAS) using the portable pulse oximeter *HandHeld Patient Monitor* (China). Based on OSAS confirmation, the patients were divided into two groups:

1. Group 1: 20 patients with COB and AH (stages I–II) without OSAS.
2. Group 2: 25 patients with COB and AH (stages I–II) with OSAS.

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Exclusion criteria: Symptomatic AH, history of stroke, myocardial infarction, severe diabetes mellitus, heart failure, and other cardiovascular diseases (e.g., ischemic heart disease, significant arrhythmias, valvular defects, cardiomyopathy) that could influence the studied parameters. Additionally, conditions predisposing to OSAS (e.g., lymphoid tissue hypertrophy of the pharynx, endocrine disorders) were excluded.

Echocardiography (EchoCG) was performed using the Mindray system (China) in the left lateral position in M and B modes, following the standards of the American Society of Echocardiography (ASE). The following parameters were assessed:

- End-diastolic dimension (EDD)
- End-systolic dimension (ESD)
- Posterior wall thickness of the left ventricle (PWTLV)
- Interventricular septum thickness (IVST)
- Left atrium size (LA)
- End-diastolic volume (EDV)
- End-systolic volume (ESV)

The left ventricular ejection fraction (EF) was calculated using the Teicholz formula [2, 15], while stroke volume (SV) was calculated as EDV - ESV. LV mass (LVM) was determined using Devereux's formula:

$$\mathrm{LVM} = 1.04 \times ((\mathrm{PWTLV} + \mathrm{IVST} + \mathrm{EDD})^3 - (\mathrm{EDD})^3) - 13.6$$

The LV mass index (LVMI) was calculated as LVM/body surface area, with hypertrophy defined as LVMI >125 g/m² for men and >110 g/m² for women. Relative wall thickness (RWT) was determined using:

$$\mathrm{RWT} = (\mathrm{PWTLV} + \mathrm{IVST})/\mathrm{EDD}$$

Statistical analysis: Data were analyzed using *Biostatistics for Windows*, version 4.03. Parameters were presented as mean ± standard error (M±σ). Group comparisons for quantitative variables were performed using Student's t-test.

Results and Discussion

Assessment of LV wall condition showed significant increases in IVST, PWTLV, RWT, LVM, and LVMI in patients with COB and AH who also had OSAS, compared to those without OSAS. Specifically:

- Structural differences in EchoCG parameters (e.g., IVST and PWTLV) between Groups 1 and 2 were 5.7% and 6.14%, respectively ($p < 0.05$).
- RWT showed significant differences, with a 16.2% increase in Group 2 compared to Group 1 ($p < 0.05$).

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Table 1 summarizes the main echocardiographic parameters for COB and AH patients with and without OSAS.

These findings indicate that OSAS is associated with significant structural changes in the LV, highlighting more pronounced remodeling in the form of increased wall thickness, RWT, and LV mass. Statistical differences suggest that OSAS exacerbates cardiovascular remodeling in COB patients with AH.

Table 1.

Echocardiographic Parameters in COB and AH Patients With and Without OSAS (M±σ)

Parameter	Group 1 (COB + AH, n=20)	Group 2 (COB + AH + OSAS, n=25)
Left atrium (LA), cm	3.55 ± 0.031	3.78 ± 0.028
Posterior wall thickness of LV (PWTLV), cm	1.06 ± 0.031	1.12 ± 0.033*
Interventricular septum thickness (IVST), cm	1.14 ± 0.026	1.21 ± 0.037*
End-diastolic dimension (EDD), cm	5.17 ± 0.051	5.09 ± 0.034
End-systolic dimension (ESD), cm	3.65 ± 0.042	3.56 ± 0.046
End-diastolic volume (EDV), mL	129.3 ± 2.55	121.88 ± 1.96
End-systolic volume (ESV), mL	58.3 ± 1.55	51.6 ± 1.34
Relative wall thickness (RWT), units	0.37 ± 0.008	0.43 ± 0.007*
LV mass (LVM), g	223.6 ± 3.74	247.67 ± 4.56**
LV mass index (LVMI), g/m²	119.33 ± 4.31	129.76 ± 3.44**
Stroke volume (SV), mL	71.92 ± 2.33	70.92 ± 2.71
Ejection fraction (EF), %	57.82 ± 1.22	55.83 ± 2.53
Cardiac output (CO), L/min	4.92 ± 0.21	4.88 ± 0.25
Cardiac index (CI), L/min/m²	2.46 ± 0.08	2.42 ± 0.1

Note:

- *$p < 0.05$ compared to Group 1.
- **$p < 0.01$ compared to Group 1.

This table demonstrates that patients in Group 2 (COB + AH + OSAS) exhibit significant differences in echocardiographic parameters, particularly increased wall thickness (PWTLV, IVST), relative wall thickness (RWT), LV mass (LVM), and LV mass index (LVMI), compared to Group 1. These findings highlight the structural impact of OSAS on left ventricular remodeling.

Key Findings and Conclusions

Further analysis of echocardiographic parameters describing the structural and geometric properties of the left ventricle (LV) revealed more pronounced signs of LV myocardial remodeling in patients with COB, AH, and OSAS. These changes were supported by statistically significant differences in LV mass (LVM) and LV mass index (LVMI) between Groups 1 and 2 ($p < 0.01$).

For Group 2 (CB + AH + OSAS):

- LVM: 247.67 ± 4.56 g vs. 223.6 ± 3.74 g in Group 1 ($p < 0.01$).
- LVMI: 129.76 ± 3.44 g/m² vs. 119.33 ± 4.31 g/m² in Group 1 ($p < 0.01$).

Hypertrophy Prevalence

- **Group 2 (with OSAS)**: LV hypertrophy (LVH) was found in **84.4**% of patients (21 out of 25; 13 men and 8 women).
- **Group 1 (without OSAS)**: LVH was present in **67**% of patients (13 out of 20; 7 men and 5 women).

OSAS patients exhibited significantly more severe LVH compared to those without OSAS.

Remodeling Patterns

Patients were categorized based on LV remodeling:

- **Concentric LVH**: More common in OSAS patients (16 in Group 2 vs. 12 in Group 1), which explains the higher values of interventricular septum thickness (IVST) and relative wall thickness (RWT).
- **Eccentric LVH**: Observed more frequently in the non-OSAS group (9 patients in Group 1 vs. 7 in Group 2).

Eccentric LVH was associated with increased thickness of the LV posterior wall and IVST, as well as enlarged chamber sizes observed during echocardiography.

Impact of OSAS on LV Remodeling

The study demonstrates that OSAS significantly contributes to LV remodeling in COB and AH patients. Differences in LV geometric parameters, including IVST, PWTLV, LVM, LVMI, and RWT, highlight the structural impact of OSAS. Larger IVST values in the OSAS group, with relatively unchanged LV cavity dimensions (EDD and ESD), suggest the predominance of concentric LVH.

Clinical Implications

LVH is an independent predictor of cardiovascular disease and complications in COB and AH patients. Even with normal blood pressure, OSAS patients exhibit more frequent signs of LVH, indicating OSAS's strong influence on the development of concentric remodeling and LVH.

Conclusions

1. OSAS in COB and AH patients is associated with more pronounced structural and hemodynamic LV abnormalities, including increased LV mass.
2. The structural-functional state of the heart in COB and AH patients with OSAS is characterized by significant remodeling, particularly concentric LV hypertrophy.

This highlights OSAS as a crucial factor contributing to cardiac remodeling, independent of the primary pathology.

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