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Multidimensional clinical and paraclinical assessment of pulmonary hypertension in COPD: A retrospective observational study of 170 patients

Steliana Simona Tudor [1]*, Simona Claudia Stefan [1], Caterina Nela Dumitru [1], Ancuta Iacob [1], Ionela Daniela Fertu [1]

[1] Medical-Pharmaceutical Research Center, Department of Pharmaceutical Sciences, Faculty of Medicine and Pharmacy, "Dunărea de Jos" University of Galaţi, Galaţi, ROMANIA
***Corresponding Author:** steliana.tudor@ugal.ro

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ABSTRACT

Chronic obstructive pulmonary disease (COPD) is a progressive respiratory disorder characterized by persistent airflow limitation and significant systemic consequences, representing a major cause of morbidity and mortality worldwide. Pulmonary hypertension (PH) is a frequent and severe complication of COPD, particularly in advanced stages of the disease, and is associated with reduced exercise capacity, increased functional impairment, and poorer prognosis. The complex pathophysiology of COPD-associated PH involves chronic hypoxia, pulmonary vascular remodeling, systemic inflammation, oxidative stress, and endothelial dysfunction. In this context, a multidimensional assessment integrating clinical, functional, and laboratory parameters is essential for improving risk stratification and optimizing therapeutic management. The present study aimed to perform an integrated evaluation of the clinical and paraclinical profile of patients with COPD and associated PH and to compare these findings with data reported in recent international literature. This retrospective observational study included 170 patients diagnosed with COPD who were evaluated in a tertiary care internal medicine department between November 2024 and October 2025. Patients were stratified into two groups according to the presence or absence of PH. Clinical evaluation, pulmonary function testing, transthoracic echocardiography, six-minute walk test (6MWT), functional classification according to the New York Heart Association, and laboratory assessment of inflammatory markers were performed. Comparative statistical analysis was used to evaluate differences between the two groups. Patients with COPD and PH demonstrated more severe respiratory functional impairment, reduced exercise tolerance, and higher functional class compared with those without PH. The PH group showed lower mean FEV1 values, shorter distances in the 6MWT, and higher levels of systemic inflammatory markers. Advanced GOLD stages and a higher prevalence of cardiovascular comorbidities were also more frequently observed in this group. PH significantly worsens the clinical and functional status of patients with COPD. A multidimensional evaluation combining clinical, functional, and biological parameters provides valuable information for risk stratification and may contribute to improving therapeutic strategies and prognostic assessment in patients with COPD-associated PH.

Keywords: chronic obstructive pulmonary disease, pulmonary hypertension, risk factors

INTRODUCTION

The present retrospective observational study evaluated 170 patients with Chronic obstructive pulmonary disease (COPD) and compared patients with and without Pulmonary hypertension (PH) using clinical, respiratory, functional and laboratory parameters. The findings were also considered in relation to selected publications identified in the Web of Science core collection.

The clinical burden of COPD-associated PH is therefore best understood through an integrated assessment of respiratory function, exercise capacity, cardiovascular status and systemic biological markers. Such multidimensional assessment may help identify patients with greater functional impairment and support risk stratification.

PH is an important complication of COPD, particularly in patients with advanced disease, and is associated with impaired exercise capacity, cardiovascular comorbidity and poorer prognosis. The COPD-PH association is influenced by chronic hypoxia, systemic inflammation, vascular remodeling and cardiovascular dysfunction [1-3].

COPD is a chronic respiratory disease characterized by persistent airflow limitation and progressive clinical impairment. Smoking remains a major risk factor, while occupational exposures, air pollution, biomass smoke and other environmental factors also contribute to disease development [4-6].

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MATERIAL AND METHODS

Study Design and Investigated Population

This was a retrospective, observational, analytical study of 170 patients with COPD treated in a tertiary-care internal medicine department in southeastern Romania between 1 November 2024 and 31 October 2025. The patients were selected from an initial cohort of 1,955 hospital presentations. Inclusion required a confirmed COPD diagnosis and sufficiently complete clinical and laboratory records to permit assessment of respiratory and cardiovascular status. Patients were stratified into group A (COPD with PH; n = 120) and group B (COPD without PH; n = 50).

The data obtained were analyzed and compared with the results reported in the specialized literature published between 2020 and 2025, indexed in the Web of Science, in order to integrate our findings in the context of current evidence and to assess the clinical relevance of this pathological association.

The clinical study was conducted on a sample of 170 patients, men and women, aged between 40 and 80 years, from both urban and rural areas. The patients were selected from an initial cohort of 1,955 people who presented to the internal medicine service at a hospital in southeastern Romania between November 1, 2024, and October 31, 2025, for various medical conditions.

The diagnosis of COPD was established based on clinical criteria, respiratory function tests, and echocardiographic evaluation, in accordance with the recommendations of current international guidelines.

Patients with a confirmed diagnosis of COPD, with complete clinical and laboratory data, which allowed for the simultaneous assessment of pulmonary and cardiovascular status, were included in the study.

Collection and Evaluation of Clinical and Paraclinical Data

Clinical and paraclinical variables included demographic characteristics, smoking and exposure history, comorbidities, spirometric parameters, oxygen saturation, transthoracic echocardiography (TTE), six-minute walk distance (6MWD), New York Heart Association (NYHA) functional class and selected laboratory/inflammatory markers. The tests are reported here only as outcome measures; detailed descriptions of the individual procedures were omitted to improve concision. PH classification in this study was based on echocardiographic assessment as described in the original clinical protocol.

The two groups were compared across the clinical, functional and laboratory variables listed above.

This stratification allowed for the comparative analysis of clinical and paraclinical characteristics between the two categories of patients.

LITERATURE REVIEW

For the comparative literature component, the Web of Science core collection was searched for publications from 2020 to 2025 using combinations of the terms “chronic obstructive pulmonary disease”, “pulmonary hypertension”, “clinical characteristics”, “echocardiography” and “functional assessment”. The current manuscript contains some publications used in the comparative narrative analysis. Because the original search log and screening flow were not retained, this number represents publications used/cited rather than a formal PRISMA-style count of records screened and eligible.

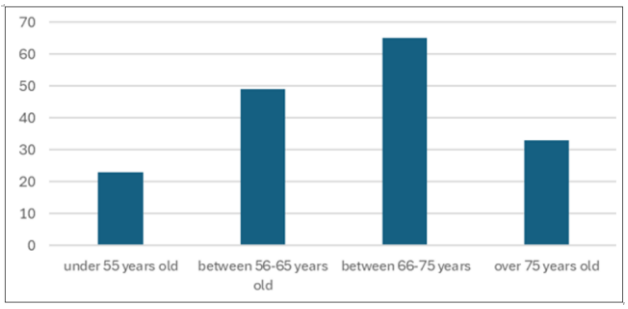


Figure 1. Distribution by age group (the authors’ own elaboration)

Publications addressing the clinical, functional or prognostic relationship between COPD and PH were considered. The stated exclusion criteria were publication before 2020, experimental/model studies, and articles without relevant clinical data. No additional database was searched.

The literature was used for contextual comparison of PH prevalence, clinical profile, functional impairment, cardiovascular comorbidity and inflammatory findings. This component should be regarded as a narrative literature comparison rather than a systematic review.

RESULTS

Following the analysis of data obtained from the clinical study, of the 170 COPD patients, 120 were classified into group A (COPD patients with PH), and 50 into group B (COPD patients without PH). The mean age was 61.75 ± 3.4 years in both groups.

The predominant age group was 66-75 years (38.23% of the cohort), and males predominated across the reported age groups. **Figure 1** shows the distribution by age group.

Smoking and other tobacco exposures were common in both groups; detailed risk-factor and clinical characteristics are presented in **Table 1**.

Table 2 shows the COPD severity and distribution among patients with FEV1 < 60%.

The percentage of patients in a higher severity class is significantly higher in patients with COPD and PHT compared to patients with COPD but without PHT.

Of the 170 patients, 120 had PH and 50 did not. Heart failure was reported in 61 patients in group A and 20 in group B; oxygen saturation below 90% was reported in 32.5% and 56.0%, respectively.

NYHA functional status for the full cohort is summarized in **Table 3**.

Exercise capacity was lower in the PH group: mean 6MWD was 417.8 ± 98.5 m versus 489.2 ± 94.3 m in the non-PH group. The test was interrupted by three patients with PH, whereas all patients without PH completed it.

Table 4 shows the mean distance on the six-minute walk test (6MWT).

Table 1. Risk factors and clinical characteristics of the two study groups

Variable	COPD with PH: Group A (n = 120)	COPD without PH: Group B (n = 50)
Smoker	49 patients (28.82%)	31 patients (18.23%)
Non-smoker	8 patients (4.70%)	4 patients (2.35%)
Ex-non-smoker	27 patients (15.88%)	10 patients (5.88%)
Passive exposure to tobacco	19 patients (11.17%)	3 patients (15.17%)
Professional exposures	17 patients (10.00%)	2 patients (1.17%)
Average age	67+/-12	60+/-15
Gender: Female/male	12/18	49/71
Smoking	78 patients (65.00%)	30 patients (60.00%)
Hypertension	85 patients (70.83%)	14 patients(28.00%)
ICC	61 patients (50.83%)	20 patients (40.00%)
VEMS < 60%	70 patients (58.33%)	39 patients (78.00%)
SaO_2 < 90%	39 patients (32.50%)	28 patients (56.00%)
Sleep apnea syndrome	42 patients (35.00%)	17 patients (34.00%)

Table 2. COPD severity and distribution among patients with FEV1 < 60%

GOLD stage	Mean FEV1, PH: Group A	Mean FEV1, no PH: Group B	FEV1 < 60%, PH: n (%)	FEV1 < 60%, no PH: n (%)
Stage 0: At risk	-	-	-	-
Stage I: Mild	77.5 ± 5.2	79.1 ± 4.4	7 (10.00%)	6 (15.38%)
Stage II: Moderate	59.8 ± 10.3	62.2 ± 9.8	15 (21.42%)	12 (30.76%)
Stage III: Severe	48.9 ± 7.9	49.8 ± 8.8	32 (45.71%)	19 (48.71%)
Stage IV: Very severe	28.6 ± 8.1	29.1 ± 7.4	16 (22.85%)	2 (5.12%)

Table 3. NYHA functional class distribution in the full cohort

NYHA class	Number of patients (%)
NYHA class I	89 patients (52.35)
NYHA class II	22 patients (12.94)
NYHA class III	39 patients (22.94)
NYHA class IV	20 patients (11.76)

Table 4. Mean distance on the 6MWT

Group	Distance traveled
Group with COPD without PHT (group B)	489.2 ± 94.3 m
Group with COPD with PHT (group A)	417.8 ± 98.5 m

Selected hematological, metabolic and inflammatory markers are summarized in **Table 5**.

C-reactive protein and several other inflammatory markers were numerically more frequent in the PH group, including leukocytosis, thrombocytosis, elevated ESR and hyperfibrinogenemia.

DISCUSSION

Our main finding is that 120 of 170 patients (70.6%) had COPD-associated PH. Compared with the non-PH group, patients with PH showed a greater overall burden of cardiovascular comorbidity, more advanced COPD in the low-FEV1 subgroup, lower exercise capacity and a higher frequency of several inflammatory abnormalities. This pattern is consistent with the recognized interaction between COPD, cardiovascular disease and systemic vascular/inflammatory mechanisms [1-3].

The smoking and exposure findings are also clinically relevant, but they should not be interpreted as evidence of causality in this retrospective cohort. Smoking was common in both groups, and the literature recognizes smoking and occupational/environmental exposures as important COPD risk factors [5, 6]. This study adds these exposures occurred in a population in which PH was frequently accompanied by substantial functional and cardiovascular burden.

Cardiovascular comorbidity was common, particularly hypertension (70.83% in group A versus 28.00% in group B), while heart failure was reported in 50.83% and 40.00%, respectively. The coexistence of COPD and cardiovascular disease is well recognized and may amplify functional limitation and prognosis [2, 3]. The current data therefore support a multidimensional clinical assessment in which PH is considered alongside respiratory severity, exercise capacity, oxygenation, comorbidity and systemic inflammatory status.

Table 5. Biological and inflammatory characteristics of the two groups

	BPCO with HTTP: Group A	BPCO without HTP : Group B
Polycythemia (Ht > 55%)	9 patients (30%)	26 patients (22%)
Leukocytosis	13 patients (43%)	45 patients(38%)
Thrombocytosis	14 patients (47%)	50 patients (42%)
Elevated ESR	15 patients (50%)	55 patients (46%)
Hyperfibrinogenemia	16 patients (53%)	53 patients (44%)
C-reactive protein	17 patients (57%)	48 patients (40%)
Hyperglycemia	4 patients (14%)	14 patients (12%)
Hyperuricemia	7 patients (24%)	19 patients(16%)
Dyslipidemia	17 patients (57%)	62 patients (52%)
Dyselectrolyteemia	4 patients (13%)	10 patients (8%)
Hepatic cytolysis syndrome	8 patients (27%)	17 patients (14%)
Nitrogen retention syndrome	2 patients (8%)	7 patients (6%)

The laboratory profile also supports a systemic component to COPD-associated PH. C-reactive protein was reported in 57% of patients with PH versus 40% without PH, while hyperfibrinogenemia, leukocytosis, thrombocytosis and elevated ESR were also numerically more frequent in the PH group. These observations are compatible with the proposed contribution of systemic inflammation and cardiovascular biomarkers to COPD-related vascular dysfunction [1, 3]. They should, however, be interpreted as associations because the retrospective design does not establish a causal pathway.

Exercise capacity showed a clearer between-group difference: mean 6MWD was 417.8 ± 98.5 m in the PH group compared with 489.2 ± 94.3 m in the non-PH group, and three tests were interrupted in patients with PH. This is clinically relevant because field walking tests integrate respiratory and cardiovascular limitations and are established measures of functional capacity and prognosis in chronic respiratory disease [7, 8]. The spirometric findings require a nuanced interpretation. In the overall sample, FEV1 < 60% was reported in 58.3% of patients with PH and 78.0% of patients without PH. However, among patients with FEV1 < 60%, GOLD stage IV represented 22.85% of the PH group versus 5.12% of the non-PH group. Thus, the presence of PH was not simply explained by a lower FEV1 threshold; rather, the distribution within the most severe categories suggests that advanced respiratory impairment may coexist with PH. These findings support interpreting lung function together with cardiovascular and functional measures rather than using spirometry alone.

Limitations

This study has several limitations. First, its retrospective, single-center design and selection of patients with sufficiently complete records may introduce selection bias and limit generalizability. Second, the analysis is observational and therefore cannot establish causal relationships between PH, COPD severity, inflammation and cardiovascular comorbidity. Third, PH was assessed by TTE in the reported clinical protocol; invasive hemodynamic confirmation was not described. Fourth, the literature component was not a structured systematic search: only the Web of Science core collection was used, no screening flow was retained, and the exact number of records screened cannot be reconstructed. The publications cited in the comparative component should therefore not be interpreted as a formally screened systematic-review sample. Finally, the manuscript reports limited details of the statistical testing strategy, which restricts the strength of conclusions regarding statistical significance.

CONCLUSIONS

In this retrospective cohort of 170 patients with COPD, PH was associated with greater functional impairment, lower 6MWD, substantial cardiovascular comorbidity and a more pronounced inflammatory profile. The findings support multidimensional assessment combining respiratory, functional, cardiovascular and laboratory parameters.

The results should be interpreted in the context of the study limitations, particularly its retrospective single-center design and the non-systematic literature comparison. Further prospective studies with standardized PH confirmation and structured literature synthesis are warranted

Author contributions: SST: conceptualization, data curation, formal analysis, investigation, project administration, resources, software, validation, writing – original draft, writing – review & editing; **SCS:** conceptualization, data curation, visualization, writing – review & editing; **CND:** conceptualization, formal analysis, funding acquisition, methodology, project administration, software, supervision, writing – original draft; **AI:** formal analysis, funding acquisition, methodology, project administration, software, supervision, writing – original draft; **IDF:** conceptualization, data curation, formal analysis, investigation, project administration, resources, software, validation, writing – original draft, writing – review & editing. All authors have agreed with the results and conclusions.

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AI statement: The authors stated that they did not use generative AI or AI-based tools during the preparation of this manuscript.

Declaration of interest: No conflict of interest is declared by the authors.

Data sharing statement: Data supporting the findings and conclusions are available upon request from the corresponding author.

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