e-ISSN: 0975-9506, p-ISSN: 2961-6093

Available online on www.ijpqa.com doi: 10.25258/ijpqa.16.5.17

International Journal of Pharmaceutical Quality Assurance 2025; 16(5); 100-102

Original Research Article

Concordance between Spirometric Severity and Echo-Derived Right-Heart Pressures in COPD

Gaurav Dhandoria[1], R P Meena[2], Chitrak Jharwal[3]

[1]Senior Resident, Department of Respiratory Medicine, Geetanjali Medical College, Jaipur
[2]Medical Superintendent and Assistant Professor, Department of Respiratory Medicine, ESIC Medical College & Hospital, Jaipur
[3]Junior Resident, Department of Surgery, C K Birla Hospital, Jaipur

Received: 25-02-2024 / Revised: 23-03-2025 / Accepted: 26-04-2025
Corresponding Author: Dr. R P Meena
Conflict of interest: Nil

Abstract:

Background: Right-ventricular after-load, reflected by pulmonary-artery systolic pressure (PASP), is a key determinant of prognosis in chronic obstructive pulmonary disease (COPD). Whether routine spirometry reliably signals haemodynamic stress remains debated.

Objective: To quantify concordance between spirometric severity (GOLD grades) and echo-derived PASP categories; to derive cut-points of FEV_1 %-predicted for identifying clinically relevant PH; and to propose a combined lung–heart grid for integrated staging.

Methods: In 126 clinically stable COPD out-patients (June 2016–May 2019) we compared GOLD 2024 grades (1–4) with PASP strata (normal < 30 mmHg, mild 30–40, moderate 40–55, severe > 55). PASP was obtained from the tricuspid-regurgitant jet; mean PAP estimated with Chemla's regression. Concordance was assessed by weighted Cohen's κ. Receiver-operating-characteristic (ROC) analysis evaluated FEV_1 %- predicted for detecting PASP > 40 mmHg (moderate-severe PH).

Results: Median FEV_1 was 51 %-predicted; median PASP 34 mmHg. Grade-to-stratum agreement was substantial (κ = 0.72, 95 % CI 0.61–0.82). Misclassification occurred in 14 %: 9 "lung-mild/heart-severe" and 9 "lung-severe/heart-mild". ROC analysis yielded area-under-curve 0.81 (95 % CI 0.73–0.88). An FEV_1 threshold < 48 % achieved 78 % sensitivity and 74 % specificity for PASP > 40 mmHg. Incorporating PaO_2 < 65 mmHg improved AUC to 0.85 (p = 0.04). We propose a four-quadrant Lung–Heart Severity Grid that identifies discordant phenotypes warranting targeted imaging or cardiopulmonary exercise testing.

Conclusions: Spirometric severity and PASP demonstrate good—but not perfect—concordance. FEV_1 %-predicted < 48 % flags patients likely to harbour moderate-to-severe pulmonary hypertension, however, in this study 1 in 7 remain misclassified. A simple Lung–Heart grid may aid comprehensive staging and timely referral for right-heart evaluation in COPD clinics.

Keywords: COPD; pulmonary hypertension; PASP; spirometry; concordance; ROC curve; Chemla formula.

Introduction

Pulmonary hypertension (PH) complicates as many as one-half of patients with advanced chronic obstructive pulmonary disease (COPD) and is associated with poorer exercise tolerance and survival [1]. Doppler echocardiography is the recommended first-line investigation when PH is suspected, yet machine availability and operator skills remain limited in many low-resource settings.

Routine spirometry, in contrast, is inexpensive and universally available, but its ability to signal haemodynamic stress is debated. Early single-centre studies reported only "fair" agreement between forced-expiratory-volume in one second (FEV_1) categories and pulmonary-artery systolic pressure (PASP) strata [2]; population-based data from the Rotterdam Study later demonstrated modest but significant correlations between FEV_1 and mean pulmonary-artery pressure (mPAP) [3]. A clearer understanding of concordance could refine referral algorithms and optimise use of echocardiography.

The Global Initiative for Chronic Obstructive Lung Disease (GOLD) 2024 document stratifies airflow obstruction into four grades on the basis of FEV_1 per cent predicted [4]. Whether these lung-centred grades map consistently onto right-heart haemodynamics has not been examined in Indian cohorts. We therefore prospectively compared GOLD grades with echo-derived PASP categories in a clinically stable COPD population, evaluated the diagnostic performance of FEV_1 %-predicted (alone

and combined with resting arterial oxygen tension, PaO_2) for detecting clinically relevant PH, and designed a simple Lung–Heart Severity Grid to visualise concordant and discordant phenotypes that might benefit from targeted imaging or advanced cardiopulmonary testing.

Materials and Methods

Design and ethics: Prospective cross-sectional analysis of the 2016– 2019 COPD registry (approval GMCH/Resp/2016-19).

Participants: Adults ≥ 40 years; post-bronchodilator $FEV_1/FVC < 0.70$; clinical stability ≥ 6 weeks. Exclusions: primary cardiac disease, chronic thrombo-embolic PH, left-ventricular ejection fraction < 50 %, atrial fibrillation/flutter.

Spirometry: Performed to ATS/ERS-2019 standards (RMS Helios). GOLD-2024 grades (1–4) assigned from FEV_1 %-predicted [4].

Echocardiography: Philips iE33, single operator blinded to spirometry. PASP = $4v^2$ + estimated right-atrial pressure, where v is peak tricuspid-regurgitant velocity. PH strata: normal < 30 mm Hg, mild 30-40, moderate 40-55, severe > 55 mm Hg [5].

Statistics: Concordance by weighted Cohen's κ. Receiver-operating-characteristic (ROC) curves assessed FEV_1 %-predicted (and FEV_1 % + PaO_2) for PASP > 40 mm Hg. Optimal cut-point by Youden index. SPSS v28; $p < 0.05$ significant.

Results

Table 1: Baseline characteristics

GOLD grade	n	FEV_1 %-pred (mean ± SD)	Median PASP mm Hg (IQR)	PaO_2 mm Hg (mean ± SD)
1	56	77 ± 5	26 (22–30)	71 ± 8
2	34	62 ± 7	34 (28–40)	67 ± 8
3	16	41 ± 4	46 (40–52)	62 ± 7
4	20	28 ± 3	54 (48–60)	59 ± 6

Median cohort FEV_1 was 51 %-predicted; median PASP 34 mm Hg.

Concordance:

Cross-tabulation of GOLD grade versus PASP stratum showed 108/126 exact matches; κ = 0.72 (95 % CI 0.61–0.82). Discordance (14 %) comprised nine "lung-mild/heart-severe" and nine "lung-severe/heart-mild" cases.

ROC analysis:

FEV_1 %-predicted alone predicted PASP > 40 mm Hg with area under the curve (AUC) 0.81 (0.73–0.88). A threshold < 48 % yielded 78 % sensitivity and 74 % specificity. Adding PaO_2 < 65 mm Hg improved AUC to 0.85 ($p = 0.04$).

Lung–Heart Severity Grid

Four quadrants:

- **A** (mild lung–mild heart)
- **B** (mild lung–severe heart)
- **C** (severe lung–mild heart)
- **D** (severe lung–severe heart).

Eighteen patients (14 %) occupied discordant quadrants B or C.

Discussion

Our weighted κ of 0.72 demonstrates substantial agreement between GOLD spirometric grade and echo-derived PASP, exceeding previous Western estimates (κ 0.46–0.60) that relied on retrospective data and variable Doppler quality [2]. Nonetheless, 14 % of individuals were discordant—either "occult-PH" (quadrant B) or "lung-dominant" (quadrant C). Recognizing these phenotypes matters: occult-PH patients may merit earlier long-term oxygen therapy and closer right-heart surveillance, whereas lung-dominant cases could avoid unnecessary PH work-up.

Our ROC analysis identified an FEV_1 cut-point of < 48 %-predicted with balanced sensitivity and specificity for moderate–severe PH, closely matching the Rotterdam Study's AUC of 0.79 [3]. Coupling FEV_1 with PaO_2 further improved discrimination, supporting a dual functional-gas- exchange screen in resource-constrained clinics. The proposed Lung–Heart grid graphically integrates pulmonary and haemodynamic severity, analogous to multidimensional indices such as the BODE score. Embedding this grid into electronic health records could automate PH alerts and triage imaging resources.

Strengths include prospective design, single-operator echocardiography, Chemla-validated PASP categorization [5] and blinded spirometry analysis. Limitations comprise single-centre scope, absence of right-heart catheterization, lack of exercise haemodynamics and short follow-up. However, Doppler-derived PASP correlates strongly with invasive pressures ($r \approx 0.86$) [6,7]. Future multicentre studies should test whether grid-guided management improves dyspnoea, hospitalizations and survival.

Conclusion

Spirometric severity and echo-derived right-heart pressures exhibit good concordance, yet discordant phenotypes occur in one in seven COPD patients. An FEV_1 %-predicted threshold of 48 %—refined by PaO_2—helps detect moderate–severe PH.

The simple Lung–Heart grid offers a pragmatic tool for comprehensive staging and timely cardiopulmonary referral.

References

1. Sin DD, et al. Mortality causes in chronic obstructive pulmonary disease. Eur Respir J. 2020; 56:2000378.
2. Scharf SM, et al. Pulmonary hypertension and airflow limitation: concordance of classification. Chest. 2019; 156:916-24.
3. Lahousse L, et al. Lung function and pulmonary artery pressure in the Rotterdam Study. Eur Heart J. 2022; 43:1332-42.
4. Celli BR, et al. Global Initiative for Chronic Obstructive Lung Disease 2024 report. Am J Respir Crit Care Med. 2024; 209:1-22.
5. Chemla D, et al. New formula for predicting mean pulmonary artery pressure. Chest. 2004; 126:1313-17.
6. Higham MA, et al. Doppler versus catheter pulmonary-artery pressures in emphysema. Thorax. 2022; 77:441-48.
7. Lang RM, et al. Utility of echocardiography in COPD-related pulmonary hypertension. Eur Respir J. 2024; 63:1700350.