CT Deep learning AI quantified fibrosis predicts prognosis in Pulmonary Hypertension associated with Chronic Obstructive Pulmonary Disease (PH-COPD)

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Background:

- Pulmonary Hypertension (PH) associated with Chronic Obstructive Pulmonary Disease (PH-COPD) is a heterogenous condition, with a spectrum of predominantly emphysema and some overlapping fibrosis.
- All patients undergo CT imaging, but it is not currently used for prognostication.
- There is conflicting evidence on the benefit of PH therapies in these patients.
- One contribution factor is the lack of precision and variability in radiological assessment for disease severity quantification.

Aim: To investigate the prognostic value of an automated deep-learning model that quantifies the percentage of fibrosis on baseline CT in PH-COPD, compared to radiological assessment.

Methods:

- Patients with PH-COPD were identified from ASPIRE registry.
- Validated PH specific deep-learning model was run and provided the percentage of fibrosis by quantifying ground glass change (GG), ground glass with reticulation (GGR) and honeycombing.
- Scans were scored as none/mild/moderate/severe fibrosis by sub-specialist radiologists.
- Cases with mean pulmonary arterial pressure ≥ 35 mmHg were classified as severe PH-COPD, and fibrosis was grouped with a threshold of 3%.
- Scaled cox regression & Kaplan Meier survival analysis was performed.

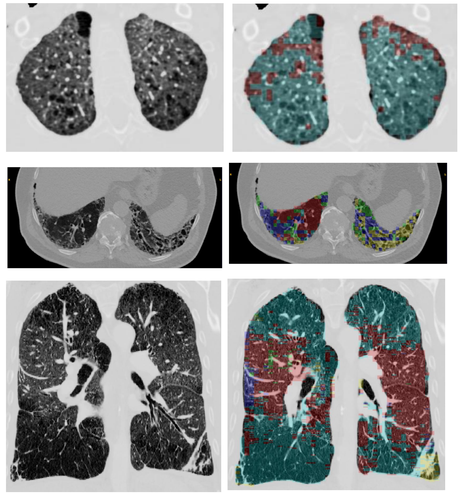


Fig 1: Example AI quantification of emphysema and fibrosis

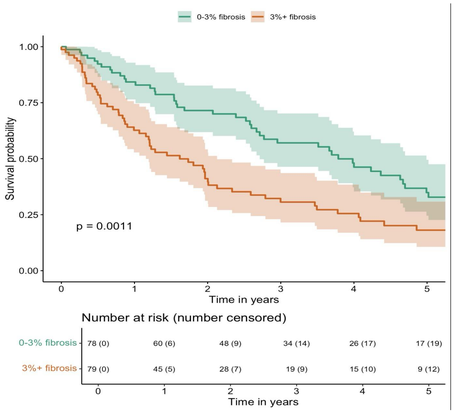


Fig 2: Survival in PH-COPD divided by fibrosis threshold of 3%

Results:

- 157 PH-CLD patients (113 severe PH-COPD) were included.
- AI quantified fibrosis % was a significant predictor of mortality (HR 1.46, p<0.001) .
- There was a significant difference (p=0.001) in survival between patients with more and less than 3% fibrosis.
- 1,3- and 5-year survival was 84%, 57% and 35% respectively in those with <3% fibrosis and 63%, 31% and 18% respectively in those with ≥3% fibrosis.
- Radiologist scored mild (HR 2.05, p=0.36) and moderate (HR 2.82, p=0.045) fibrosis was a significant predictor, but not severe fibrosis.
- In severe PH-COPD, radiological scoring was not a significant predictor at any level, but AI fibrosis% was a significant predictor (HR 1.37, p<0.001).

Conclusions:

1. CT Deep learning AI model quantified fibrosis is prognostic in predicting survival in PH-COPD and provides additional value over radiological assessment in severe PH-COPD.
2. Quantitative CT AI models used in adjunct with radiological reporting can provide repeatable objective metrics of disease severity.
3. In the future, this quantitative data can be combined with genomic data to identify distinct clusters and potentially therapy responsive patient sub-phenotypes

Characteristic	PH-COPD N = 157[1]	Severe PH-COPD N = 113[1]
Age at diagnosis, years	68 (62, 74)	70 (64, 75)
Sex, female	71 (45%)	50 (44%)
Body Mass Index	25.8 (22.9, 30.4)	25.9 (23.0, 30.5)
WHO Function class		
2	19 (12%)	4 (3.5%)
3	97 (62%)	72 (64%)
4	41 (26%)	37 (33%)
FVC, percent predicted	87 (68, 104)	88 (73, 109)
FEV1, percent predicted	55 (38, 79)	62 (43, 85)
FEV1 / FVC ratio	50 (41, 64)	52 (43, 65)
DLCO, percent predicted	27 (19, 37)	22 (18, 30)
mPAP, mm Hg	41 (33, 47)	45 (40, 50)
PVR, wood units	6.0 (3.8, 9.7)	7.5 (5.1, 10.3)
AI quantified % of Fibrosis	3 (1, 9)	4 (1, 10)
Radiologist reported fibrosis	28 (20%)	27 (28%)
Radiologist reported fibrosis severity		
None	112 (84%)	70 (78%)
Mild	12 (9.0%)	12 (13%)
Moderate	4 (3.0%)	4 (4.4%)
Severe	5 (3.8%)	4 (4.4%)

[1] Median (Q1, Q3); n (%)

Table 1: Patient characteristics in both cohorts