Diagnostic Accuracy of Chest Radiography for Detecting Fibrotic Interstitial Lung Disease

To the Editor:

Interstitial lung disease (ILD) comprises diffuse pulmonary parenchymal disorders, with fibrotic ILD leading to poor outcomes when progressive (1). Though reliably detected by high-resolution computed tomography (HRCT), diagnostic delays remain common in patients with ILD and are associated with disease progression (2–4). Immunosuppressive and antifibrotic therapies have been shown to slow lung function decline in patients with fibrotic ILD (5, 6), underscoring the importance of early detection.

While delays in ILD diagnosis are multifactorial (3), diagnostic testing decisions may contribute. The chest radiograph is commonly used to evaluate dyspnea and cough in the primary care setting. While this may sufficiently evaluate some conditions (7–9), HRCT provides a higher degree of confidence when diagnosing diffuse parenchymal lung disease, including fibrotic ILD (10). Despite this observation, the diagnostic utility of chest radiography remains unclear. In this investigation, we conducted a retrospective analysis to determine test performance characteristics of chest radiography for detecting ILD, confirmed by contemporaneous HRCT.

Methods

This study was approved by the University of California at Davis (UC-Davis) Institutional Review Board (#875917). Adult patients receiving primary care at UC-Davis from 2014 to 2021 with a multidisciplinary diagnosis of fibrotic ILD, including idiopathic pulmonary fibrosis, connective tissue disease-associated ILD, chronic hypersensitivity pneumonitis, and unclassifiable ILD were identified using the UC-Davis ILD registry. Those with incident ILD who underwent chest radiography up to 12 months before the first HRCT confirming ILD were eligible for inclusion.

The presence of fibrotic ILD on HRCT was confirmed by a chest radiologist (A.G. or M.K.) during multidisciplinary evaluation and was defined as fibrotic changes (reticular opacities, traction bronchiectasis, and/or honeycombing) affecting >10% of the lung parenchyma, consistent with prior therapeutic trials in ILD (11). HRCT pattern was further characterized as usual interstitial pneumonia (UIP), probable UIP, indeterminate, or alternate pattern on the basis of guideline criteria (12). Chest radiograph reports were reviewed to determine whether features of ILD were mentioned and were considered present when any of the following were mentioned: reticulation, reticular, fibrosis, fibrotic, or interstitial.

Consecutive age- and sex-matched control subjects without ILD, ascertained by review of radiology report and secondary visual assessment by an ILD-trained pulmonologist (J.V.P.), were identified over the same timeframe and matched 1:1 with ILD cases to determine test performance characteristics.

Statistical Analysis

Continuous variables are reported as means ± standard deviation and compared using a student's *t* test. Categorical variables are reported as counts and percentages and compared using a chi-square test. Time to pulmonologist evaluation was compared between ILD cases according to whether ILD features were mentioned on chest radiograph using Cox proportional hazards regression and plotted using the Kaplan-Meier estimator. Statistical analysis was performed using Stata, Release 16.1 (StataCorp).

Results

Of 264 eligible patients, 76 (29%) were excluded because of lack of prior chest radiography and 8 (3%) because of prevalent ILD, leaving 180 ILD cases (Figure 1A). Case characteristics are shown in Table 1. Idiopathic pulmonary fibrosis was the most common diagnosis (36%), followed by connective tissue disease associated-ILD (26%). A chest radiologist interpreted roughly half of the chest radiographs. When comparing patients with and without mention of ILD features on chest radiography (Table 1), few differences were observed, suggesting ILD severity did not influence the mention of ILD features.

Compared with the HRCT gold standard, the chest radiograph demonstrated a sensitivity of 63% and specificity of 93%, with a positive predictive value of 90% and a negative predictive value of 72% (Table 2). After stratification by HRCT pattern, the chest radiograph detected a higher percentage of cases with definite or probable UIP compared with other patterns (Figure 1B). Those for whom ILD was mentioned had a significantly shorter time to pulmonologist evaluation (Figure 1C), with a 40% higher likelihood of pulmonologist evaluation (hazard ratio, 1.40; 95% confidence interval, 1.03–1.91; $P = 0.013$).

Discussion

In this study, we found that the chest radiograph had good specificity but modest sensitivity for detecting ILD. These data suggest that using chest radiography to screen for fibrotic ILD will miss nearly 30% of cases. Furthermore, baseline lung function was similar between those with and without ILD mentioned, suggesting that chest radiography does not simply select for more advanced ILD. Our findings also suggest that failure to mention ILD features on chest radiography is associated with a delay in pulmonology evaluation, underscoring the importance of reporting ILD features. Together, these findings highlight the limited utility of the chest radiograph for diagnosing ILD.

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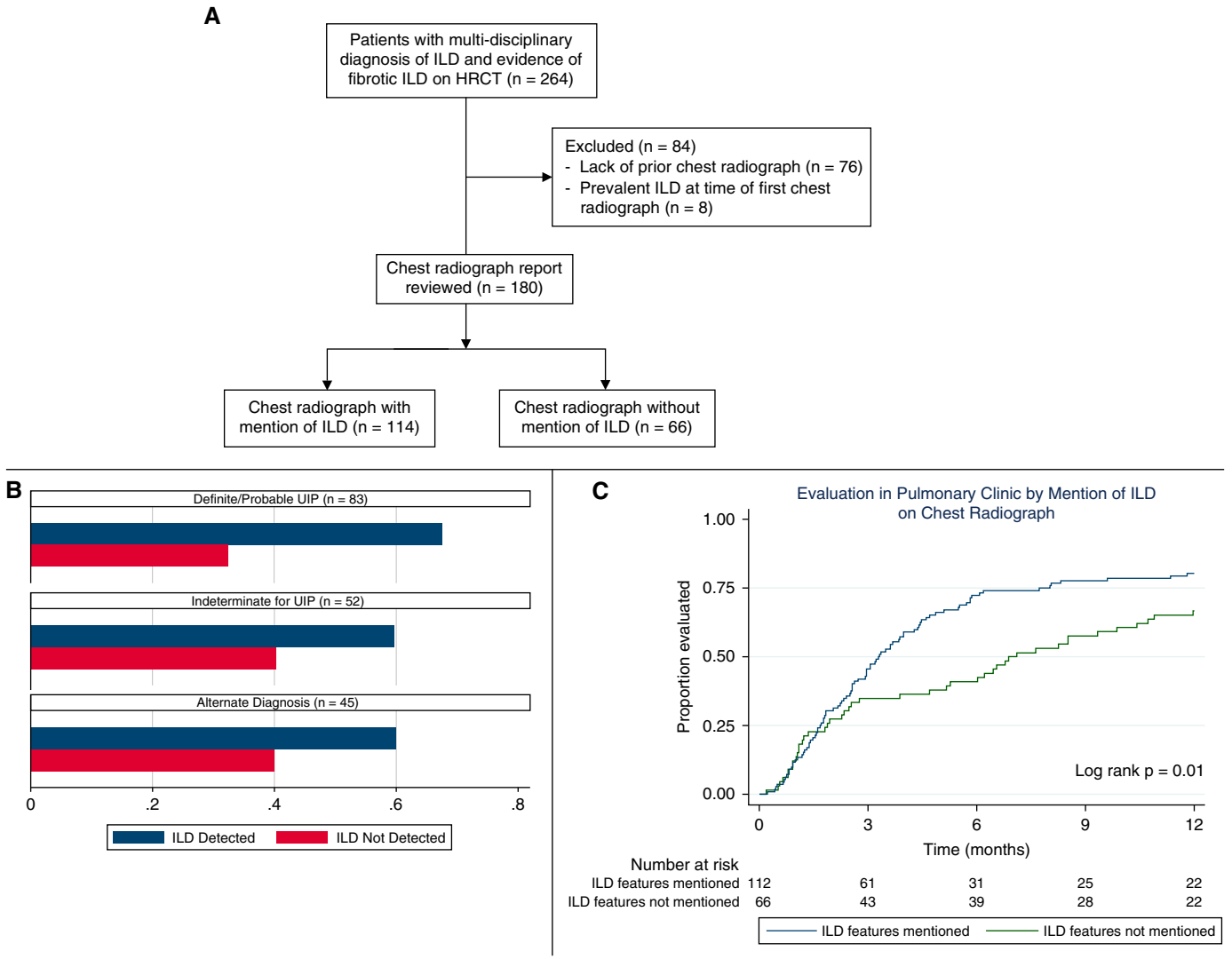

Figure 1. (*A*) Flow diagram of eligible and included interstitial lung disease (ILD) cases. (*B*) Percentage of cases with ILD mentioned on chest radiography, stratified by high-resolution computed tomography pattern. (*C*) Time to pulmonary evaluation stratified by the mention of ILD on chest radiography. HRCT = high-resolution computed tomography; UIP = usual interstitial pneumonia.

To our knowledge, our study is among the first to assess the test performance of chest radiography for detecting common fibrotic ILDs. This work corroborates two previous investigations showing HRCT to be superior to chest radiography in reaching a confident diagnosis among patients with diffuse parenchymal lung disease, including fibrotic ILD, nonfibrotic ILD, and other non-ILD processes (10, 13). However, these studies predated our current radiologic schema of understanding and classifying ILD and included large numbers of rare lung diseases, limiting the interpretation of results in the context of fibrotic ILD. Our data build on these findings and suggest that the chest radiograph will miss a large proportion of a potentially deadly disease. A study by Afzal and colleagues suggested that chest radiography had 80% sensitivity for diagnosing ILD (14). However, patients were aged 20–50, and ILD diagnoses were not specified, suggesting that this study population was systematically different from ours, as many common fibrotic ILDs are associated with older age (15).

Limitations

Our study has several limitations. First, this is a single-center, retrospective study of patients with both chest radiography and computed tomography, which may have introduced selection bias and limited generalizability. Furthermore, reliance on existing radiology interpretations may not accurately capture the true performance of the chest radiograph, though this approach is more likely to reflect real-life primary care settings.

Conclusions

Chest radiography is likely to miss a large proportion of patients with fibrotic ILD, but ILD is likely when features are detected. A chest

Table 1. Baseline characteristics for interstitial lung disease cases with and without mention of interstitial lung disease features on chest radiography

Characteristic	Patients with ILD (*n* = *180*)	ILD Features Mentioned (*n* = *114*)	ILD Features not Mentioned (*n* = *66*)	*P* Value
Age (yr), mean (±SD)	69.7 (11.4)	70.9 (10.2)	67.7 (13.1)	0.073
Male sex, *n* (%)	108 (60.0)	70 (61.4)	38 (57.6)	0.61
Race/ethnicity, *n* (%)	—	—	—	0.65
White	130 (72.2)	81 (71.1)	49 (74.2)	—
Black	10 (5.6)	5 (4.4)	5 (7.6)	—
Asian	19 (10.6)	14 (12.3)	5 (7.6)	—
Hispanic	19 (10.6)	12 (10.5)	7 (10.6)	—
Other/unknown	2 (1.1)	2 (1.8)	0 (0)	—
Ever-smoker, *n* (%)	108 (60.0)	70 (61.4)	38 (57.6)	0.64
Radiograph interpreted by chest radiologist, *n* (%)	88 (48.9)	56 (49.1)	32 (48.5)	0.93
ILD classification, *n* (%)	—	—	—	0.76
IPF	64 (35.6)	43 (37.7)	21 (31.8)	—
CTD-ILD	46 (25.6)	28 (24.6)	18 (27.3)	—
uILD	40 (22.2)	25 (21.9)	15 (22.7)	—
CHP	23 (12.8)	15 (13.2)	8 (12.1)	—
Other non-IPF IIP	7 (3.9)	3 (2.6)	4 (6.1)	—
Pulmonary function, mean (±SD)	—	—	—	—
FVC% predicted	80.5 (18.5)	79.9 (17.2)	81.4 (20.6)	0.61
D_{LCO}% predicted	54.9 (16.6)	53.2 (15.1)	57.7 (18.5)	0.085

Definition of abbreviations: CHP = chronic hypersensitivity pneumonitis; CTD-ILD = connective tissue disease-associated interstitial lung disease; D_{LCO} = diffusion capacity of the lung for carbon monoxide; FVC = forced vital capacity; ILD = interstitial lung disease; IIP = idiopathic interstitial pneumonia; IPF = idiopathic pulmonary fibrosis; SD = standard deviation; uILD = unclassifiable interstitial lung disease.

Table 2. Chest radiograph test performance characteristics

Mention of ILD on chest radiograph	ILD by HRCT (+)	ILD by HRCT (−)
(+)	114	13
(−)	66	167

	Test characteristic (95% CI)
Sensitivity	0.63 (0.56–0.70)
Specificity	0.93 (0.88–0.96)
Receiver–operator curve area	0.78 (0.74–0.82)
Positive predictive value	0.90 (0.83–0.94)
Negative predictive value	0.72 (0.65–0.77)
Positive likelihood ratio	8.77 (5.13–14.98)
Negative likelihood ratio	0.40 (0.32–0.48)

Definition of abbreviations: CI = confidence interval; HRCT = high-resolution computed tomography; ILD = interstitial lung disease.

radiograph showing features of ILD should be followed up with HRCT, while ILD should remain among the differential diagnoses in those without ILD mentioned. Further research is needed to validate these findings and further elucidate factors underpinni ng diagnostic delays in patients with fibrotic ILD. ■

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Interpersonal Perception: Family- and Physician-reported Conflict in the Intensive Care Unit

To the Editor:

Conflict about treatment decisions is common between families and clinicians in the intensive care unit (ICU) (1) and leads to negative outcomes for patients, families, and clinicians. Interpersonal conflict delays medical decision-making and results in longer ICU stays for patients, causes lasting psychological distress for families, and contributes to moral distress and burnout among clinicians (2–5). Despite the prevalence of interpersonal conflict and its myriad negative effects, little is known about the factors that influence clinician and family perceptions of conflict (1, 5). Therefore, our objective was to describe patient, family, and physician characteristics associated with both physician- and family-reported conflict.

Methods

We conducted a secondary analysis of data from a randomized clinical trial of a decision aid about prolonged (≥10 d) mechanical ventilation (6). One family member who self-identified as the person most involved in medical decision-making was enrolled per patient. Families randomized to the intervention viewed a decision aid about expected outcomes of prolonged mechanical ventilation, then ICU physicians held unscripted meetings with all families. Families and physicians completed surveys after the meeting, including sociodemographic characteristics and one question about perceived conflict, "I think that there is conflict between the family and the ICU team", with four possible responses: strongly disagree, disagree, agree, and strongly agree. Trained research coordinators abstracted patient outcomes from the electronic health record after their ICU stay. Family–physician dyads that were missing both responses to the conflict item were excluded from the analysis. To test agreement between families and physicians, responses to the conflict item were regrouped into three categories (strongly disagree, disagree, and any agreement), and an unweighted exact κ statistic was used (7).

Results

Among 275 family participants, the analytic sample comprised 257 (93.5%) family members and 155 physicians. Most family members were White (78.9%) and female (75.1%), and their median age was 52.0 years (interquartile range [IQR], 42.0–61.0) (Table 1). Physicians were predominantly White (76.8%) and male (63.2%), and their median age was 35.0 years (IQR, 31.0–43.0). Many physicians (64.9%) reported equally prioritizing the social–emotional and technological–scientific aspects of patient care, and 76.2% reported engaging families as equal partners in medical decision-making (Table 1).

Physicians reported conflict with 13 (5.1%) families, and 20 (7.8%) families reported conflict with physicians. Physicians and families agreed about the presence of conflict in only 1 case ($\kappa = 0.12$, no to very slight agreement; $P = 0.007$).

Compared with family members with whom physicians did not perceive conflict, those with whom physicians perceived conflict were more likely to be Black (46.2% vs. 12.7%), of a different racial identity than the physician (61.5% vs. 35.0%), female (92.3% vs. 74.2%), the child of the critically ill patient (46.2% vs. 21.7%), lacking social support (23.1% vs. 3.7%), perceived by physicians to be mistrustful of the ICU team (53.8% vs. 2.0%), and disproportionately optimistic about their loved one's likelihood of survival (50.0 [IQR, 25.0–76.0] versus 28.5 [10.0–49.0], using a measure of family–physician prognostic discordance). Patients with whose families physicians perceived conflict were older (median age, 67.0 vs. 57.0 yr) and more likely to die in the hospital (61.5% vs. 29.9%) than other patients.

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