Diagnostic performance of lung ultrasound for the detection of interstitial lung disease in patients with rheumatoid arthritis: comparison with risk scoring systems

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Abstract

Introduction: Interstitial lung disease (ILD) is a frequent and severe complication of rheumatoid arthritis (RA), often remaining subclinical and associated with substantial morbidity and mortality. Given the limitations of high-resolution computed tomography (HRCT) for widespread screening, alternative tools for early detection are needed.

Aim: The objective of this study was to assess the diagnostic performance of lung ultrasound (LUS) for the detection of ILD in patients with RA, compared with HRCT and established clinical risk scores, stratified by symptom status.

Methods: A diagnostic test study was conducted in RA patients fulfilling the ACR 2010 criteria who had undergone HRCT within the previous six months. LUS was performed using a 14-point protocol, with abnormal findings defined as >5 B-lines or pleural irregularities in ≥2 windows. Two validated RA-ILD risk scores were applied. LUS findings were compared with HRCT, and logistic regression was used to identify clinical and imaging predictors of ILD.

Results: A total of 147 patients were included (23.8% male; mean age 62.3 years; mean disease duration 12.3 years), of whom 68 had HRCT-confirmed ILD. Abnormal LUS findings were present in 58.5% of patients. Factors associated with RA-ILD included male sex (OR 2.8), dyspnea (OR 2.5), and velcro crackles (OR 47.5). Abnormal LUS (OR 59.8), >5 B-lines (OR 37.6), and pleural irregularities (OR 29.5) were strongly associated with ILD. In asymptomatic patients, LUS showed high sensitivity (95.4%) and specificity (77.7%), with a +LR of 4.3 and a −LR of 0.06. Risk scores showed limited diagnostic value (Spanish consensus ≥5: +LR 0.97; Juge et al. ≥25: +LR 1.45). Combining LUS with risk scores increased sensitivity to 100%.

Conclusion: LUS outperforms clinical risk scores for the detection of RA-associated ILD, including in asymptomatic patients. Its integration with risk scores may optimize screening strategies for the early identification of RA-ILD.

Keywords: Ultrasonography; Rheumatoid arthritis; Interstitial lung diseases; Tomography; Risk score; Screening.

Introduction

Interstitial lung disease (ILD) is a significant complication of connective tissue diseases, with a prevalence of 11% in rheumatoid arthritis (RA), followed by mixed connective tissue disease, idiopathic inflammatory myopathies, systemic sclerosis, and Sjögren's disease[1]. Pulmonary involvement occurs in 10–20% of patients with RA, with subclinical disease present in up to 58%[2]. The most frequent pattern is usual interstitial pneumonia (UIP), which carries higher mortality compared with other forms[3]. Early diagnosis may enable novel management strategies and potentially improve prognosis[4].

Mortality in RA-ILD reaches 9% annually and up to 56.9% at five years[5], highlighting the importance of early detection. HRCT remains the recommended standard for symptomatic patients or those with functional decline. In asymptomatic individuals, screening is mainly advised for those with a significant smoking history, while the role of age and disease duration remains less clearly defined[6]. Reported risk factors include late-onset RA, higher disease activity, MUC5B mutations, and seropositivity for RF and ACPA, which are strongly associated with ILD and extra-articular disease[7-18].

Risk scores have been developed to guide HRCT use. The Spanish consensus stratifies patients as low (≤4), moderate (5–6), or high risk (≥7), recommending clinical follow-up, functional testing, or HRCT accordingly[19]. Additional predictors include male sex, smoking, high disease activity, and telomere shortening. Juge et al.[20] proposed a weighted score incorporating sex, age at onset, DAS28, and MUC5B variants, with a threshold of 25 points (excluding genetic data), yielding moderate sensitivity (69–75%) and specificity (47–86%).

In systemic sclerosis, LUS has proven effective for ILD screening through the detection of pleural irregularities and B-lines[21]. In RA, simplified protocols using as few as eight intercostal spaces and a cutoff of 5.5 B-lines have shown diagnostic accuracy comparable to that of extended protocols[22].

Given the limitations in access to HRCT and functional testing, particularly in low-resource settings, LUS emerges as a cost-effective, non-invasive, and feasible tool. This study aimed to assess the diagnostic performance of LUS for detecting ILD in patients with RA, compared with HRCT and established clinical risk scores, in both symptomatic and asymptomatic individuals. Specifically, we evaluated the ability of LUS to identify ILD across clinical presentations, analyzed whether its integration with risk scores improves diagnostic performance, and explored the

relationship between ultrasound findings and respiratory symptoms. Based on these results, we propose a potential screening algorithm for RA-ILD incorporating lung ultrasound.

Patients and Methods

Study design, patients and clinical data

This was a diagnostic test study. The study was approved by the local Bioethics and Research Committee (act CEI-HUN-ACTA-2023-11). A convenience sampling strategy was employed. Adult patients (≥18 years) who met the 2010 ACR classification criteria for RA[23] and were attending the rheumatology outpatient clinic were invited to participate if they had undergone HRCT within the previous six months. Exclusion criteria included inadequate acoustic windows, prior thoracic trauma or surgery, pre-existing pulmonary disease, known heart failure or clinical evidence of volume overload at the time of evaluation, or incomplete data on interstitial lung disease risk factors. Patients who agreed to participate provided written informed consent after receiving a detailed explanation of the study and having their questions addressed.

The sample size calculation was based on previously reported sensitivity and specificity values using a 5 B-line cutoff, selected in accordance with prior evidence, particularly the findings reported by Yan et al[24,25] and an estimated prevalence of 40% for ILD in asymptomatic patients. With an alpha error of 0.05 and a two-tailed power of 80%, 53 patients with ILD and 77 without ILD were required, for a total sample of 130 patients.

Patients were classified as symptomatic if they presented with any of the following: cough, dyspnea, digital clubbing, or Velcro crackles on auscultation. In asymptomatic patients, the risk of developing ILD was assessed using the Spanish risk score[19], with cutoffs of >5 and >7 points indicating moderate and high risk, respectively, and the Juge et al. score, with a cutoff of 25 points, excluding MUC5B genotyping[20]. The variables included in these scores comprise male sex, older age at RA onset, and higher DAS28 scores[20].

Clinical, sociodemographic, laboratory, and disease-related data—including age, sex (recorded as the binary sex assigned at birth), disease activity, serological status, smoking history, and extra-articular manifestations were extracted from the referral hospital's electronic medical records.

Lung Ultrasound

All enrolled patients underwent LUS using a portable linear Philips Lumify probe (8–10 MHz). Examinations were performed by a rheumatologist with formal postgraduate training in musculoskeletal and rheumatologic ultrasound and more than five years of experience in LUS,

who was blinded to clinical and HRCT data. A 14-point protocol based on the method described by Tardella et al.[24] was applied. Dynamic longitudinal clips of 5 seconds were recorded for each scanning window. All images were independently reviewed by a second blinded reader with similar expertise. LUS was considered abnormal if >5 B-lines or pleural abnormalities were detected in at least two scanning windows. In cases of disagreement, a third expert adjudicated the final classification.

Thoracic High Resolution Computed Tomography

HRCT scans were interpreted by a radiologist or pulmonologist with expertise in RA-ILD. Scans were classified as positive or negative for ILD based on RA-associated pulmonary abnormalities. Standard quality criteria for HRCT included supine positioning, sustained full inspiration, volumetric acquisition from the thoracic inlet to the lung bases, thin-section slices, absence of intravenous contrast, and availability of axial, coronal, and multiplanar reconstructions.

Statistical Analysis

Data were entered into a REDCap database and analyzed using Stata 17®. Normality was assessed using the Shapiro–Wilk test. Continuous variables are reported as mean (standard deviation, SD) or median (interquartile range, IQR), as appropriate. Categorical variables are presented as frequencies and percentages.

The diagnostic performance of LUS and clinical risk scores was assessed using 2 × 2 contingency tables to calculate sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), positive likelihood ratio (LR+), and negative likelihood ratio (LR−). Based on these results, a screening algorithm was proposed.

Associations between clinical findings and ultrasound results were explored. Risk factors associated with ILD were identified using multivariate logistic regression models adjusted for conventional risk factors and variables identified in this cohort, including age at disease onset, sex, smoking history, serological status, disease activity, and extra-articular involvement. Odds ratios (ORs) with 95% confidence intervals (CIs) were reported. Due to the conceptual overlap between LUS-derived variables (abnormal LUS, >5 B-lines, and pleural abnormalities), separate multivariable logistic regression models were constructed for each ultrasound parameter to avoid multicollinearity and overfitting.

Variables with more than 30% missing data were excluded from inferential analyses. A p-value <0.05 was considered statistically significant.

Results

Study population

A total of 148 patients were initially included; one patient was excluded due to inadequate HRCT image quality, resulting in a final sample of 147 patients. HRCT-confirmed RA-associated ILD was identified in 68 patients (46.3%). The cohort was predominantly female (76.2%), with a mean age of 62.3±11.6 years and a mean disease duration of 12.3±10 years. At the time of RA diagnosis, 29.2% of patients were older than 58 years. A history of smoking was reported by 36% of patients, and 8.1% were active smokers. Extra-articular manifestations were present in 14.3% of patients. Seropositivity for RF and ACPA was observed in 85.8% and 74% of patients, respectively. Sjögren's disease overlap was present in 19.7% of cases. Methotrexate was the most frequently prescribed drug (70%).

Abnormal LUS findings were observed in 58.5% of patients, with >5 B-lines detected in 53.7% and pleural irregularities in 51.7%.

Baseline characteristics stratified by the presence or absence of RA-ILD are shown in Table I. Compared with patients without ILD, those with ILD were more frequently male (33.8% vs. 15.9%, p = 0.008), older than 58 years at RA diagnosis (38.2% vs. 21.5%, p=0.02), and had a smoking history >20 pack-years (14.7% vs. 5%, p=0.004). No significant differences were observed in RF or ACPA seropositivity.

Prednisolone use was more frequent among patients with RA-ILD (50% vs. 31.6%, p=0.02). Abnormal LUS findings were markedly more common in the ILD group (95.6% vs. 26.6%, p<0.005), as were >5 B-lines (91.1% vs. 21.5%, p<0.005) and pleural abnormalities (88.2% vs. 20.2%, p<0.005).

Clinical manifestations and imaging findings

Among the 147 patients, 80 (54%) were classified as symptomatic and 67 (46%) as asymptomatic (Figure 1a). The most frequent symptoms were dyspnea (42.1%), cough (32.6%), and Velcro crackles (17.9%). Only 2% of patients presented with all four predefined symptoms. Forty-seven percent of symptomatic patients reported more than one symptom.

Figure 1b illustrates the relationship between clinical manifestations and LUS findings. Thirty-six patients (24%) were asymptomatic with normal LUS findings, whereas 31 patients (21%) were asymptomatic but had abnormal LUS findings. Among symptomatic patients with abnormal LUS findings, the most frequent combinations were cough and dyspnea (13%) and the triad of Velcro crackles, cough, and dyspnea (8%). No patients with normal LUS findings had Velcro crackles.

Figure 1c shows the distribution of symptoms according to HRCT findings. Forty-five patients (31%) were asymptomatic with normal HRCT results, while 22 patients (15%) had HRCT-confirmed ILD despite the absence of symptoms. Among patients with both symptoms and abnormal HRCT findings, the most common combinations were cough and dyspnea (10%) and the triad of Velcro crackles, cough, and dyspnea (7%).

Figure 1d summarizes the overlap between symptoms, LUS, and HRCT findings. HRCT identified one asymptomatic patient not detected by LUS. Conversely, LUS identified abnormal findings in 7% of asymptomatic patients with normal HRCT findings.

Multivariate Analysis

The results of the multivariate logistic regression analysis are shown in Table II. Male sex (OR 2.8, 95% CI 1.3–6.3), dyspnea (OR 2.5, 95% CI 1.3–5.0), Velcro crackles (OR 47.5, 95% CI 6.2–363), and a smoking history >20 pack-years (OR 3.23, 95% CI 2.3–4.2) were independently associated with RA-ILD.

Abnormal LUS findings were strongly associated with RA-ILD (OR 59.8, 95% CI 16.9–211). Specific ultrasound features, including >5 B-lines (OR 37.6, 95% CI 13.9–101) and pleural abnormalities (OR 29.5, 95% CI 11.7–74), also showed strong associations.

No significant associations were found between RA-ILD and age >58 years at diagnosis, cough, RF positivity, or ACPA positivity.

Diagnostic performance

The diagnostic performance of clinical variables and LUS compared with HRCT in the total population is shown in Table III. The presence of any respiratory symptom yielded a +LR of 1.57, while isolated dyspnea and cough had +LRs of 1.72 and 1.63, respectively. Velcro crackles showed a markedly higher +LR (29.04), with high specificity (98.7%) but limited sensitivity (36.7%).

LUS demonstrated high sensitivity (95.5%) and specificity (73.4%), with a +LR of 3.6 and a −LR of 0.06. Combining symptoms with LUS increased sensitivity but substantially reduced specificity.

Symptomatic and asymptomatic subgroups

The diagnostic performance of LUS and risk scores stratified by symptom status is summarized in Table IV. In symptomatic patients (n=80), LUS showed a sensitivity of 95.6%, specificity of 67.6%, +LR of 2.96, and −LR of 0.06. In asymptomatic patients (n = 67), LUS maintained high sensitivity (95.5%) and specificity (77.8%), with a +LR of 4.3 and a −LR of 0.06. In contrast, the Spanish consensus score (cutoff ≥5) yielded a +LR of 0.97, and the Pierre et al. score (cutoff ≥25)

yielded a +LR of 1.45. When LUS was combined with the risk scores, sensitivity increased to 100% across all combinations, although specificity remained modest.

Discussion

Rheumatoid arthritis–associated interstitial lung disease (RA-ILD) remains a major determinant of morbidity and mortality in this population[3]. Early identification of pulmonary involvement is crucial, as it may allow timely therapeutic adjustments that could modify disease trajectory[26]. In this diagnostic test study, LUS demonstrated high sensitivity for the detection of RA-ILD, including in asymptomatic patients, and outperformed currently available clinical risk scores. These findings support the potential role of LUS as a first-line screening tool in routine rheumatology practice.

The high sensitivity observed for LUS in both symptomatic and asymptomatic patients is consistent with the predominantly subpleural distribution of RA-ILD, which makes this pathology particularly amenable to ultrasound detection (6). The negative predictive value of LUS was especially high, allowing for the reliable exclusion of ILD in most patients. This feature is particularly relevant in clinical settings where access to HRCT and pulmonary function testing is limited, and where repeated imaging with ionizing radiation is undesirable.

Our findings are aligned with previous studies in other connective tissue diseases, particularly systemic sclerosis, in which LUS has demonstrated strong diagnostic performance for ILD screening through the identification of B-lines and pleural abnormalities[27]. In RA, earlier studies have reported variable sensitivities and specificities, likely influenced by differences in ultrasound protocols and B-line cutoffs. Di Carlo et al.[21] reported lower sensitivity and higher specificity, which may be explained by their higher B-line threshold. In contrast, We selected a >5 B-line threshold to prioritize sensitivity, consistent with the intended screening role of LUS. This approach yielded results comparable to those reported by Yan et al.[25], suggesting that diagnostic performance is largely determined by the chosen cutoff. Although alternative thresholds were considered, formal sensitivity analyses were not performed due to sample size limitations.

Similarly, our results are consistent with those of Otaola et al.[28], who reported a sensitivity of 90.6% and a high negative predictive value, and with those of Cogliati et al.[29], who demonstrated that even portable ultrasound devices can reliably detect RA-ILD in outpatient settings. The use of ultra-portable equipment in our study reinforces the feasibility of LUS as a point-of-care screening modality.

In contrast, clinical symptoms alone showed limited diagnostic value. Dyspnea and cough were weak predictors of RA-ILD, and only the presence of Velcro crackles demonstrated high specificity, albeit with low sensitivity. These findings are consistent with previous reports highlighting the limited utility of physical examination for early ILD detection[30]. While Manfredi et al.[31] reported higher sensitivity using an electronic crackle detection system, their lower specificity and differing inclusion criteria limit direct comparisons. Importantly, Velcro crackles are typically associated with more advanced disease, reducing their value as a screening marker.

One of the most clinically relevant findings of this study is the performance of LUS in asymptomatic patients. A substantial proportion of patients with HRCT-confirmed RA-ILD were asymptomatic, consistent with prior observations[32]. In this subgroup, LUS clearly outperformed the Spanish consensus and Juge et al. risk scores in terms of sensitivity. These results suggest that clinical algorithms based solely on demographic and serological risk factors may be insufficient for early disease detection. However, when LUS was combined with risk scores, sensitivity reached 100%, indicating that a multimodal strategy may optimize screening performance.

Based on these findings, we propose a screening-oriented algorithm (Figure 2) incorporating LUS as a first-line tool for RA-ILD detection. In this approach, a normal LUS would allow for safe clinical follow-up, whereas abnormal findings would prompt HRCT evaluation, regardless of symptom status. This strategy aims to reduce unnecessary HRCT use while maintaining high sensitivity. Importantly, this proposal should be considered hypothesis-generating and requires external validation before being implemented in routine practice.

The specificity of LUS was moderate, particularly in symptomatic patients. Although patients with known heart failure or clinical signs of volume overload were excluded, subclinical cardiac dysfunction or mild extravascular lung water cannot be entirely ruled out and may have contributed to false-positive findings. RA patients have an increased prevalence of cardiovascular disease, and pulmonary congestion can generate B-lines that mimic interstitial involvement[33]. Additionally, smoking-related changes and other comorbidities may produce similar ultrasound artifacts. These limitations are well recognized in the literature[34] and underscore that LUS should not be used as a standalone confirmatory test.

This study has several strengths. It evaluated LUS performance across the full clinical spectrum of RA, including both symptomatic and asymptomatic patients. All ultrasound examinations were performed by experienced operators using a standardized protocol, and image interpretation was blinded, minimizing measurement bias. The use of portable devices further supports real-world applicability.

Nevertheless, important limitations should be acknowledged. This was a single-center study with a relatively limited sample size, which may affect generalizability. Patients with heart failure were not excluded, potentially impacting specificity. Additionally, ultrasound interpretation remains operator-dependent, although the use of blinded readers aimed to mitigate this effect. Finally, the cross-sectional design precludes evaluation of longitudinal changes or prognostic implications.

Conclusion

In conclusion, LUS demonstrated high sensitivity for the detection of RA-ILD, including in asymptomatic patients, and demonstrated superior sensitivity compared with currently available clinical risk scores. Its integration into risk-based strategies may improve early detection while reducing reliance on HRCT. Future multicenter studies are needed to validate these findings, refine screening algorithms, and explore the role of LUS in longitudinal monitoring and treatment decision-making.

Tables and Figures

Table I. Baseline characteristics of the study population according to the presence of RA-associated ILD

Variable	Total (N = 147)	No ILD (N = 79)	ILD (N= 68)	p value
Sociodemographic characteristics				
Male sex, n (%)	35 (23.8)	13 (15.9)	23 (33.8)	0.008
Age, years, mean (SD)	62.3 (11.6)	60.1 (11.0)	64.7 (12.0)	0.053
Age at RA diagnosis 50–58 years, n (%)	33 (22.4)	21 (26.6)	12 (17.6)	0.19
Age at RA diagnosis >58 years, n (%)	43 (29.2)	17 (21.5)	26 (38.2)	0.02
Disease duration, years, mean (SD)	12.3 (10.7)	12.0 (11.1)	12.5 (10.2)	0.79
Clinical characteristics				
Moderate–severe disease activity, n (%)	60 (40.8)	32 (40.5)	28 (41.1)	0.90
Dyspnea, n (%)	62 (42.1)	25 (31.6)	37 (54.4)	0.005
Cough, n (%)	48 (32.6)	20 (25.3)	28 (41.2)	0.04
Digital clubbing, n (%)	5 (3.4)	0 (0.0)	5 (7.3)	0.01
Velcro crackles, n (%)	26 (17.9)	1 (1.2)	25 (37.8)	<0.005
Smoking history				
Ever smoker, n (%)	53 (36.0)	26 (32.9)	27 (39.7)	0.39
Current smoker, n (%)	12 (8.1)	7 (8.8)	5 (7.3)	0.73
Pack-years, mean (SD)	4.15 (10.4)	3.0 (7.6)	5.4 (12.8)	0.17
>20 pack-years, n (%)	14 (9.5)	4 (5.0)	10 (14.7)	0.004
Disease-related features				
Extra-articular manifestations, n (%)	21 (14.3)	12 (15.2)	9 (13.2)	0.73
RF positive, n (%)	126 (85.8)	69 (86.8)	57 (84.6)	0.70
ACPA positive, n (%)	109 (74.0)	61 (76.7)	48 (71.0)	0.44
Erosive disease, n (%)	89 (60.7)	49 (61.5)	40 (59.7)	0.82
Sjögren's disease overlap, n (%)	29 (19.7)	16 (20.2)	13 (19.1)	0.86
Treatment				
Leflunomide, n (%)	61 (41.5)	36 (45.5)	25 (36.7)	0.28
Methotrexate, n (%)	103 (70.0)	56 (70.9)	47 (69.1)	0.81
Sulfasalazine, n (%)	15 (10.2)	7 (8.8)	8 (11.7)	0.56
Prednisolone, n (%)	59 (40.1)	25 (31.6)	34 (50.0)	0.02
Biological therapy, n (%)	34 (23.1)	15 (18.9)	19 (27.9)	0.19
Lung ultrasound findings				
Abnormal LUS, n (%)	86 (58.5)	21 (26.6)	65 (95.6)	<0.005
>5 B-lines, n (%)	79 (53.7)	17 (21.5)	62 (91.1)	<0.005
Pleural abnormalities, n (%)	76 (51.7)	16 (20.2)	60 (88.2)	<0.005

ILD, interstitial lung disease; RA, rheumatoid arthritis; RF, rheumatoid factor; ACPA, anti-citrullinated protein antibodies; LUS, lung ultrasound; SD, standard deviation.

Table II. Multivariate logistic regression analysis of factors associated with RA-associated ILD

Variable	OR (95% CI)
Male sex	2.8 (1.3–6.3)
Age at RA diagnosis >58 years	2.25 (1.0–4.66)
Dyspnea	2.5 (1.3–5.0)
Cough	2.0 (1.0–4.1)
Velcro crackles	47.5 (6.2–363)
>20 pack-years	3.23 (2.3–4.2)
Abnormal LUS	59.8 (16.9–211)
>5 B-lines	37.6 (13.9–101)
Pleural abnormalities	29.5 (11.7–74)
RF positivity	0.8 (0.32–2.14)
ACPA positivity	0.74 (0.34–1.6)

ILD, interstitial lung disease; RA, rheumatoid arthritis; LUS, lung ultrasound; RF, rheumatoid factor; ACPA, anti-citrullinated protein antibodies; OR, odds ratio; CI, confidence interval. Separate multivariable models were constructed for ultrasound parameters.

Table III. Diagnostic performance of clinical and imaging variables compared with HRCT in the total study population

Variable	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	LR+	LR−
LUS	95.5	73.4	30.7	99.2	3.6	0.06
Any respiratory symptom	67.6	56.9	16.2	93.4	1.57	0.57
Dyspnea	54.4	68.3	17.5	92.3	1.72	0.67
Cough	41.1	74.6	16.7	91.1	1.63	0.79
Velcro crackles	36.7	98.7	78.2	92.6	29.04	0.64
Symptoms + LUS	98.5	44.3	17.9	99.5	1.77	0.03
Velcro crackles + LUS	95.5	73.4	30.7	99.2	3.6	0.06

HRCT, high-resolution computed tomography; LUS, lung ultrasound; PPV, positive predictive value; NPV, negative predictive value; LR+, positive likelihood ratio; LR−, negative likelihood ratio.

Table IV. Diagnostic performance of lung ultrasound and clinical risk scores stratified by symptom status

Variable	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	LR+	LR−
Symptomatic patients (N = 80)						
Lung ultrasound	95.6	67.6	80.0	92.0	2.96	0.06
Asymptomatic patients (N = 67)						
Lung ultrasound	95.5	77.8	67.7	97.2	4.30	0.06
Juge et al. score ≥25	77.2	15.1	94.3	65.5	1.45	0.49
Spanish consensus score ≥5	77.2	20.0	10.7	87.7	0.97	1.14
Spanish consensus score ≥7	31.8	60.0	9.0	87.7	0.80	1.14
Juge et al. score ≥25 + LUS	100.0	40.0	44.9	100.0	1.67	0.00
Spanish consensus score ≥5 + LUS	100.0	17.8	37.3	100.0	1.22	0.00
Spanish consensus score ≥7 + LUS	100.0	48.9	48.9	100.0	1.96	0.00

LUS, lung ultrasound; PPV, positive predictive value; NPV, negative predictive value; LR+, positive likelihood ratio; LR−, negative likelihood ratio.

Figure 1. Distribution of clinical findings in the symptomatic patient group and abnormal imaging findings on HRCT and portable LUS

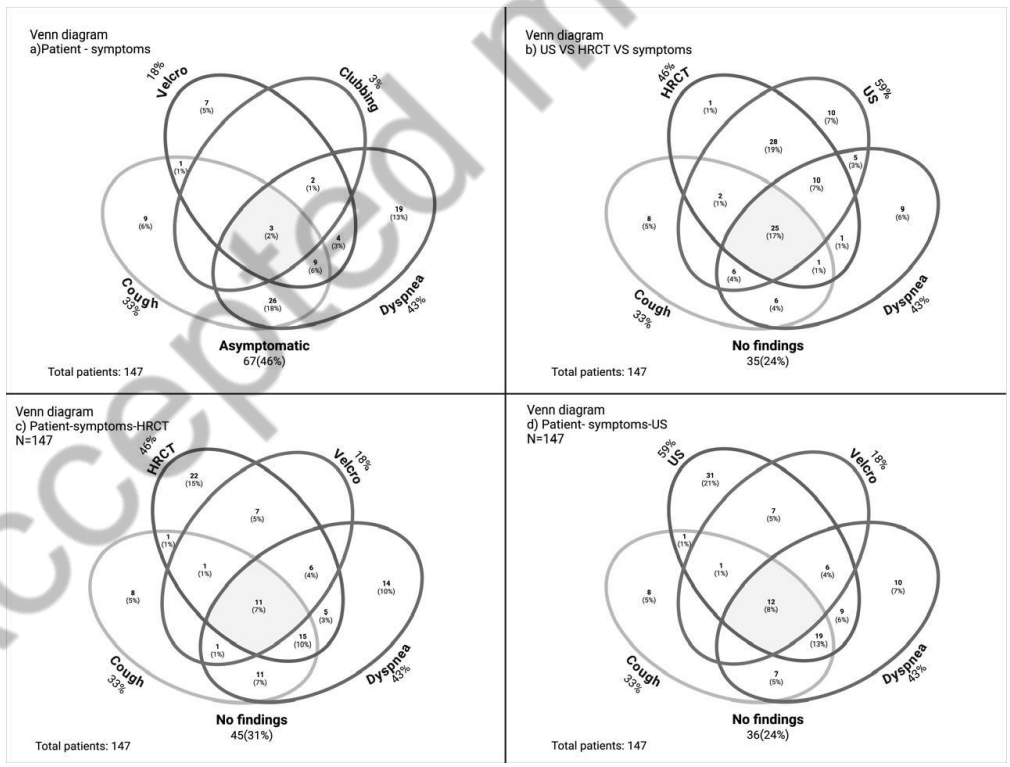
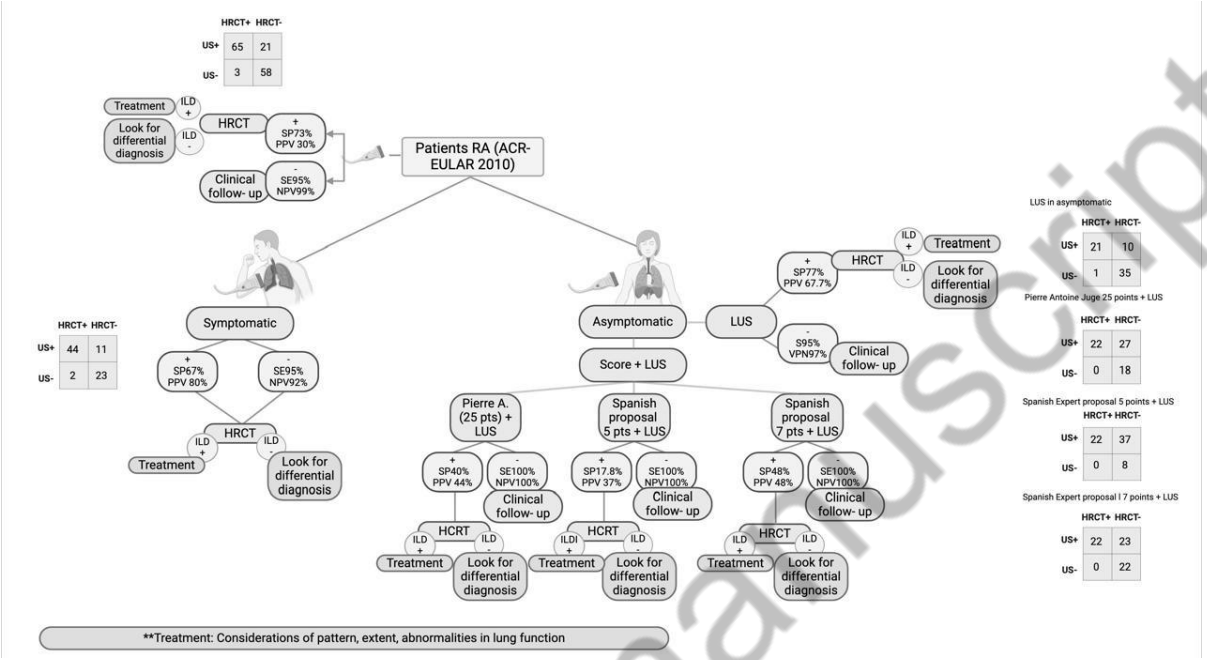


Figure 1a illustrates the distribution of symptoms and their relationship with the lung ultrasound and HRCT findings. Figure 1b highlights the relationship between abnormal lung ultrasound findings and clinical manifestations. Figure 1c shows the associations between symptoms and HRCT findings. Figure 1d shows the relationships between the main symptoms (cough and dyspnea) and both the HRCT and portable lung ultrasound findings. US: ultrasound, HRCT: High-resolution computed tomography.

Figure 2: Proposed screening algorithm for RA-associated interstitial lung disease incorporating lung ultrasound.



HRCT: High-resolution computed tomography, LUS: lung ultrasound, ILD: interstitial lung disease, SE: Sensitivity, SP: Specificity, PPV: positive predictive value, NPV: negative predictive value, ACR: American College of Rheumatology, EULAR: European alliance of associations for rheumatology.

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