Journal of Izmir Chest Hospital 2022;36(2):113–117
DOI: 10.14744/IGH.2022.92486

RESEARCH ARTICLE / ÖZGÜN ARAŞTIRMA

Radiologic and Clinical Characteristics of Rheumatoid Arthritis-associated Lung Disease

Romatoid Artrit ile İlişkili Akciğer Hastalığının Radyolojik ve Klinik Özellikleri

[1]Gazi GÜNDÜZ
[2]Özgül SOYSAL GÜNDÜZ
[3]Burak POLAT

[1]Department of Chest Disease, Manisa State Hospital, Manisa, Türkiye
[2]Department of Rheumatology, Celal Bayar University, Manisa, Türkiye
[3]Department of Radiology, Manisa State Hospital, Manisa, Türkiye

ORCID ID
GG : 0000-0001-5523-3272
ÖSG : 0000-0002-8149-9311
BP : 0000-0001-7265-8862

ABSTRACT

Objective: Rheumatoid arthritis (RA) is a chronic inflammatory disease that usually affects the synovial joints, but can also affect other organs. One of the most common forms of extra-articular manifestations is RA-associated lung disease (RA-LD), which causes significant morbidity and mortality. There are several pulmonary findings of RA, including pulmonary parenchymal disease, pleural inflammation, airway diseases, vasculitis, and pulmonary hypertension. It has been reported that the most common pulmonary disease is interstitial lung disease in RA patients. The aim of this study is assessing the tomographic findings of RA-LD patients of a single center, and their possible correlation with the clinical and laboratory findings of the disease.

Material and Methods: Medical records of 32 RA-LD patients were investigated retrospectively. The radiological, clinical, and laboratory data, disease activity and disability scores were recorded.

Results: 32 patients (78% female) with a mean age of 50.23±10.48 years were included in the study. The mean disease duration was 52.42±15.48 months. Pulmonary lesions were detected on chest X-ray in 16 patients (50%) and on high resolution computed tomography (HRCT) scans in all of 32 patients. Parenchymal involvement was detected in 25 patients (78.1%). The most common lesions seen on HRCT scans were pulmonary nodules (31.2%), ground-glass attenuation (25%), and bronchiectasis (25%). No association was found between radiological involvement patterns and laboratory findings, DAS28-CRP, and medications ($p>0.05$ for all).

Conclusion: In the presence of a pulmonary lesion on X-ray, HRCT should be considered in every RA patients. Parenchymal involvement is the most common pattern in RA-LD. In addition, pulmonary nodules may be seen frequently in young and female RA patients.

Keywords: High resolution computed tomography, interstitial lung disease, rheumatoid arthritis, rheumatoid arthritis-associated lung disease.

Cite this article as: Gündüz G, Soysal Gündüz Ö, Polat B. Radiologic and Clinical Characteristics of Rheumatoid Arthritis-associated Lung Disease. Journal of Izmir Chest Hospital 2022;36(2):113–117.

Received (Geliş): March 01, 2022 **Accepted (Kabul):** July 27, 2022 **Online (Çevrimiçi):** August 15, 2022
Correspondence author (Sorumlu yazar): Gazi GÜNDÜZ, MD. Manisa Şehir Hastanesi, Göğüs Hastalıkları Kliniği, Manisa, Türkiye.
Tel: +90 505 262 63 00 **e-mail:** gazigunduz@gmail.com

ÖZ

Amaç: Romatoid artrit, genellikle sinovyal eklemleri etkileyen, ancak diğer organları da etkileyebilen kronik inflamatuvar bir hastalıktır. Romatoid artrit ile ilişkili akciğer hastalığı en yaygın eklem dışı belirtilerden biri olup, önemli morbidite ve mortaliteye neden olur. Romatoid artrit hastalarında pulmoner parankimal hastalık, plevral inflamasyon, hava yolu hastalıkları, vaskülit ve pulmoner hipertansiyon gibi çeşitli pulmoner bulgular olabilir. Romatoid artrit hastalarında en sık görülen akciğer hastalığının interstisyel akciğer hastalığı olduğu bildirilmiştir. Bu çalışmanın amacı, tek merkezdeki romatoid artrit ile ilişkili akciğer hastalığı olan hastaların tomografik bulgularını ve bunların hastalığın klinik ve laboratuvar bulgularıyla olası ilişkisini değerlendirmektir.

Gereç ve Yöntemler: Otuz iki romatoid artrit ile ilişkili akciğer hastalığı olan hastanın tıbbi kayıtları geriye dönük olarak incelendi. Radyolojik, klinik ve laboratuvar verileri ile hastalık aktivitesi skorları kaydedildi.

Bulgular: Yaş ortalaması 50,23±10,48 yıl olan 32 (%78'i kadın) hasta çalışmaya dahil edildi. Ortalama hastalık süresi 52,42±15,48 ay idi. On altı (%50) hastada akciğer grafisinde ve 32 hastanın tümünde yüksek çözünürlüklü bilgisayarlı tomografi tetkiklerinde akciğer lezyonları tespit edildi. Yirmi beş (%78,1) hastada parankim tutulumu saptandı. Yüksek çözünürlüklü bilgisayarlı tomografi taramalarında en sık görülen lezyonlar pulmoner nodüller (%31,2), buzlu cam görünümü (%25) ve bronşektazi (%25) idi. Radyolojik tutulum paternleri ile laboratuvar bulguları, DAS28-CRP ve ilaçlar arasında ilişki bulunmadı (tümü için p>0,05).

Sonuç: Akciğer grafisinde pulmoner lezyon olması durumunda her romatoid artrit hastasında yüksek çözünürlüklü bilgisayarlı tomografi düşünülmelidir. Romatoid artrit ile ilişkili akciğer hastalığında parankimal tutulum en sık görülen paterndir. Ayrıca genç ve kadın romatoid artrit hastalarında pulmoner nodüller sık görülebilir.

Anahtar kelimeler: İnterstisyel akciğer hastalığı, romatoid artrit, romatoid artrit ilişkili akciğer hastalığı, yüksek çözünürlüklü bilgisayarlı tomografi.

INTRODUCTION

Rheumatoid arthritis (RA) is the most common chronic, erosive, autoimmune, inflammatory arthritis in the population.[1] Although RA primarily affects the joints, it is a systemic disease that may also involve extra articular tissues and organs. Pulmonary involvement is a common extra-articular manifestation of RA and is associated with mortality.[2] Approximately 50% of the RA patients develop pulmonary involvement at any stage of the disease and pulmonary involvement is the cause of death in 10% to 20% of these patients.[3,4] While pulmonary changes usually occur after the diagnosis of RA, they may occur before the onset of arthritis.[5] There are several pulmonary manifestations of RA, including pulmonary parenchymal disease, pleural inflammation, airway diseases, vasculitis, and pulmonary hypertension. Interstitial lung disease (ILD) is the most common pulmonary manifestation of RA.[6] These changes may result from chronic immune activation, increased susceptibility to infection, or direct toxicity from disease-modifying medications.

There are diagnostic challenges for RA-associated lung diseases (RA-LD). The diagnostic accuracy of a plain posterior-anterior (PA) chest X-Ray alone in detecting lung involvement in RA has been reported as only 1.6–6%.[7,8] More sensitive diagnostic modalities such as high resolution computed tomography (HRCT) are required to detect pulmonary involvement in RA. HRCT is a beneficial modality to determine the location and extent of RA-LD. The prevalence of pulmonary involvement in RA was found to be 10 fold higher than estimated before the introduction of HRCT.[9]

The present study aimed to assess the tomographic findings of RA-LD patients of a single center, and their possible correlation with the clinical and laboratory findings of the disease.

MATERIAL AND METHODS

The patients diagnosed as RA according to the 2010 American College of Rheumatology/European League Against Rheumatism Classification Criteria for RA following in internal medicine rheumatology outpatient were included consecutively from September 2016 to December 2019 to this retrospective study.[10] This study was approved by the ethics committee of University Faculty of Medicine, with the number of E-20478486/1448. A total of 32 patients with RA-LD were analyzed for the study after excluding patients with pulmonary comorbidities such as pulmonary tuberculosis, chronic obstructive pulmonary disease, and lung masses. Their demographic characteristics, disease duration, extra-articular symptoms, medications, and laboratory findings of last visit were recorded from hospital database. Pulmonary disease risk factors (smoking, medications, household pets, and occupational exposure) and symptoms (coughing, expectoration, chest pain, hemoptysis, and shortness of breath) were also recorded. Data including HRCT, PA chest X-Ray, and pulmonary function tests (PFTs) were examined. DAS-28-CRP (Disease activity score-28 C-Reactive protein) was used to assess disease activity. The disability of every patient was determined based on the health assessment questionnaire (HAQ).

Chest X-ray and HRCT images were reassessed by a radiologist who was blind to the clinical data. The lung lesions detected on HRCT scans classified as parenchyma disease (pulmonary nodules, ground-glass attenuation, honeycombing, and fibrobullous lesion), airway disease (bronchiectasis and air trapping), and pleural disease (pleural effusion and pleural thickening). Figure 1 shows HRCT images of two patients.

Statistical Analysis

The data were recorded in a database and analyzed using IBM SPSS Statistics version 22.0 (IBM Corp, Armonk, NY, USA). Depending on the results of the normality test, numerical data were compared between independent groups using independent samples t-test or Mann–Whitney U test and categorical variables were compared using Pearson's Chi-square or Fischer's exact test. We tested the equality of means in more than two independent samples (radiolog-

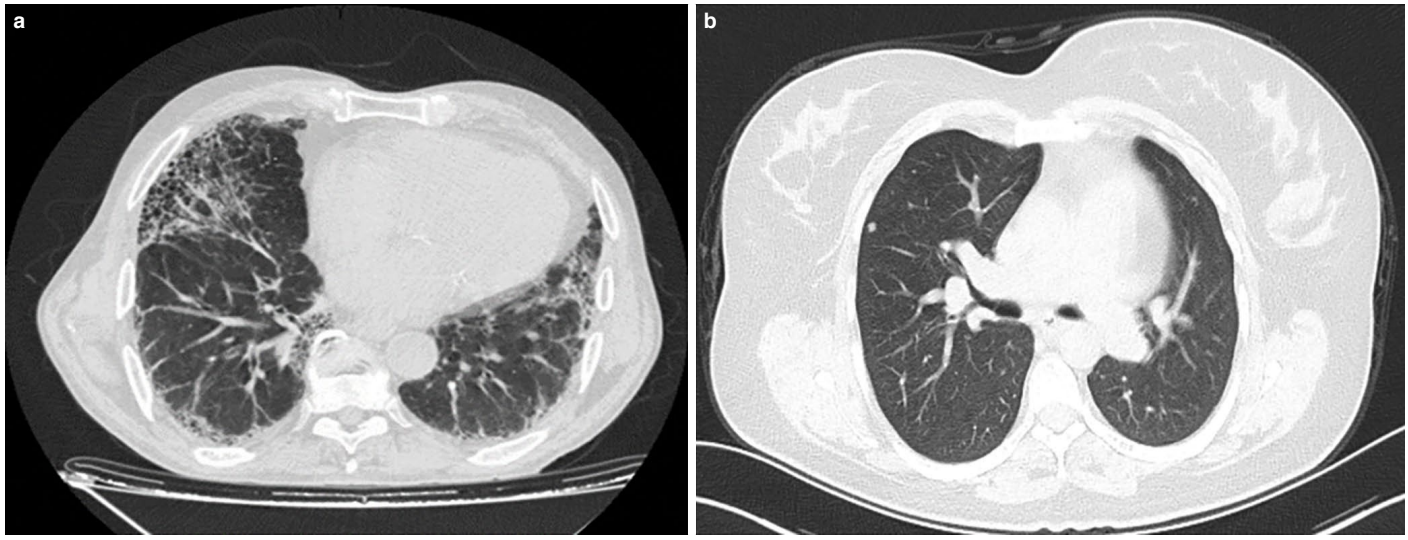

Figure 1 (a, b): An axial HRCT image of our 71-year-old nonsmoker male patient with RA show honeycombing in the bilateral lower lobes. An axial HRCT image of our 47-year-old female patient with RA shows a rheumatoid pulmonary nodule with 6 mm diameter located in the periphery of the right upper lobe anterior segment.

HRCT: High-resolution computed tomography, RA: Rheumatoid arthritis.

ical involvement patterns in HRCT) using analysis of variance. The results were assessed within a 95% confidence interval and $p<0.005$ was considered as statistically significant.

RESULTS

Twenty-five of 32 patients (78%) were female with a mean age of 50.23±10.48 years. The mean disease duration was 52.42±15.48 months. Eight patients (25%) were smokers. The rates of respiratory symptoms were as follows: Dyspnea 53.1%, Cough 62.5%, sputum 15.6%, and chest pain 3.2%. The most common physical examination finding was the decreased breath sounds (28.1%), fine crackles (53.1%), and ronchi (9.4%). Medications used for RA determined as 78.1% methotrexate (MTX), 71.8% corticosteroid (KS), 81.2% nonsteroidal anti-inflammatory drugs, 46.8% hydroxychloroquine, 43.7% leflunomide, 50.0% sulfasalazine, 18.7% tumor necrosis factor-α inhibitor, and 6.2% tofacitinib. The rate of rheumatoid factor (RF) and anti-cyclic citrullinated peptide antibody positivity was found as 81.2% (n=26) and 75.0% (n=24), respectively. Pulmonary lesions were detected on chest X-ray in 16 patients (50%) and on HRCT scans in all of 32 patients. Regarding to the locations of the lesions on HRCT scans, parenchymal involvement which was the most prevalent pattern was seemed in 25 (78.1%) patients (Table 1). More than one lung structure was involved in nine patients. The most common lesion seen on HRCT scans was pulmonary nodule (31.2%). The distribution of other pulmonary lesions detected on HRCT scans is shown in Table 1. When the HRCT findings were examined in terms of the relevant region, it was determined that most of the pulmonary nodules were localized in subpleural regions of the upper lobes and interstitial involvement (the ground glass and honeycomb appearance) was frequently seen in the lower lobes.

HAQ and DAS28-CRP levels were measured as 0.48±0.21 and 3.34±1.35, respectively. No significant association was found between the respiratory symptoms and radiological involvement patterns (parenchymal, airway, and pleural). Furthermore, no association was found between radiological patterns and laboratory findings, DAS28-CRP and, medications ($p>0.05$ for all).

When PFTs were examined, 46.9% normal, 34.3% restrictive type respiratory disorder, 15.6% mixed type respiratory disorder, and 3.1% obstructive type respiratory disorder were observed.

DISCUSSION

It is important to detect lung involvement in the early stage of RA, as it is one of the most common causes of death in RA. There is several clinical, laboratory, and radiological features of pulmonary involvement in RA patients. Symptoms and indicators of RA-LD, such as a dry cough, dyspnea with exertion, and fine crackles on auscultation, should be checked regularly. In addition, after the diagnose of RA, a chest x-ray is required. When RA-LD is suspected due to radiological or clinical features, further procedures such as PFTs and HRCT

Table 1: The distribution of involved lung structures and HRCT findings

Lung structures	HRCT findings	n	%
Parenchym (25, 78.1%)	Pulmonary nodule	10	31.2
	Ground-glass attenuation	8	25.0
	Honeycombing	6	18.8
	Fibrobullous lesion	1	3.1
Airway (10, 31.3%)	Bronchiectasis	8	25.0
	Air trapping	2	6.2
Pleura (6, 18.8%)	Pleural effusion	1	3.1
	Pleural thickening	5	15.6

HRCT: High-resolution computed tomography

should be performed. HRCT can detect the early stages of RA-LD even in patients who don't have any respiratory symptoms. In our study, we identified 32 RA-LD patients in our 3-year hospital records. All had pulmonary lesions on HRCT, but only 50% had abnormal findings on chest X-ray. The previous studies commonly concluded that HRCT was the most sensitive and specific method to detect pulmonary involvement in RA.[9] It was reported that the sensitivity of chest X-rays for detecting pulmonary lesions, might vary from 2% to 5% in patients with RA.[11] In a study conducted in our country, the pulmonary involvement detection rate of chest X-rays was reported as 22.5% in RA, while this rate was 57.5% for HRCT.[12] Up to 64% of RA patients with ILD on HRCT have been shown to have no visible interstitial changes on chest X-ray.[13] In our HRCT scans revealed a pulmonary lesion in every patient who had a lesion on X-ray, while in the absence of a pulmonary lesion on chest X-ray, the lesion detection rate of HRCT was found to be 50%. These data indicated that chest X-ray is a diagnostic modality with high specificity but low sensitivity in detecting RA-LD. Therefore, HRCT is a mandatory part of the diagnostic work up if RA-LD is suspected.

The pulmonary manifestations of RA range from pleuritis and nodules to interstitial lesions and include a wide range of symptoms. The types of the lesions and their incidence may show variations among different studies on HRCT. While honeycombing and ground-glass appearance were the most frequent lesion patterns in certain studies, bronchiectasis and air-filled cysts were found to be more frequent in the others. The variations in the prevalence rates of the lesions detected on HRCT scans may be interpreted by the differences in the clinical characteristics of the patients in the study groups, the difference between the HRCT patterns that are looked for and the use of expiratory HRCT in certain studies. We found that the most frequent lesions detected on HRCT scans were pulmonary nodules with a prevalence rate of 31.2%. In line with our study, the prevalence of pulmonary nodules was reported as 28% by Perez et al.[14] In a study of 63 RA patients with pulmonary involvement, the prevalence of pulmonary nodules on HRCT scans was reported as 49% by Tanaka et al.[15] Although it has been reported in the literature that ILD is the most common pulmonary involvement in RA, honeycombing and ground glass images, which are signs of ILD, were found less frequently in our patients than reported before. The reason for this may be that our patients did not have findings previously shown to predict ILD (male gender predominance, advanced age, long disease duration, and smoking).[16–18] The disease duration of our patients was short (50.23±10.48 years), 78% of them were women and the smoking rate was low. In addition, pulmonary nodules can be detected incidentally in population. It cannot be proven that all nodules seen in our patients are associated with RA.

Rheumatoid pulmonary nodules can be highly variable in appearance: They can be single or multiple, range in size from 0.5 to 7 cm, rarely with calcification, tend to be peripheral, subpleural, or pleural, and cavitation may be seen.[19] In our patients, most of the pulmonary nodules were localized subpleural.

Although ILD can occur as part of RA pulmonary involvement, pulmonary fibrosis has been also related with MTX; a condition also known as MTX-pneumonitis (M-pneu). M-pneu, usually has an acute/subacute course (usually observed within the 1st year of treatment) characterized by non-specific interstitial pneumonia with ground-glass and/or reticular opacities in HRCT.[20] Although, approximately 80% of our patients were using MTX, none of them had clinical and radiological findings suggestive of M-pneu in the differential diagnosis.

Bronchiectasis that is detected on HRCT may be either associated with RA or may develop secondary to the pulmonary infections due to the immunosuppressive effects of the medications used in the treatment of RA. In line with the previous studies, the prevalence of bronchiectasis was found as 25% in our study.[12,15] The pleural involvement is one the most common manifestations of RA-LD. In our study, the rate of pleural involvement was found as 18.8%. Our results, as well as the results of the previous studies indicate that the current diagnostic modalities are not adequate to detect pleural involvement in RA. We showed that parenchymal disease is the most common pattern (78.1%) on HRCT of the patients with RA-LD, as previously emphasized by many researchers.

PFTs are useful in determining the severity of the pulmonary restrictive disorders. Spirometry is the most common used lung function test, followed by diffusing capacity of the lungs for carbon monoxide (DLCO). Previously, it was reported that a decreased DLCO value was an independent predictor of ILD development in RA.[21] Test results were within normal limits in approximately 50% of our patients who underwent PFTs. Because in our study, the rate of ILD was relatively lower than the previous ones. Furthermore, DLCO could not be performed due to technical inadequacies. Although pulmonary involvement in RA is usually associated with symptoms such as cough, shortness of breath and expectoration, some patients may be asymptomatic. The rate of asymptomatic patients was 25% in our study. The results of our study did not indicate any statistically significant association between the presence of certain pulmonary lesions on HRCT scans and respiratory symptoms. In the evaluation of the relationship between the pulmonary involvement and clinical and laboratory findings in RA, various parameters may be investigated as risk factors. These risk factors include RF, subcutaneous nodules, disease severity scales, anti-rheumatic agents, and immunological markers of disease severity such as HLA-DR4. Pérez-Dórame et al.[22] found a correlation between RA disease activity and ground-glass appearance in the HRCT. However, any significant relationship was not found between the pulmonary involvement and rheumatoid disease activity indexes, inflammatory parameters, or sex in many studies in the literature. In line with the literature, no relationship was found between the pulmonary lesion detected on HRCT scans and DAS-28 index, RF, CRP, ESR, or medications in our study. However, these findings may be due to the small number of patients and retrospective design, which are the main limitations of our study.

Detection of lung involvement is important for determining the prognosis and treatment protocol, as the delay in diagnosis of RA-LD increases mortality in RA.[23] Our study demonstrated that HRCT should be considered in every patient in the presence of pulmonary symptoms or a pulmonary lesion on chest X-ray. In addition, it should be kept in mind that pulmonary nodules may be seen frequently in young and female RA patients. Patients with RA should also be well evaluated in terms of pleural involvement. There is a need for prospective studies investigating the diagnostic methods, clinical and laboratory findings that predict lung involvement, especially for non-ILD patterns, in RA patients.

Disclosures

Ethics Committee Approval: The study was approved by The Manisa Celal Bayar University Faculty of Medicine Health Sciences Ethics Committee (date: 03.08.2022, number: E-20478486/1448).

Peer-review: Externally peer-reviewed.

Author Contributions: Concept – G.G., Ö.S.G., B.P.; Design – G.G., Ö.S.G., B.P.; Supervision – G.G., Ö.S.G., B.P.; Fundings – G.G., Ö.S.G., B.P.; Materials – G.G., Ö.S.G., B.P.; Data Collection and/or Processing – G.G., Ö.S.G., B.P.; Analysis and/or Interpretation – G.G., Ö.S.G., B.P.; Literature Search – G.G., Ö.S.G., B.P.; Writing – G.G., Ö.S.G., B.P.; Critical Reviews – G.G., Ö.S.G., B.P.

Conflict of Interest: The authors have no conflict of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

REFERENCES

1. Gabriel SE. The epidemiology of rheumatoid arthritis. Rheum Dis Clin North Am 2001;27:269–81.
2. Olson AL, Swigris JJ, Sprunger DB, Fischer A, Fernandez-Perez ER, Solomon J, et al. Rheumatoid arthritis-interstitial lung disease-associated mortality. Am J Respir Crit Care Med 2011;183:372–8.
3. Turesson C, O'Fallon WM, Crowson CS, Gabriel SE, Matteson EL. Occurrence of extraarticular disease manifestations is associated with excess mortality in a community based cohort of patients with rheumatoid arthritis. J Rheumatol 2002;29:62–7.
4. Sihvonen S, Korpela M, Laippala P, Mustonen J, Pasternack A. Death rates and causes of death in patients with rheumatoid arthritis: A population-based study. Scand J Rheumatol 2004;33:221–7.
5. Lee HK, Kim DS, Yoo B, Seo JB, Rho JY, Colby TV, et al. Histopathologic pattern and clinical features of rheumatoid arthritis-associated interstitial lung disease. Chest 2005;127:2019–27.
6. Suda T. Up-to-Date information on rheumatoid arthritis-associated interstitial lung disease. Clin Med Insights Circ Respir Pulm Med 2016;9(Suppl 1):155–62.
7. Gabbay E, Tarala R, Will R, Carroll G, Adler B, Cameron D, et al. Interstitial lung disease in recent onset rheumatoid arthritis. Am J Respir Crit Care Med 1997;156:528–35.
8. Lamblin C, Bergoin C, Saelens T, Wallaert B. Interstitial lung diseases in collagen vascular diseases. Eur Respir J Suppl 2001;32:69s–80s.
9. Salaffi F, Carotti M, Di Carlo M, Tardella M, Giovagnoni A. High-resolution computed tomography of the lung in patients with rheumatoid arthritis: Prevalence of interstitial lung disease involvement and determinants of abnormalities. Medicine (Baltimore) 2019;98:e17088.
10. Aletaha D, Neogi T, Silman AJ, Funovits J, Felson DT, Bingham CO 3rd, et al. 2010 Rheumatoid arthritis classification criteria: An American College of Rheumatology/European League Against Rheumatism collaborative initiative. Arthritis Rheum 2010;62:2569–81.
11. Cortet B, Flipo RM, Rémy-Jardin M, Coquerelle P, Duquesnoy B, Rêmy J, et al. Use of high resolution computed tomography of the lungs in patients with rheumatoid arthritis. Ann Rheum Dis 1995;54:815–9.
12. Saracoglu M, Nacir B, Incel NA, Genc H, Erdem HR. Relationship between high-resolution computed tomography findings and the Stoke index in patients with rheumatoid arthritis. Clin Rheumatol 2005;24:14–7.
13. Skare TL, Nakano I, Escuissiato DL, Batistetti R, Rodrigues Tde O, Silva MB. Pulmonary changes on high-resolution computed tomography of patients with rheumatoid arthritis and their association with clinical, demographic, serological and therapeutic variables. Rev Bras Reumatol 2011;51:325–37.
14. Perez T, Remy-Jardin M, Cortet B. Airways involvement in rheumatoid arthritis: Clinical, functional, and HRCT findings. Am J Respir Crit Care Med 1998;157:1658–65.
15. Tanaka N, Kim JS, Newell JD, Brown KK, Cool CD, Meehan R, et al. Rheumatoid arthritis-related lung diseases: CT findings. Radiology 2004;232:81–91.
16. Bendstrup E, Møller J, Kronborg-White S, Prior TS, Hyldgaard C. Interstitial lung disease in rheumatoid arthritis remains a challenge for clinicians. J Clin Med 2019;8:2038.
17. Svendsen AJ, Junker P, Houen G, Kyvik KO, Nielsen C, Skytthe A, et al. Incidence of chronic persistent rheumatoid arthritis and the impact of smoking: A historical twin cohort study. Arthritis Care Res (Hoboken) 2017;69:616–24.
18. Kelly CA, Saravanan V, Nisar M, Arthanari S, Woodhead FA, Price-Forbes AN, et al. Rheumatoid arthritis-related interstitial lung disease: Associations, prognostic factors and physiological and radiological characteristics--a large multicentre UK study. Rheumatology (Oxford) 2014;53:1676–82.
19. Weerakkody Y, Fortin F. Rheumatoid pulmonary nodule. Available at: Radiopaedia.org. Accessed Jul 21, 2022.
20. Fragoulis GE, Nikiphorou E, Larsen J, Korsten P, Conway R. Methotrexate-associated pneumonitis and rheumatoid arthritis-interstitial lung disease: Current concepts for the diagnosis and treatment. Front Med (Lausanne) 2019;6:238.
21. Hamblin MJ, Horton MR. Rheumatoid arthritis-associated interstitial lung disease: Diagnostic dilemma. Pulm Med 2011;2011:872120.
22. Pérez-Dórame R, Mejía M, Mateos-Toledo H, Rojas-Serrano J. Rheumatoid arthritis-associated interstitial lung disease: Lung inflammation evaluated with high resolution computed tomography scan is correlated to rheumatoid arthritis disease activity. Reumatol Clin 2015;11:12–6.
23. Cano-Jiménez E, Vázquez Rodríguez T, Martín-Robles I, Castillo Villegas D, Juan García J, Bollo de Miguel E, et al. Diagnostic delay of associated interstitial lung disease increases mortality in rheumatoid arthritis. Sci Rep 2021;11:9184.