Egyptian Journal of Chest Diseases and Tuberculosis (2016) **65**, 319–323

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The Egyptian Society of Chest Diseases and Tuberculosis

Egyptian Journal of Chest Diseases and Tuberculosis

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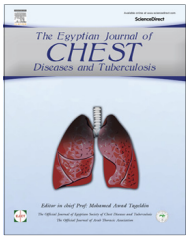

ORIGINAL ARTICLE

The role of HRCT in evaluation of thoracic manifestations of rheumatoid arthritis

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Received 2 April 2015; accepted 18 October 2015
Available online 28 November 2015

KEYWORDS

Rheumatoid arthritis;
Pulmonary complications;
HRCT findings.

Abstract *Background:* Pulmonary involvement is frequent and among the most severe extra-articular manifestations of rheumatoid arthritis (RA) ranking as the second cause of mortality in this patient population. RA can affect lung parenchyma, airways and pleura. HRCT is currently the imaging modality of choice in diagnosis of thoracic manifestations of RA being superior to chest radiography in demonstrating the presence and extent of lung abnormalities.

Aim of work: Evaluate the HRCT findings in patients with pulmonary complications of RA.

Patients and methods: This study involved 20 patients; 14 females and 6 males, age range 16–64 years (average 48 years). All patients were known cases of RA presenting with dyspnea and cough. Pulmonary complications associated with RA have been evaluated through: clinical examination; laboratory tests mostly CBC and other tests were considered according to case e.g., sputum analysis etc.; and radiological (chest radiograph and HRCT) and functional (Spirometry) assessment.

Results: HRCT findings showed signs of interstitial disease in 9 cases (45%), air-way disease in 9 cases (45%) and findings of both entities in 2 cases (10%). 11 cases showed HRCT signs of ILD as follows: 10 (91%) cases showed bilateral subpleural predominantly basal GGO, 8 (73%) cases showed bilateral subpleural predominantly basal reticulation with traction bronchiolectasis, 1 (9%) case showed diffuse GGO, and 2 (18%) cases showed cysts. Out of 11 cases, 9 (89%) cases were consistent with NSIP and 2 (11%) cases were consistent with LIP. 11 cases showed HRCT signs of airway disease, 10 (91%) cases showed bronchial wall thickening, 9 (82%) cases showed hyperinflation, 6 (55%) cases showed bronchiectasis, 5 (45%) cases showed mosaic perfusion, 3 (27%) cases showed beading of the bronchial wall, and 1 (9%) case showed air trapping. PFT showed restrictive changes in 6 out of the 9 patients with HRCT findings of ILD, obstructive changes with signs of small airway disease in 8 out of the 9 patients with HRCT findings suggestive of airway disease, and mixed restrictive and obstructive findings in the 2 patients with both entities by HRCT.

Abbreviations: RA, rheumatoid arthritis; HRCT, high resolution computed tomography; CBC, complete blood count; GGO, ground glass opacification; ILD, interstitial lung diseases; UIP, usual interstitial pneumonia; NSIP, nonspecific interstitial pneumonia; OP, organizing pneumonia; DAD, diffuse alveolar damage; PFT, pulmonary function test; FVC, forced vital capacity; FEV1, forced expiratory volume in 1st second; FEF 25–75%, forced expiratory flow at 25–75% of forced vital capacity; MSCT, Multi-slice Computed Tomography.

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Peer review under responsibility of The Egyptian Society of Chest Diseases and Tuberculosis.

http://dx.doi.org/10.1016/j.ejcdt.2015.10.007

Conclusion: Role of HRCT imaging in the evaluation and diagnosis of patients with intra-thoracic manifestations of RA is central, being accurate and non-invasive.

Introduction

Rheumatoid arthritis (RA) is a common collagen vascular disease that affects 1–2% of the general population. It occurs more often in women than in men (female-to-male ratio, 3:1), with the highest incidence occurring between the ages of 25 and 50 years. In nearly 50% of patients with RA, there is some form of extra-articular involvement in the disease process. Lung disease is the second most common cause of death (18% of patients with RA), after infection [1].

Although RA is more common in women, respiratory disease more commonly develops in men. Respiratory symptoms are often absent, or non-specific such as dyspnoea and chronic cough [2].

Although pulmonary infection and/or drug toxicity are frequent complications, lung disease directly associated with the underlying RA is the most common. RA associated lung disease includes: interstitial lung diseases (ILD) such as usual interstitial pneumonia (UIP), nonspecific interstitial pneumonia (NSIP), organizing pneumonia (OP), and diffuse alveolar damage (DAD); airway diseases such as bronchiectasis and bronchiolitis; pleuritis; pulmonary vascular disease; and rheumatoid nodules [3].

Knowledge of the main chest imaging findings and understanding of the major associated complications are crucial for adequate disease management [1].

Chest radiography represents the imaging method most frequently utilized in the initial evaluation of intra-thoracic manifestations of RA. Chest radiography, however, has low sensitivity and specificity [4].

HRCT is now widely recognized as more sensitive and specific than chest radiography and it has been integrated into the diagnostic algorithms for the assessment of a number of diffuse lung processes, most notably the interstitial pneumonias, and obstructive lung diseases. Furthermore, HRCT has become a front-line test for the evaluation of patients with a number of very common clinical complaints, including patients with chronic cough and dyspnea [4].

The aim of this study is to evaluate the HRCT findings in patients with pulmonary complications of RA.

Subjects

This study involved 20 patients; 14 females and 6 males, age range 16–64 years (average of 48 years). All patients were known cases of RA presenting with dyspnea and cough.

Methods

The pulmonary complications associated with RA have been evaluated through: clinical examination with history taking, general and chest examination; laboratory tests mostly complete blood picture, the other tests were considered according to case e.g. sputum analysis etc.; and radiological (chest radiograph and HRCT) and functional (Spirometry) approaches.

Pulmonary function tests

Flow/volume loop using body plethysmography with highly transparent box; Sensor-medics V max series, 2130 Spirometer, V6200 Autobox, 6200DL was done in chest department Kasr Alainy hospital. Spirometry measurements are evaluated by comparison of the results with appropriate reference value based on age, height, sex, and race. The Forced vital capacity (FVC), the forced expiratory volume in the first second (FEV1), the ratio of FEV1 to FVC and the average of forced expiratory flow at 25–75% of forced vital capacity (FEF 25–75%) were measured. The (FEV1/FVC) ratio is important for distinguishing obstructive airways disease and restrictive disease. An obstructive ventilatory defect is defined by a reduced FEV1/VC ratio below the 5th percentile of the predicted value while a restrictive ventilatory defect is characterized by a normal or increased FEV1/VC [5].

HRCT chest

It was done in radiology department Kasr Al-Aini hospital using both techniques GE Light Speed Plus MSCT 4 channels set (for 11 cases), and Toshiba Aquilion MSCT 64 channels set (for 9 cases).

Results

This study involved 20 known cases of RA presenting with cough and dyspnea; 14 females and 6 males, age range 16–64 years (average of 48 years).

HRCT findings showed signs of interstitial disease in 9 cases (45%) as shown in (Table 1), air-way disease in 9 cases (45%) as shown in (Table 2) and findings of both entities in 2 cases (10%) as shown in (Table 3).

In our study 11 cases showed HRCT signs of ILD, 9 (89%) cases were consistent with NSIP, 2 (11%) cases were consistent with LIP.

The summary of HRCT results were shown in Tables 1–3. Incidental CT findings were summarized in Table 4 (see Figs. 1–4).

In our study 11 cases showed HRCT signs of ILD as following: 10 (91%) cases showed bilateral subpleural predominantly basal GGO, 8 (73%) cases showed bilateral subpleural predominantly basal reticulation with traction bronchiolectasis, 1 (9%) case showed diffuse GGO, and 2 (18%) cases showed cysts as shown in Tables 1 and 3.

11 cases showed HRCT signs of airway disease, 10 (91%) cases showed bronchial wall thickening, 9 (82%) cases showed hyperinflation, 6 (55%) cases showed bronchiectasis, 5 (45%) cases showed mosaic perfusion, 3 (27%) cases showed beading

Table 1 Summary of HRCT Findings of Interstitial lung disease.

HRCT chest findings	No. of cases
Bilateral sub-pleural predominantly basal ground glass opacification	8
Bilateral sub-pleural predominantly basal reticulation with traction bronchiolectasis	6
Diffuse ground glass	1
Cysts	1
Pulmonary artery more than 29 mm in mediastinal window (suggesting pulmonary hypertension)	5

Table 2 Summary of HRCT Findings of air-way disease.

HRCT chest findings	No. of cases
Hyperinflation	9
Bronchial wall thickening	9
Mild bronchiectasis	6
Mosaic perfusion	5
Beading of the bronchial wall (suggesting follicular bronchiolitis)	3

Table 3 Summary of HRCT Findings of both air-way and interstitial lung diseases.

HRCT chest findings	No. of cases
Bilateral subpleural predominantly basal ground glass opacification	2
Bilateral subpleural predominantly basal reticulation	2
Peribronchial thickening	1
Cysts	1
Air-trapping	1

Table 4 Summary of incidental CT findings.

Incidental CT findings	No. of cases
Pericardial thickening	3
Cardiomegaly	1
Prominent azygos and hemiazygos veins	1
Tracheal bronchus	1
Retrosternal goiter	1

of the bronchial wall, and 1 (9%) case showed air trapping as shown in Tables 2 and 3.

PFT showed restrictive changes in 6 out of the 9 patients with HRCT findings of ILD, obstructive changes with signs of small airway disease in 8 out of the 9 patients with HRCT findings suggestive of airway disease, and mixed restrictive and obstructive findings in the 2 patients with both entities by HRCT.

Discussion

RA is a common collagen vascular disease that affects 1–2% of the general population. In nearly 50% of patients with RA, there is some form of extra-articular involvement in the disease process. Pulmonary complications of RA include pleural thickening or effusion, bronchiectasis, ILD, obliterative bronchiolitis, follicular bronchiolitis, pulmonary nodules, pulmonary hypertension, and lung infections [1].

The purpose of this study was to evaluate the HRCT findings in patients with pulmonary complications of RA.

This study involved reviewing both HRCT and Spirometry results of 20 known cases of RA presenting with dyspnea and cough.

From the 20 patients in this study, 14 were females and 6 were males (ratio 2.3:1), age range was 16–64 years (average of 48 years) which is more or less consistent with the study done by Gabriel [6] that states that RA occurs 2–3 times more commonly in women with onset generally in adulthood, peaking in the 4th and 5th decades.

HRCT findings showed signs of ILD in 9 cases (45%) as shown in Table 1, air-way disease in 9 cases (45%) as shown in Table 2 and findings of both entities in 2 cases (10%) as shown in Table 3.

Although Woodhead et al. [7] found that pleural disease is the most common thoracic manifestation of RA (38–73% of cases), none of the cases in the present study showed pleural disease.

Also none of our patients showed rheumatoid pulmonary nodules, while according to Anaya et al. [8] its incidence is 4%.

Morrison et al. [9] stated that the finding of airway disease is seen in 38–68% of patients with RA, which is more or less consistent with the present study in which 11 (55%) out of 20 patients showed findings of airway disease. While in a retrospective study conducted by Tsuchiya et al. [10] of 144 patients with RA, a total of 83 (58%) patients were identified with ILD, 42 (29%) with air-way disease and 19 (13%) with combined disease.

In the present study 11 cases showed HRCT signs of airway disease, 10 (91%) cases showed bronchial wall thickening, 9 (82%) cases showed hyperinflation, 6 (55%) cases showed bronchiectasis, 5 (45%) cases showed mosaic perfusion, 3 (27%) cases showed beading of the bronchial wall, and 1 (9%) case showed air trapping as shown in Tables 2 and 3.

In contrast, a prospective study conducted by Perez et al. [11] which aimed at evaluating airway changes in RA, a study group consisted of 50 outpatients (9 males and 41 females), ranging in age from 34 to 73 years revealed air trapping in 16 (32%) cases, bronchiectasis in 15 (30%) cases, mosaic attenuation in 10 (20%) cases and bronchial wall thickening in 5 (10%) cases.

While in a prospective study of the prevalence of bronchiectasis in RA conducted by Despaux et al. [12] over an 18-month period in 46 patients (34 women and 12 men with a mean age of 60.1 years) meeting 1987 American College of Rheumatology criteria for RA. Bronchiectasis or bronchiolectasis was found in 23 (50%) patients and was the most common abnormality detected by HRCT. 18 of the 23 (78%) patients had not been diagnosed with bronchiectasis before the study and 13 (57%) were free of respiratory symptoms. Despaux et al. [12] concluded that routine use of HRCT, a technique capable of

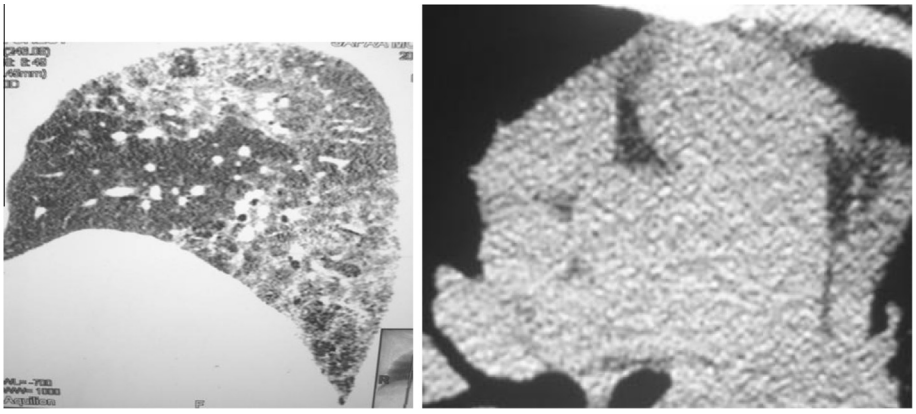

Figure 1 HRCT in sagittal reconstructed image in a 57 year-old RA female patient presenting with dyspnea and dry cough showing subpleural predominantly lower lobar GGO and reticulation, a picture of interstitial pneumonia, likely NSIP. Mediastinal window shows prominent main pulmonary artery; sign of pulmonary hypertension.

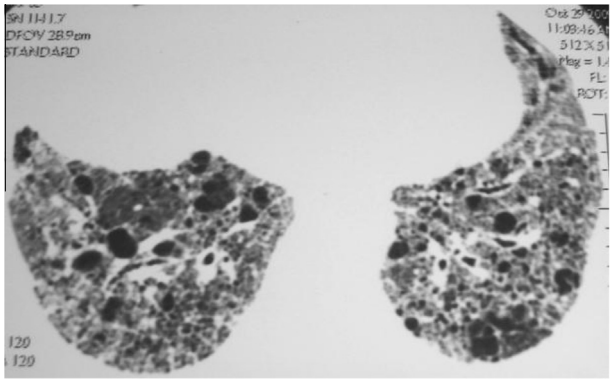

Figure 2 HRCT axial image in a 43 year-old RA male patient presenting with dyspnea and dry cough showing the basal aspect of lungs. Bilateral fairly symmetrical GGO, reticulation, traction bronchiectasis and bronchiolectasis with multiple bilateral cysts are seen, findings suggest interstitial pneumonia likely lymphocytic interstitial pneumonia (LIP).

demonstrating silent bronchiectasis, showed that bronchiectasis was the most common air-way disease in RA in his study.

In the present study 11 cases showed HRCT signs of ILD, 9 (89%) cases were consistent with NSIP, 2 (11%) cases were consistent with LIP, while none of the cases in our study showed findings suggestive of UIP.

The HRCT findings of these cases were as following: 10 (91%) cases showed bilateral subpleural predominantly basal GGO, 8 (73%) cases showed bilateral subpleural predominantly basal reticulation with traction bronchiolectasis, 1 (9%) case showed diffuse GGO, and 2 (18%) cases showed cysts as shown in Tables 1 and 3.

In consistence to the present study in which 11 (55%) out of the 20 patients showed ILD, Lee et al. [13] stated that ILD has been described in approximately 40% of patients with RA. Lee et al. [13] also stated that the pulmonary areas primarily affected are the bases of the lungs which is also consistent with our study in which 10 out of the 11 (91%) patients with ILD showed predominantly basal GGO or reticulations.

Silva et al. [14] stated that the frequency of ILD in RA is as follows: UIP is the most common, NSIP and OP are relatively common, and LIP and DAD are relatively uncommon which is inconsistent with our study in which NSIP was the most common finding constituting 9 (89%) cases out of the 11 cases diagnosed with ILD while none of the cases showed features of UIP.

In contrast to the present study, the study conducted by Biederer et al. [15] correlated HRCT, PFT and bronchoalveolar lavage cytology in patients with ILD associated with RA.

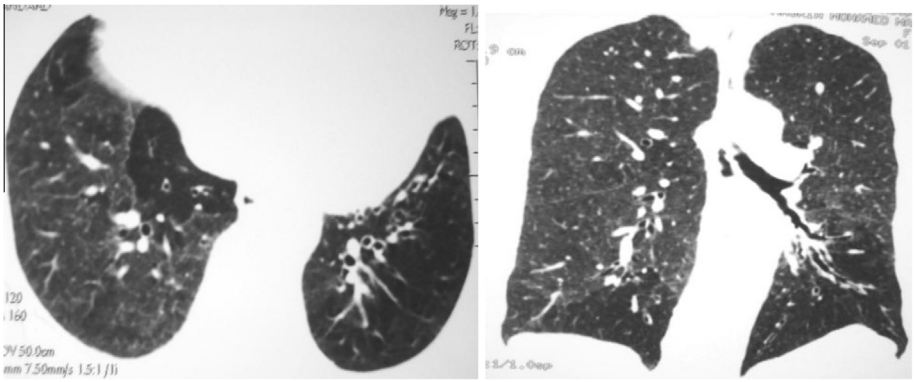

Figure 3 HRCT in axial and coronal reconstructed images in a 58 year-old RA female patient presenting with dyspnea and cough showing hyperinflation, bronchial wall thickening, mild bronchiectasis, and mosaic perfusion.

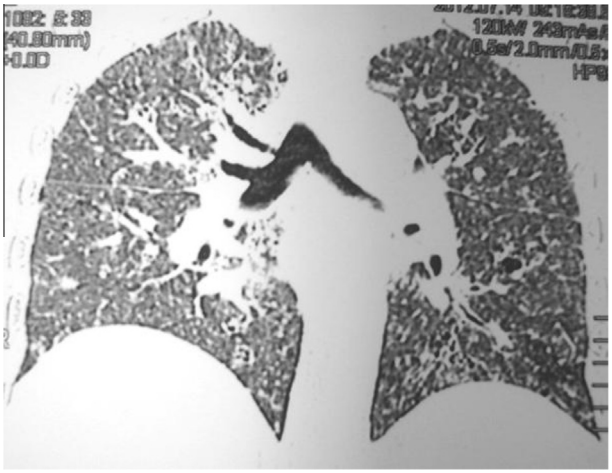

Figure 4 HRCT coronal reconstructed image in a 49 year-old RA female patient presenting with dyspnea and dry cough showing diffuse bilateral GGO and right tracheal bronchus.

53 RA patients with suspected ILD (19 men, 34 women) underwent HRCT. In 49 of 53 (92%) patients, HRCT was suggestive of ILD associated with RA. Reticular lesions were found in 40 of 53 (75%) patients, in 15 of 40 (38%) presenting as mixed pattern with GGO. Pure reticular patterns predominated in patients with long duration of ILD. Pure GGO were not observed.

The present study showed that 5 patients (45%) out of the 11 cases with ILD showed pulmonary artery measuring more than 29 mm (ranging from 31 mm to 43 mm) in diameter in mediastinal window (suggesting pulmonary hypertension) as shown in Table 1.

Similarly, in the study conducted by Tanaka et al. [16] reviewing CT scans obtained in 63 patients with RA who underwent a CT examination of the chest, enlargement of the pulmonary artery was observed in 26 (46%) of 57 patients in whom the pulmonary artery diameter was measured.

The present study concluded that the role of HRCT imaging in the evaluation and diagnosis of patients with intra-thoracic manifestations of RA is central, being accurate and non-invasive. To provide optimal treatment, physicians must always consider the possibility of associated pulmonary manifestations when patients with RA are evaluated.

Conflict of interest

We have a competing interest to declare: the Medical Journal of Cairo University.

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