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ROLE OF HIGH RESOLUTION COMPUTED TOMOGRAPHY LUNG IN PATIENTS WITH BREATHLESSNESS ATTRIBUTED TO PRIMARY PULMONARY PATHOLOGY AND ITS COMPARISION WITH CHEST X RAYS

Radiodiagnosis

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ABSTRACT

Dyspnoea/breathlessness is defined as a "subjective experience of breathing discomfort that consists of qualitatively distinct sensations that vary in intensity"1. Pulmonary causes include obstructive, restrictive, alveolar and airway pathologies. The most common obstructive causes are chronic obstructive pulmonary disease (COPD) and asthma. Restrictive lung disease includes extra-pulmonary etiologies like obesity, spinal deformities or chest wall deformities, and intrinsic pulmonary etiologies such as interstitial lung disease, interstitial fibrosis, pneumoconiosis, granulomatous disease or collagen vascular disease. Alveolar pathologies include chronic pneumonia and broncho-alveolar carcinoma. Airway diseases include chronic bronchitis and bronchiectasis2, 3.In our study we excluded non respiratory causes like cardiac, neurogenic, metabolic causes & patients with neoplastic lung mass.

In a suspected pulmonary pathology as a cause of breathlessness, a chest-X ray is often the first radiological investigation. The conventional chest X-ray is cheap and easily accessible but limited in scope and sensitivity. High-resolution thin section (HRCT) is far superior for detection, characterization and demonstration of the pulmonary interstitium, air spaces and airways4.In our study done on 80 patients, HRCT is recognized as more sensitive and specific than chest radiography for the evaluation of patients with breathlessness.

KEYWORDS

INTRODUCTION:

American Thoracic Society defines dyspnoea/breathlessness as a "subjective experience of breathing discomfort that consists of qualitatively distinct sensations that vary in intensity"[1]. Dyspnoea that is greater than expected with the degree of exertion is considered pathologic and a symptom of disease[5]. Dyspnoea may be of neurogenic, respiratory, or cardiac origin, and may be associated with conditions such as anemia, or anxiety. Asthma, congestive heart failure, chronic obstructive pulmonary disease, pneumonia, cardiac ischemia, interstitial lung disease, and psychogenic causes responsible for approximately 85 % of patients presented with breathlessness[6]. The etiology of dyspnoea is multi-factorial in about one-third of patients[7].The approach to a patient with dyspnoea starts with a careful and detailed history including the mode of onset, duration, aggravating and relieving factors, associated symptoms like fever, cough, etc. History of smoking, occupational history, chemical exposure, and medication use is important.

In a suspected pulmonary pathology as a cause of breathlessness, a chest-X ray is often the first radiological investigation. The conventional chest X-ray is cheap and easily accessible but limited in scope and sensitivity. In the last two decades, improvements in technique (use of a high kilovoltage (kV), reduced exposure time, and evolution from conventional radiography to digital radiography) resulted in a significant impact on chest X-rays analysis by radiologists and clinicians. Lots of effort has been made to facilitate the visualization of disease on chest X-rays (e.g., zooming, windowing, bone filtration). High-resolution thin section (HRCT) is far superior for detection, characterization and demonstration of the pulmonary interstitium, air spaces and airways[4]. HRCT is now widely recognized as more sensitive and specific than chest radiography for the evaluation of patients with breathlessness and it has been included into the diagnostic algorithms for the assessment of various lung diseases like diffuse lung diseases, idiopathic interstitial pneumonia, pneumoconiosis, granulomatous disease or collagen vascular disease and obstructive lung diseases. HRCT by using narrow collimation and high spatial frequency reconstruction algorithms will maximize spatial resolution. High resolution computed tomography is a valuable tool and has high accuracy in defining the imaging features and characterization of the disease based on various patterns.

AIM: To evaluate role of HRCT in patients with breathlessness secondary to pulmonary pathology and its comparison with chest x-rays.

OBJECTIVES:

- To study the different radiographic patterns evident in both conventional chest radiography and HRCT in patients presenting with breathlessness.
- To evaluate if HRCT can detect pulmonary abnormalities in patients of breathlessness with normal chest radiograph.
- To compare the sensitivity and specificity of CXR and HRCT in evaluation of lung pathology.

MATERIALS AND METHOD:

- With the initial aim of the role of HRCT lung in patients presenting with breathlessness and its comparison with chest X rays, the present study has gathered data on 80 patients. These subjects of varying ages between 18 to 75 years and of both gender were referred to the department of radio-diagnosis, Geetanjali Medical College and Hospital, Udaipur from department of medicine and dept of TB and chest for evaluation of breathlessness during the period from Nov 2017 to Nov 2019. Detailed history, clinical examination and relevant laboratory investigations apart from routine ones were performed for each subject.
- **Chest radiography-** PA view was taken for all cases (AP in the morbidly ill) and lateral view wherever needed using machine ALLENGER. CXR images were assessed for patterns and distribution of lung abnormality. CXR patterns included nodular lesions, air-space consolidation, cavitatory lesions, ground-glass opacity, bronchiectasis, reticular opacities, cystic lesions, emphysematous changes, lymph node enlargement, pleural effusion, fibrosis, calcification, collapse and combination of patterns.
- **HRCT evaluation-** CT images were assessed for CT patterns and distribution of lung abnormality. HRCT scans were performed on a 64-slice volume scanner (SIEMENS SOMATOM Definition). The scans were obtained at end inspiration by using 0.6mm collimation and at 10-mm intervals from the apex of the lung to the diaphragm. The scans were obtained by using 120 kV and 200–300 mAs. Expiratory and prone scans were obtained wherever deemed appropriate. CT images were assessed for CT patterns and distribution of lung abnormality. CT patterns included nodule, air-space consolidation, cavitatory lesions, ground-glass opacity, tree-in-bud pattern, bronchiectasis, reticular opacities, cystic lesions, emphysematous changes, lymph node enlargement, pleural effusion, fibrosis, calcification, collapse, honeycombing, septal thickening, mosaic perfusion, air crescent and combination of CT patterns.

After the evaluation of the parenchymal findings, a diagnosis was made without knowledge of laboratory findings and before follow-up of patients. Pneumonia was considered as the diagnosis in patients with lobar / segmental consolidations with air bronchogram, whereas active tuberculosis was considered in cases where there was consolidation with surrounding nodular opacities, lobular consolidation, tree in bud appearance and cavities. Patchy Fibrosis with calcification was considered as focus of healed tuberculosis and any consolidation or nodular opacities in the background of healed tuberculosis findings was considered relapsing tuberculosis. Fungal infection was suggested as the diagnosis in patients with nodules on the chest CT that did not have any specific features, such as centrilobular nodules or acinar nodules. Air crescent sign were assumed to be a sign of fungal infection. ILD was considered in patients with reticular opacities in sub pleural and basal distribution, fibrosis, traction bronchiectasis and volume loss.

Final diagnosis was based on the clinical correlation, relevant laboratory investigations, response to antibiotics and ATT and follow up examinations.

Criteria for patient Inclusion in the study :

1. Patients above 18yrs of both sexes presenting with breathlessness secondary to respiratory etiology.
2. Patients in whom the plain chest skiagram showed the presence of respiratory pathology, however the reports are inconclusive and patterns of pathology needed to be further understood to come to a diagnosis.
3. Patients who already had known diagnosed lung pathology, who are presently under evaluation for the treatment response.

Criteria for patient exclusion from the study:

1. Patients with breathlessness due to non respiratory causes like cardiac, neuro genic and metabolic causes.
2. Patients with neoplastic lung mass.
3. Uncooperative and agitated patients who were not able to hold the breath.

OBSERVATION AND RESULTS

Table 1: Age and gender wise distribution of studied cases:

AGE GROUP(YRS)	MALE	FEMALE	TOTAL	%*
18 – 25	2	3	5	6.25
26 – 35	3	2	5	6.25
36 – 45	4	10	14	17.5
46 – 55	12	6	18	22.5
56 – 65	16	10	26	32.5
66 – 75	10	2	12	15
TOTAL	47	33	80	100

*percentage of cases in each age group out of total number of cases studied

Table 2:Distribution of the study group according to the duration of symptom(dyspnoea):

DURATION	NUMBER	PERCENTAGE
< 3 MONTHS	16	20
3 – 6 MONTHS	23	28.75
>6 MONTHS	41	51.25
TOTAL	**80**	**100**

Table 3: Chest X ray and HRCT findings:

Radiological abnormality	In CXR(n=80)		In HRCT(n=80)		z value	p value
	Number	%	Number	%		
Consolidation	18	22.5	23	28.75	0.724	0.469 (NS)
Nodules	12	15	36	45	3.968	<0.001 (HS)
Tree in bud	0	0	11	13.75	3.124	0.002 (HS)
Cavity	9	11.25	27	33.75	3.218	0.001 (HS)
GGO	2	2.5	24	30	4.5	<0.001 (HS)
Collapse	16	20	18	22.5	0.195	0.847 (NS)
Honeycombing	0	0	07	8.75	2.319	0.020 (HS)
Bronchiectasis	5	6.25	29	36.25	4.445	<0.001 (HS)
Reticular opacities	24	30	27	33.75	0.339	0.734 (NS)
Cyst	2	2.5	04	5	0.416	0.677 (NS)
Fibrosis	22	27.5	33	41.25	1.665	0.096 (NS)
Calcification/ old healed lesions	17	21.25	23	28.75	0.913	0.361 (NS)
Pleural effusion	6	7.5	08	10	0.280	0.780 (NS)
Pleural thickening/ plaque	5	6.25	17	21.25	2.525	0.012 (HS)
Septal thickening	0	0	19	23.75	4.399	<0.001 (HS)
Mosaic perfusion	0	0	05	6.25	1.817	0.069 (NS)
Emphysematous changes	8	10	16	20	1.550	0.121 (NS)
Lymph nodes	3	3.7	39	48.75	6.298	<0.001 (HS)
Air crescent	0	0	4	5	1.519	0.129 (NS)

NS: Not significant, S: Significant, HS: Highly Significant

Total number of radiological abnormalities	CXR	HRCT
	149	370

Table 4: Comparison of total final diagnosis made on CXR and HRCT:

Final diagnosis	CXR n = 80	%	HRCT n = 80	%	z value	p value
Active tuberculosis	3	3.75	10	12.5	2.000	0.050 (S)
Relapsing tuberculosis	4	5	14	17.5	2.252	0.024 (S)
Old tuberculosis	5	6.25	7	8.75	0.300	0.764 (NS)
Military tuberculosis	1	1.25	2	2.5	0	1 (NS)
Pneumonia	14	17.5	11	13.75	0.435	0.663 (NS)
Bronchiectasis	6	7.5	8	10	0.280	0.780 (NS)
ILD	0	0	17	21.25	4.105	<0.001 (HS)
Silicosis	0	0	2	2.5	0.712	0.477 (NS)
Silico-tuberculosis	0	0	2	2.5	0.712	0.477 (NS)
Emphysema	6	7.5	8	10	0.280	0.780 (NS)
Aspergilloma	0	0	4	5	1.519	0.129 (NS)

NS: Not significant, S: Significant, HS: Highly Significant

Total number of final diagnosis	CXR	HRCT
	39	85

Diagnoses of ILD, aspergilloma, silicosis and silico-tuberculosis were missed on CXR due to inadequate pattern or non specific pattern recognition and on HRCT accounted for 20, 4.7, 2.3, 2.3 respectively.

Sensitivity of chest X ray for Pneumonia, active tuberculosis, relapsing tuberculosis and old tuberculosis were 50%, 6.6%, 20% & 25% respectively while that of HRCT is 83.3%, 66.6%, 100% & 58.3% respectively. Specificity of chest X ray for pneumonia, active tuberculosis, relapsing tuberculosis and old tuberculosis were 88.2%, 96.9%, 97.1% & 97% respectively while that of HRCT was 98.5%, 100%, 94.2% & 100% respectively.

Table 5: HRCT findings in ILD:

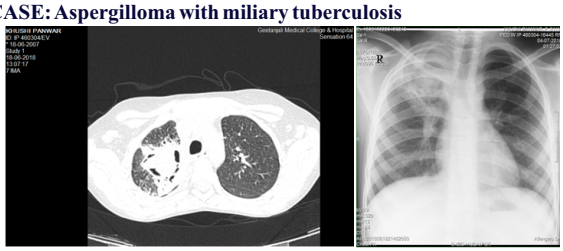
HRCT findings in ILD	Number n = 17
Reticular opacities	6 (35%)
Honeycombing	7 (41%)
Ground glass opacity	12 (70%)

Bronchiectasis	6 (35%)
Emphysema	1(5.8%)
Septal thickening	17 (100%)
Fibrosis	3 (17.5%)

Table 6: Chest radiographic pattern of ILD:

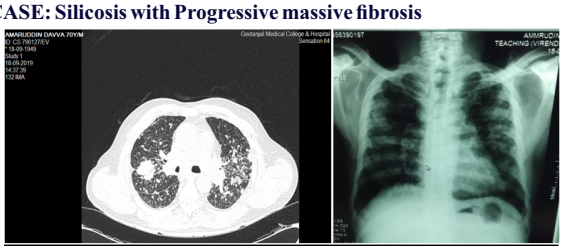
Chest radiographic pattern of ILD	Number
Normal	3 (17.6%)
Reticular opacities	11(64.7%)
Broncheictasis	4 (23.5%)

CASE: Aspergilloma with miliary tuberculosis



Patient presented with breathlessness since 4 months with cough. On CXR-There is cavity like lesion in right upper lobe. On HRCT cavitatory lesion with intracavitary mass lesion and air crescent surrounding it seen in right upper lobe.There are multiple tiny millet like densities seen in both lung fields.

CASE: Silicosis with Progressive massive fibrosis



Patient presented with history of breathlessness (3 yrs) with cough. Patient had occupational history of working in textile industry for 10 yrs.On CXR: There are reticulo-nodular opacities in both lungs with areas of fibrosis. On HRCT: There are multiple centrilobular nodules in both lungs with few conglomerated mass like lesions in both upper lobes associated with fibrotic strands. There are multiple enlarged mediastinal lymphnodes.

DISCUSSION

In our study chest x-ray picked up 149 findings in total 80 patients whereas HRCT showed 370 pulmonary findings (Table 3), indicating a high disparity in the sensitivity of CXR and HRCT. In our study HRCT is certainly better for detection and characterization of radiological abnormalities and results in our study is statistically highly significant for nodules (p-value <0.001), tree in bud(p-value 0.002), cavity(p-value 0.001), GGO(p-value <0.001), honeycombing(p-value 0.020), bronchiectasis(p-value <0.001), pleural thickening(p-value 0.012), septal thickening(p-value <0.001) & Lymph nodes(p-value <0.001).

In our study sensitivity of chest X ray was low for all of the radiological abnormality (Considering HRCT as criterion standard).The lowest sensitivity was noted for GGO followed by bronchiectasis. Highest sensitivity was for pleural effusion followed by reticular opacities, collapse & consolidation. However true negative rate (specificity) of chest X-rays for most of the radiological abnormality was quite good exceeding 90% in all the findings and it was 100% in Cysts, bronchiectasis, pleural effusion, cavity and GGO**.** In a study by Wesley H. et al[8]. done on 3423 patients, pulmonary opacities were visualized on 309 CXRs and 191 CT scans. They concluded that CXR demonstrated poor sensitivity and positive predictive value for detecting pulmonary opacities. In our study also sensitivity was quite less for various opacities, lowest sensitivity was noted for GGO followed by bronchiectasis.

In our study, we had normal chest X rays in 9 patients and 26 patients had non- specific symptoms like GGO and reticular opacities because of inadequate pattern recognition. Final conclusion was offered in only 39 out of 80 patients whereas on HRCT all the patients were offered a diagnosis based on radiological patterns (85 diagnoses in 80 patients). So this study emphasizes the important role of HRCT in helping to confirm or refute the presence of abnormality when the chest radiograph is normal or questionably abnormal and underlines the superior diagnostic accuracy of HRCT compared with conventional chest radiography. This is even supported in a study by Kang Mandeep et al[9].

In our study diagnosis of active tuberculosis, relapsing tuberculosis, military tuberculosis, old tuberculosis, bronchiectasis, emphysema and Pneumonia offered on both CXR and HRCT where as ILD, aspergilloma, silicosis, silico-tuberculosis & bagassosis were the missed entity on CXR.

Our results are a contradiction to study done by bogaarts et al.[10]wherein he reports the sensitivity of CXR to detect bronchiectasis to be 87.8% with a specificity of 74.4%. In our study sensitivity of chest radiograph to detect bronchiectasis is 17.2% with specificity 100%.

In our study HRCT findings of active tuberculosis in total of 10 patients are nodular opacities in 70%, tree in bud appearance in 50%, cavitations in 70%, lymphnodes in 60%, lobular consolidation in 70%, bronchiectasis in 20% and pleural effusion in 30% whereas in a study by Naseem Arshad et al.[11] HRCT findings in adults with pulmonary tuberculosis included centrilobular nodules in 92% cases, lobular consolidation in 84%, cavitations in 76%, 'tree-in-bud' appearance in 68% and lymphadenopathy in 8%.

Four cases aspergillomas had soft tissue within the cavitations with air crescent sign (monad sign) which showed change in position with respect to gravity. These findings were missed out in CXR. One patient of aspergilloma presented with bronchiectasis and one with miliary tuberculosis. In a study by Sangani et al[12] A crescent sign suggests intracavitary contents with a thin crescent of residual air. It is commonly seen in fungal infections as in an aspergilloma. They found air crescent sign in 12.5% of cases with cavitary lesions which were consistent with aspergilloma. In our study out of four patients two were presented with hemoptysis. This shows a significant association of hemoptysis in patients with aspergilloma which is consistent with study by Ding WY et.al[13].

In the present study, we have observed 17 total cases of ILD (on final diagnosis) of which all are detected on HRCT and all are missed on CXR. Of these cases, 4 cases had normal chest X ray. 9 cases had non-specific reticular opacities, 2 cases had non-specific opacities and 2 cases had bronchiectasis (Table 6). On HRCT the predominant patterns were septal thickening (100%), GGO (70%), honeycombing (41%), reticular opacities in 35% seen in the subpleural and basal distribution, bronchiectasis in 35%, fibrosis in 17.5% and emphysema in 5.8% of cases (Table 5). In our study 58.8% were females while 41.2% were males. In a study by Bhat, et. al[14] there were 44% male patients and 56% female patients which is consistent with the 41.2% of male and 58.8% female patients in our study. In their study only 21 patients out of 50 patients with ILD had findings in chest x-ray, rest 29 patients had normal chest x-ray. Most common findings in ILDs on HRCT in his study was septal thickening seen in 21 (42%) patients followed by bronchiectasis seen in 20 (40%) patients, ground glass haze was seen in 16 (32%) patients, and honeycombing was present in 10 (20%) cases. In our study also most common finding is septal thickening followed by GGO, honeycombing & reticular opacities. So in conclusion by Bhat, et. al[14] HRCT is a valuable technique for evaluating the extent of lung involvement in ILDs even when chest X-rays are normal.

CONCLUSION

Chest X rays are undoubtedly the most commonly done investigation for imaging. Chest radiography plays a non-dispensable role in the detection of pulmonary pathologies and as follow up for the response to treatment. High resolution computed tomography is a valuable tool and has high accuracy in defining the imaging features and characterization of the disease based on various patterns. It should be considered as investigation of choice in clinically suspected pulmonary infection, diffuse in filtrative lung diseases, chronic obstructive lung disease and small airway disease as it is non-invasive. It is helpful in initial management to reduce morbidity and mortality.

REFERENCES

1. Dyspnoea. Mechanisms, assessment, and management: a consensus statement. American Thoracic Society. Am J Respire C it C M d 1999 159 321 C it Care Med 1999; 159:321
2. Wahls SA. Causes and evaluation of chronic dyspnea Am Fam Physician.2012;

86(2):173-82.
3. Morgan WC1, Hodge HL Diagnostic evaluation of dyspnea. Am Fam Physician. 1998 Feb 15, pp. 57(4):711-6.
4. Gamsu G, Klein JS. HRCT of diffuse lung disease. Radiol 1989; 40: 550 -554.
5. Shiber JR, Santana J. Dyspnea. Med Clin North Am. 2006; 90(3):453-479.
6. Karnani NG1, Reisfield GM, Wilson GR. "Evaluation of chronic dyspnea." Am Fam Physician. 2005; 71(8): 1529-37.
7. American College of Radiology. ACR Appropriate- ness Criteria. Chronic dyspnea—suspected pulmonary origin. 2012.
8. Self WH, Courtney DM, McNaughton CD, Wunderink RG, Kline JA. High Discordance of Chest X-ray and CT for Detection of Pulmonary Opacities in ED Patients: Implications for Diagnosing Pneumonia. The American journal of emergency medicine. 2013; 31(2):401-405. doi:10.1016/j.ajem.2012.08.041.
9. Kang M, Deoghuria D, Varma S, Gupta D, Bhatia A, Khandelwal N. Role of HRCT in detection and characterization of pulmonary abnormalities in patients with febrile neutropenia. Lung India :Official Organ of Indian Chest Society. 2013;30(2):124-130.doi:10.4103/0970-2113.110420.
10. van der Bruggen-Bogaarts BA1, van der Bruggen HM, van Waes PF, Lammers JW. Screening for bronchiectasis. A comparative study between chest radiography and high-resolution CT Chest 1996 Mar; 109(3):608-11.
11. Arshad Naseem, Waseem Saeed and Shamrez Khan: High Resolution Computed Tomographic Patterns in Adults with Pulmonary Tuberculosis:J Coll Physicians Surg Pak. 2008; 18 (11):703-7.
12. Sangani, Shailesh G.; Suprabhat, S.B.; Grover, Seema V.; Wagh, Abhijeet A.; Dave, Krupa A.; Anantkaw. Spectrum of findings in pulmonary infections on CT / HRCT scan of the chest. Journal of Evolution of Medical and Dental Sciences 2014,18.
13. Ding WY, Chan T, Yadavilli RK, et al.Aspergilloma and massive haemoptysis.Case Reports 2014;2014:bcr2013200019. http://dx.doi.org/10.1136/bcr-2013-200019
14. Bhat IM, Bhat JA, Shamshad M, Malik AA, Mir S. Role of High-resolution Computed Tomography Chest in Interstitial Lung Diseases. Int J Sci Stud 2016;4(2):20-26.