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ORIGINAL RESEARCH

Comparative study of chest computed tomography and chest-x ray in pulmonary tuberculosis

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Abstract

Aims and objectives: 1) Comparison of the overall sensitivity of chest computed tomography andchest x-rayindetecting pulmonarytuberculosis among bacteriologically confirmed cases. 2) Comparison of the sensitivity of individual findings (i.elymphadenopathy and lung parenchymal abnormalities) on chest computed tomography andchest x-ray indetecting pulmonarytuberculosis among bacteriologically confirmed cases.

Material and methods: 100 patients with microbiologically confirmed pulmonary TBreferred to the Department of Radiodiagnosis and Imaging for chest x ray and chest CT scan were included in thestudy.

Results: Overall sensitivity of chest CT scan and chest X ray to detect pulmonary tuberculosis were 78% and 63% respectively and show significant difference. Chest CT scan detected pulmonary T.B. with overall lymphadenopathy, mediastinal lymphadenopathy, nodular opacities, collapse, pleural effusion/thickness and cavity/abscess better than chest X ray, however there was no significant difference between chest X ray and chest CT scan in detection of pulmonary T.B. with consolidation/G.G.O, hilar lymphadenopathy, bronchiectasis.

Conclusions: Chest X-ray was not as sensitive as Chest CT scan in detecting mediastinal lymphadenopathy, nodule/nodular infiltration, collapse, pleural effusion and cavity, so in a clinically relevant setting with a Chest X-ray negative for these findings Chest CT scan should be considered, but if these findings are depicted well in Chest X-ray, Chest CT scan may not add further clinically significant information over the Chest X-ray.

Keywords: Tuberculosis, ground glass opacity, computed tomography, Lymph nodes.

Introduction

Tuberculosis parallels the history of human development from the paleolithic age to the present. Tuberculosis continues to be in the top 10 causes of human mortality over that period.[1]

3 Stages of pulmonary tuberculosis are

(a) Primary infection/Primary pulmonary TB, (b) Latent infection, (c) Post primary TB.[2]

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Findings s/o Active TB are consolidation, thick-walled cavities, acinar/centrilobular nodules (bronchogenic spread), clustered nodules, miliary nodules, pleural effusion or empyema, rim-enhancing LNs and conglomeration of lymph nodes.
Findings s/o Healing TBare bronchovascular distortion, fibro-parenchymal lesions**,** calcified mediastinal LNs, emphysema**,** fibro-atelectatic bands, bronchiectasis, pleural thickening (with/without calcification), tuberculomas and thin-walled cavities.

Diagnosis of tuberculosis

a) Mycobacteriology - Sputum examination, sputum culture and AFB smear.[3,4]
b) Imaging- Chest X ray, Chest CT scan, USG, MRI, PET-CT scan[5].
c) Culture media- LJ media, Middle brook7H10, 7H11, BACTEC.

Imaging modalities in pulmonary tuberculosis

a) Chest X ray –CXR (PA)view is frequently used as the first investigation to evaluate unexplained cough.
b) USG - Ultrasound is very useful investigation for pleural effusion detection.
c) CT Chest - Multi-detector CT (MDCT) is an important tool in the detection of radiographically occult disease, differential diagnosis of parenchymal lesions, evaluation of mediastinal lymph nodes (LNs), assessing disease activity, and evaluating complications. It not only enables earlier and more accurate diagnosis of pulmonary lesions, but also can be used to differentiate the etiologies of pneumonia.[6]

Material and methods

A prospective study was conducted on 100 patients with microbiologically confirmed pulmonary TB at Department of Radiodiagnosis and Imaging, government medical college Amritsar for duration of 2 years.

Imaging technique

- CT scan 64 slice Philips machine. CT windows to be used will be lung and mediastinal for all pulmonary tuberculosispatient.
- Samsung X ray diagnostic system, model GU60A-65.Chest X ray PA view will be used for pulmonary tuberculosis patient.

In present study as all of the patients are bacteriologically/confirmatory positive for pulmonary TB, so no comments can be made regarding the specificity of Chest X ray and Chest CT scan in detecting pulmonary TB and only sensitivity of both scans will be compared. McNemar's test will be used to compare the overall sensitivity and sensitivity of individual finding to detect pulmonary TB on Chest X ray and Chest CT scan on same group of patients.

Result and discussion

In our study out of 100 study cases Chest CT Scan was able to detect pulmonary TB in 78 cases, while it was negative in 22 cases and Chest X ray was able to detect pulmonary TB in 63 cases, while it was negative in 37 cases. McNemar's Chi square value and p-value for detection of pulmonary tuberculosis on Chest X ray and Chest CT Scan was 15 and 0.0001.
Chest CT scan most common findings– In our study most common Chest CT scan findings were consolidation (57 cases) > nodules (53 cases), lymphadenopathy (53 cases) > pleural effusion/thickness (30 cases) > cavity/abscess (29 cases) > fibrosis (19 cases) > bronchiectasis (18 cases) > cicatricial volume loss (14 cases) > collapse (10 cases).
Chest x ray most common findings– In our study most common Chest X ray findings were consolidation (54 cases) > lymphadenopathy (17 cases) > bronchiectasis (16 cases) >

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cicatricial volume loss (13 cases) > cavity/abscess (13 cases) > nodules (12 cases), pleural effusion/thickness (12 cases) > fibrosis (4 cases) > collapse (2 cases).

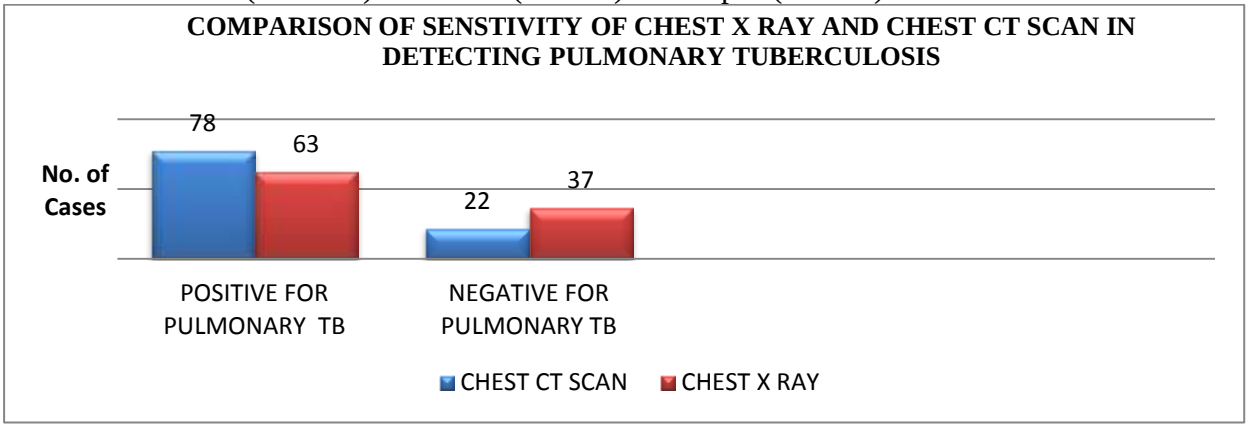

Table I- Sensitivity of individual findings OF CHEST x ray and ct scan to detect pulmonary TB among bacteriologically confirmed cases (Total number of pulmonary TB cases= 100)

Sr. no.	Finding on Chest X ray and Chest CT Scan	Overall Sensitivity/Individual finding sensitivity of Chest X ray to detect pulmonary tuberculosis	Overall Sensitivity/Individual finding sensitivity of Chest CT Scan to detect pulmonary tuberculosis
1.	Overall Sensitivity of Chest X ray/CT scan	63%	78%
2.	Overall lymphadenopathy	17%	53%
3.	Hilar lymphadenopathy	14%	15%
4.	Mediastinal lymphadenopathy	02%	18%
5.	Both(Hilar and mediastinal) lymphadenopathy	01%	20%
6.	Consolidation/GGO	54%	57%
7.	Upper/middle zone consolidation	46%	48%
8.	Lower zone consolidation	05%	06%
9.	Whole lung consolidation	03%	03%
10.	Nodular opacity	12%	53%
11.	Bronchiectasis	16%	18%
12.	Collapse	02%	10%
13.	Cavity/Abscess	13%	29%
14.	Pleural effusion/thickness	12%	30%

Table II-Findings with p-value <0.05 (Statistically significant)

Sr. no.	Finding of Pulmonary tuberculosis on Chest X Ray and Chest CT Scan	p-value
1.	Chest X ray/CT scan Positive for pulmonary TB	0.0001
2.	Overall lymphadenopathy	<0.00001
3.	Mediastinal lymphadenopathy	0.00006
4.	Both(Hilar and mediastinal) lymphadenopathy	0.000013
5.	Nodular opacity	<0.00001

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6.	Collapse	0.004
7.	Pleural effusion/thickness	0.00002
8.	Cavity/Abscess	0.00006

Table III- Findings with p-value >0.05 (Statistically not significant)

Sr no.	Finding of Pulmonary tuberculosis on Chest X Ray and Chest CT Scan	p-value
1.	Hilar lymphadenopathy	0.31
2.	Consolidation/GGO	0.08
3.	Upper/middle zone consolidation	0.15
4.	Lower zone consolidation	0.31
5.	Whole lung consolidation	01
6.	Bronchiectasis	0.15

Discussion

In present study, we observed that pulmonary tuberculosis was slightly more common in male than female. This study included 61 male and 39 female with F/M sex ratio of 0.63. This was consistent with study conducted by Borgdorff M.W. et al.[7]

Majority of patient in the present study presented with complaint of cough with sputum and fever. In addition to these complaints patient also presented with complaint of breathlessness, night sweats, chest pain, weight loss, hemoptysis and other manifestations like vomit, pallor, edema, diarrhea etc. This was in correlation with findings of study conducted by Nagwaali et al on pulmonary TB patients. In their study it was reported that most common complaints among pulmonary TB patients is cough with sputum, fever followed by chest pain, breathlessness, night sweats and weight loss.[8]

Overall sensitivity of chest x ray and chest CT scan- Overall sensitivity of Chest X ray to detect pulmonary TB was 63% and overall sensitivity of Chest CT scan to detect pulmonary TB was 78% with p-value of 0.0001(significant).

This was consistent with study conducted by Bolursaz MR et al. In their study it was reported that Chest X ray was positive in 63.2% and Chest CT scan was positive in 79% of patient along with p-value of less than 0.05 for these two scans.[9]

Lymphadenopathy (mediastinal/ hilar/both)–Sensitivity of lymphadenopathy on Chest X ray to detect pulmonary TB was 17% and Sensitivity of lymphadenopathy on Chest CT scan to detect pulmonary TB was 53% with p-value of<0.00001 (significant).

Similar results were also reported by studies conducted by Marcia seiscento et al,[10] E. kadakovska et al,[11]Nooshinbaghaie et al[12].

Hilar lymphadenopathy– Sensitivity of hilar lymphadenopathy on Chest X ray to detect pulmonary TB was 14% and Sensitivity of hilar lymphadenopathy on Chest CT scan to detect pulmonary TB was 15% with p-value of 0.31.

Chiranjibi pant et al conducted study on clinically diagnosed pulmonary tuberculosis cases and they found that both Chest X ray and CT scan were able to detect hilar lymphadenopathy in 4.8% of cases.[13]

Mediastinal lymphadenopathy– Sensitivity of mediastinal lymphadenopathy on Chest X ray to detect pulmonary TB was 02% and Sensitivity of mediastinal lymphadenopathy on Chest CT scan to detect pulmonary TB was 18% with p-value of 0.00006 (significant).

Studies conducted by Salil Mehta et al,[14] GH swingler et al[15] also reported that Chest CT scan was more sensitive to detect pulmonary TB with mediastinal lymphadenopathy than Chest X ray.

Nodules/tuberculomas– Sensitivity of nodules/tuberculomas on Chest X ray to detect pulmonary TB was 12% and Sensitivity of nodules/tuberculomas on Chest CT scan to detect

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pulmonary TB was 53% with p value of<0.00001 (significant).
In a study conducted by YW Oh et al on role of Chest CT in detection of nodules, they found that Chest CT was able to detect small nodules throughout the lung parenchyma in all patients, while Chest X ray was not able to find nodules in these cases.[16]
Consolidation– Sensitivity of consolidation on Chest X ray to detect pulmonary TB was 54% and Sensitivity of consolidation on Chest CT scan to detect pulmonary TB was 57% with p value of 0.083.
In this study, it was also observed that in pulmonary tuberculosis upper/middle zone consolidations are more common than lower zone consolidations and consolidations involving whole lung.
M.R. boloursaz et al study also reported that pulmonary tuberculosis was more commonly seen in upper/middle zone in their study.[17]Chiranjibi pant et al also find in their study that CT scan and Chest X ray had no significant difference in detection of consolidation in pulmonary TB.[13]
Bronchiectasis– Sensitivity of bronchiectasis on Chest X ray to detect pulmonary TB was 16% and Sensitivity of bronchiectasis on Chest CT scan to detect pulmonary TB was 18% with p value of 0.15. In this study, it was also observed that pulmonary tuberculosis bronchiectasis was most commonly seen in upper lobes than lower lobes, middle lobes and lingular segments.
Similar results were also reported by study conducted by Nooshinbaghaie et al.[12]
Collapse– Sensitivity of collapse on Chest X ray to detect pulmonary TB was 02% and Sensitivity of collapse on Chest CT scan to detect pulmonary TB was 10% with p value of 0.004(significant).
Results of present study is consistent with study conducted by Mohammad rezabolursaz et al, who reported that Chest CT scan detected pulmonary TB with collapse better than Chest X ray with p value of less than 0.004.[9]
Cavity/Abscess– Sensitivity of cavity/abscess on Chest X ray to detect pulmonary TB was 08% and Sensitivity of cavity/abscess on Chest CT scan to detect pulmonary TB was 32%with p value of <0.00001(significant).
Results of present study was consistent with study conducted by E.kadakovska et al[11] and Nooshinbaghaie et al.[12]
Pleural Effusion/Thickness– Sensitivity of pleural effusion/thickness on Chest X ray to detect pulmonary TB was 12% and Sensitivity of pleural effusion/thickness on Chest CT scan to detect pulmonary TB was 30%with p value was 0.00002(significant).
In a study conducted by AydanurMihmanli et al on pulmonary TB patients, it was reported that Chest X ray, Chest CT scan was positive for pleural effusion was 14%, 36% respectively.[18]

Case
A 35 year old male presented with cough, expectoration and hemoptysis. Loss of appetite and loss of weight were also present. Sputum for AFB was positive.

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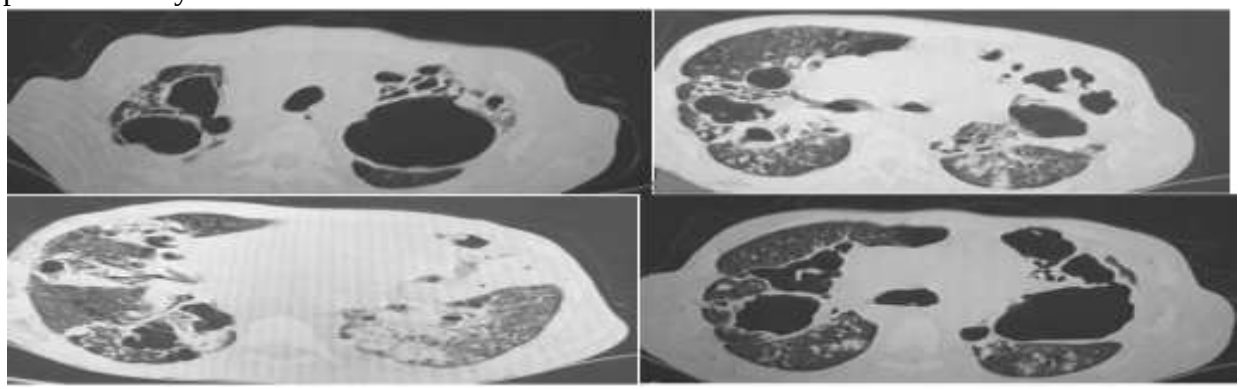
Chest X ray showing- Multiple cavitatory lesions were seen in bilateral lung field, predominantly in upper lobes with surrounding fibrotic bands.Bronchiectatic changes were seen in bilateral lung field.Small consolidative opacities were also seen in bilateral lung field predominantly in lower lobes.



Chest CT scan shows

- Multiple fibro-bronchiectatic changes in form of tubular, varicose and cystic bronchiectasis were seen in bilateral lung field along with peribronchial cuffing.
- Multiple fibro-cavitatory lesions were seen in bilateral lung field, predominantly in bilateral upper lobes, largest of the cavity seen in left upper lobe.
- Multiple tree in bud opacities were seen in bilateral lung field and these opacities are coalescing to form few patches of consolidation in bilateral lower lobes.

Conclusion and summary

- It was observed that chest X-ray detected lymphadenopathies predominantly in hilar region. However, there was no significant difference for hilar lymphadenopathy detection between Chest CT and Chest X-ray (p-value was 0.31). It was also observed in our study that Chest CT scan was significantly better than Chest X ray in detecting mediastinal lymph node enlargement (p-value was 0.00006), this was due to mediastinal lymph node superimposition over the sternum.
- Collapse (p value was 0.004), nodular opacity (p value was<0.00001), pleural effusion/thickness (p value was 0.00002), cavity/abscess (p value was 0.00006) are other findings which Chest CT scan detected significantly better than Chest X ray in this study. In this study it was also observed that cavity/abscess were more commonly seen in bilateral upper lobes than bilateral lower lobes, right middle lobe and left lingular segments.
- While Sensitivity of detection consolidation/ground glass opacity (p value was 0.083) was not significantly different between these two modalities.
- For bronchiectasis Sensitivity was not markedly different between these two scans (p value was 0.15).
- At last we can conclude that Chest X-ray was not as sensitive as Chest CT scan in detecting mediastinal lymphadenopathy, nodule/nodular infiltration, collapse, pleural effusion, fibrosis and cavity, so in a clinically relevant setting with a Chest X-ray negative for these findings, Chest CT scan should be considered. Also early investigation of patient of tuberculosis by Chest X-ray was still of great value and can obviate the need for Chest CT scan and hence protect patient from excessive radiation in many cases.

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