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ORIGINAL ARTICLE

The Role of High Resolution Computed Tomography in the Diagnosis of Suspected Sputum Smear Negative Active Pulmonary TB

GULRAIZ HIKMATYAR[1], SAJAN LAL[2], BHESHAM KUMAR[3], MUHAMMAD ALI[4], RAFAY GUL[5], KIRAN KHURSHID[6]
[1](MBBS, Resident Radiology), Dr. Ziauddin University Hospital, Karachi, Pakistan.
[2](MBBS, FCPS, EDIR), Assistant professor Radiology, Dr. Ziauddin University Hospital, Karachi, Pakistan.
[3](MBBS, FCPS, EDIR), Assistant Professor Radiology, Dr. Ziauddin University Hospital, Karachi, Pakistan.
[4](FCPS, EDiR, Fellowship in VIR), Professor and head Radiology, Dr. Ziauddin University Hospital, Karachi, Pakistan.
[5](MBBS, FCPS, VIR fellow), Dr. Ziauddin University Hospital, Karachi, Pakistan.
[6](MBBS, Resident Radiology), Dr. Ziauddin University Hospital, Karachi, Pakistan.
Correspondence to: Dr. Gulraiz Hikmatyar, Email ID; dr.gulraiz.khanzada@gmail.com, Mobile No; +92 300 8375118

ABSTRACT

Objective: To evaluate the diagnostic accuracy of high resolution CT (HrCT) for confirmatory evaluation of patients having active pulmonary TB (PTB) taking Acid-fast bacillus (AFB) culture reporting as standard parameter.

Methods: In this cross-sectional (validation) analysis we included 200 patients having chest X-rays and clinical evidence of active TB and sputum smear (SS) –ve results. These patients were recruited from March-2019 to December-2019. Data of patients regarding baseline hematology investigations, sputum smear findings, and presenting symptoms was obtained. Sputum samples were obtained again for each patients, and sent for AFB culture reporting. The HrCT was performed in the radiology unit using a 64 slices CT machine.

Results: The mean age of included patients was 53.61 ± 11.96 years. There 81 (40.5%) female and 119 (59.5%) male patients. The proportion of true positive (TP) cases was 79 (39.5%), true negative cases was 96 (48.0%), false positive (FP) cases 11 (5.5%) and false negative (FN) was 14 (7.0%). The HrCT was found to have sensitivity of 84.9%, specificity 89.7%, PPV 87.8% and NPV 87.3%.

Conclusion: HrCT is a reliable imaging method for accurately diagnosis the active Pul. TB with a good sensitivity and specificity. In our view, HrCT can be used as a firstline imaging evaluation test for diagnosing pul. TB in suspected patients.

Keywords: Pulmonary TB, Microbial culture, high resolution CT.

INTRODUCTION

Tuberculosis (TB) is one of the highly deadly infectious diseases caused by mycobacterium tuberculosis worldwide. In 2016, it About 9.02 million individuals globally and caused 1.2 million deaths.[1] TB has surpassed the human immunodeficiency virus (HIV) as a single cause of death due to infectious diseases.[2] TB is a pandemic in developing countries with 95% cases and 98% of TB related deaths occurring only in these regions such as Africa, Asia and South America.[3] More than 40% of Asian population is affected by TB at some stages of life.[4]

AFB sputum microbiological culture is the gold standard for the diagnosis of active TB. It has high accuracy, but has prolonged waiting time of 6 to 7 days and efficacy is sometimes limited by contamination of culture medium.[5] Delay in TB diagnosis puts significant burden on health care resources and increases the risk of spread of infection from affected individuals. This delay in diagnosis can be due to clinical and radiological reasons as TB patients present with symptoms mimicking other diseases such as interstitial lung disease, pneumonia or malignancy.[6] Therefore, early diagnosis and management of active TB is a key factor for controlling TB. The early and readily available modality for PTB is X-rays. Typical findings of PTB on X-rays are; consolidation, inflamed lymph nodes, miliary nodules or pleural effusion. Some of these features are also present in post-infected TB patients. Therefore, X-rays also have a limited yield in diagnosis of TB.[7] Recently, some studies have reported the utility of high resolution CT (HrCT) for diagnosis of active TB in suspected patients.[8, 9] In this study, we evaluated the diagnostic accuracy of HrCT for confirmatory evaluation of patients having active PTB taking AFB culture reporting as standard parameter.

METHODS

In this cross-sectional (validation) analysis we included 200 patients having chest X-rays and clinical evidence of active TB and were SS -ve. Patients who were presently taking anti-tuberculosis drugs, or who took anti-TB treatment ever in life were excluded. These patients were recruited from March-2019 to December-2019. Data of patients regarding baseline hematology investigations, sputum smear findings, and presenting symptoms was obtained. All patients signed a written consent for study participation, and approval of IRB of hospital was also gained.

After inclusion, sputum samples were obtained again for each patients, and sent for AFB culture reporting, Löwenstein-Jensen (LJ) medium was used for culture growth, the test was positive if significant mycobacterial growth was seen on culture media.

The HrCT was performed in the radiology unit using a 64 slices CT machine (brand name), the CT images were evaluated for TB; presence of consolidation, tree shaped nodules, cetri-lobular nodules, lymph adenopathy, consolidations, and pleural effusion as confirmatory signs of TB.

Data was tabulated in SPSS v25. We calculated specificity, sensitivity, negative predictive value (NPV) and positive predictive value (PPV) for determining the diagnostic accuracy by using SPSS generated 2×2 table.

RESULTS

The mean age of included patients was 53.61 ± 11.96 years. There 81 (40.5%) female and 119 (59.5%) male patients. On AFB microbiology reporting, positive results were achieved in 90 (45%) patients, while remaining 110 (55%) were negative on AFB reporting. HrCT findings were positive for active TB in 93 (46.5%) patients and were negative in 107 (53.5%) patients [Table 1].

The proportion of true positive (TP) cases was 79 (39.5%), true negative cases was 96 (48.0%), false positive (FP) cases 11 (5.5%) and false negative (FN) was 14 (7.0%). The HrCT was found to have sensitivity of 84.9%, specificity 89.7%, PPV 87.8% and NPV 87.3% (Table 2).

Table 1. Study Variables.

Age	53.61 ± 11.96
Gender	
Female	81 (40.5%)
Male	119 (59.5%)
AFB Microbial Culture Diagnosis	
Negative	110 (55%)
Positive	90 (45%)
HrCT Diagnosis	
Yes	107 (53.5%)
No	93 (46.5%)

Table 2. Accuracy of HRCT Chest Taking AFB Culture Findings As Gold Standard.

TB on HrCT	TB on AFB Microbiology Culture		Total
	Yes	No	
Yes	79 (39.5%)	11 (5.5%)	90 (45.0%)
No	14 (7.0%)	96 (48.0%)	110 (55.0%)
Total	93 (46.5%)	107 (53.5%)	200 (100%)
Sensitivity = 84.9%			
Specificity = 89.7%			
Positive predictive value (PPV)=87.8%			
Negative predictive value (NPV)=87.3%			

DISCUSSION

Pakistan is among the top 30 high TB burden nations. These nations account for 87% of total TB worldwide burden.[10, 11] In Pakistan the reported TB prevalence is 5.0%. In Pakistan the National TB control program (NTP) has been developed in collaboration of govt. of Pak and WHO for TB control.[12] This program provides screening to suspected persons such as X-rays, and sputum microscopy. The aim of NTP is to reduce TB prevalence in Pakistan by 2025. For this purpose, Pakistan has developed a local level network including the basic health units and private clinics that provide basic screening of TB patients.[11, 13]

TB not only involves the lungs but can involve any human organ, however the lungs are the commonest one. The first-line investigation in suspected clinical and X-rays based patients is sputum smear. This test takes some days for final report to be produced and has low accuracy.[14] Similarly, the sputum microbial culture reporting though is the gold standard with high accuracy but also is limited because of prolonged waiting results. The only way of instantly diagnosing TB are radiological investigation. Therefore, in this study, we used HrCT for diagnosis of PTB and determined its correlation with culture findings.[14]

The preliminary reports of HrCT utility in diagnosing PTB have reported promising accuracy and have reported HrCT to be useful for diagnosis of PTB and the normal HrCT findings are helpful in excluding the possibility of TB.[15]

In our study, the sensitivity of HrCT was 84.9% and that of specificity was 89.7%. Rasheed et al. in a study from Karachi, Pakistan including 108 patients, reported HrCT sensitivity of 89.09% (87.50% for SS +Ve and 81.67% for SS -ve), specificity of 79.25% (88.57% for SS +ve and 90.0% for SS -ve) patients, with PPV of 81.67% (93.94% for SS +ve and 66.67% for SS -ve), and NPV of 87.50% (73.33% for SS +ve and 93.94% for SS –ve patients).[16]

A study from Turkey by Tozkoparan et al. involving 85 patients of SS –ve TB on utility of CT for diagnosis of active TB reported HrCT is 88% sensitive and 88% specific for active TB determination.[17] A study from India by Raghuvanshi et al. on 69 patients reported 82.9% sensitivity and 96.4% specificity of HrCT. The authors further elaborated that accuracy of HrCT aslo depends on patients positioning with sensitivity varying from 53.6% to 100% and specificity 35.7% to 100%.[14]

Ye et al. in a study from Taiwan including 180 patients, reported 90.9% sensitivity and 96.4% specificity of HrCT.

These slight differences in HrCT accuracy in different reported many be attributed because of differences in epidemiology, age at presentation, risk factors profile and resolution used for CT scanning. The other possible reasons may be the interpreting radiologist experience and parameters studied for TB diagnosis.

This study is limited by relatively small population proportion and because it was conducted in a high volume center having a huge burden on radiology department. Moreover, reports were reviewed by different radiologists for TB diagnosis that may create operator biasedness. There is still need to conduct larger studies after controlling all bias variables so that the HrCT accuracy in active TB patients can be established more accurately.

CONCLUSION

HrCT is a reliable imaging method for accurately diagnosis the active PTB with a good sensitivity and specificity. In our view, HrCT can be used as a firstline imaging evaluation test for diagnosing PTB in suspected patients.

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