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To Compare the Diagnostic Efficacy of HRCT Lung with Chest Radiographic Findings and Clinical Correlation with Microbiological Findings in 200 Patients.

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ABSTRACT

Background: The radiological diagnosis of tuberculosis is regarded as the most sensitive screening tool. The current study is undertaken to evaluate the chest X-ray and HRCT Chest as the tools to evaluate the active tubercular lesions in symptomatic and sputum positive patients. Aims and Objectives: The purposes of this study was to compare the diagnostic efficacy of radiographic and HRCT findings of pulmonary tuberculosis and to determine the radiologic features frequently seen in this disease. As complications of tuberculosis are frequent, correct diagnosis of tuberculosis is important. The purposes of this study is to summarize radiographic and CT findings of pulmonary tuberculosis. **Methods:** All Suspected patients referred for chest x ray and HRCT in radio diagnosis dept JNIMS were included in the study. **Results:** On chest radiography air-space consolidation was the most common parenchymal lesion, occurring in 160 patients (80%). Nodular lesions were found in 56 patients (28%), and, among them, ipsilateral or contralateral air-space consolidation was seen in 44 patients (22%).**Conclusion:** Since Diagnostic efficacy of HRCT is 91 %. Diagnostic efficacy of Chest X-Ray is 70.5 %. So diagnostic efficacy of HRCT is more than the Chest X-Ray.

Keywords: Tuberculosis, Chest X Rays, HRCT.

INTRODUCTION

Tuberculosis (TB) is a common and often fatal infectious disease caused by various strains of mycobacteria, usually mycobacterium tuberculosis (MTB) in humans.[1] World Health Organization (WHO) estimates that one-third of the world's population is infected with MTB, with the highest prevalence being in Asia.[2] The lifetime risk of developing the disease after infection is 43% in infants, 24% in children between 1 to 5 years and 15% in adolescents, compared to immuno-competent adults who have a lifetime risk of 5% to 10%.[3] Younger children also experience more severe disease like neuro-tuberculosis or disseminated disease.[4] In India nearly 3-4 million children have tuberculosis and another 94 million are at risk for this disease. The annual infection rate is about 3%.[5,6]

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Difficulty in establishing a definitive diagnosis, the presence of extra-pulmonary disease and lower public health priority are a few of the challenges to estimate the burden of TB in children. Frequent radiological findings of TB in children are hilar and mediastinal lymphadenopathy with central necrosis and airspace consolidations. Chest radiographs provide important information, but computed Tomography (CT) has advantages over it in diagnosing TB in patients and can detect the disease in patients whose chest radiographs are inconclusive or complications of TB are suspected.[7] HRCT may identify indicators of active disease not seen on chest radiograph.[8-10]

MATERIALS AND METHODS

Source of data-All Suspected patients referred for chest x ray and HRCT in radio diagnosis dept JNIMS.
Age-All ages for a period of 1 year (Aug 2015-July 2016)
Inclusion criteria -Both female and male patients of all age.
Exclusion criteria -Very Sick Patients.
The study was done in JNIMS, Dept. of radio-diagnosis, Imphal.

Sample Size:
It's a 1 year study of approximately 200 cases. The total number of subjects will be those referred to Department of Radio diagnosis, JNIMS.
Toshiba CT Scanner -Toshiba aquilion 64 sliced.

Ultrasound- Toshiba Colour Doppler ultrasound Machine.

RESULTS

On chest radiography air-space consolidation was the most common parenchymal lesion, occurring in 160 patients (80%). Nodular lesions were found in 56 patients (28%), and, among them, ipsilateral or contralateral air-space consolidation was seen in 44 patients (22%). Disseminated nodules were found in 48 patients (24%). Cavitations within parenchymal lesions were noted in 42 patients (21%). Mediastinal bulging, suggesting mediastinal or hilar lymphadenopathy was seen in 144 patients (72%), but discerning the difference between a pulmonary parenchymal lesion near the hilum and lymphadenopathy was difficult on chest radiographs in many cases. Hyperinflation of the lung (n= 64, 32%), bronchial narrowing (n = 32, 16%), and atelectasis (n= 32, 16%) were also frequent findings. We found pleural effusion in 38 patients (19%) and lastly parenchymal calcifications in 10 pts (5%).

On chest CT scans air-space consolidation was seen in all 180 patients (90). Mass like consolidation was seen in 42 patients (21%). The multifocal low-attenuation areas within the consolidation were seen in 82 patients (41%). Cavities within the consolidation were observed in 58 patients (29%). Disseminated pulmonary nodules were revealed in 10 patients (5%). In three of them, disseminated nodules were larger (> 2 mm in diameter) than the usual miliary nodules of adult tuberculosis and coalesced with each other. In one patient, cavities were seen within disseminated nodules. Bronchogenic nodules were found in 82 patients (41%). In all three patients who had high-resolution CT, centrilobular nodules or branching linear structures suggesting bronchogenic spread of tuberculosis were seen in 100 patients (50%). Mediastinal and hilar lymphadenopathies were observed in all 160 patients (100%). On enhanced CT, involved lymph nodes showed central low attenuation and peripheral enhancement in all patients. The right paratracheal and subcarinal nodes were the most frequently involved. Lymphadenopathies of right hilar nodes were seen in 59%, left paratracheal nodes were found in 53%, and left hilar nodes were found in 41%. In 12% of the patients show calcifications within the enlarged nodes. Airway complications were also frequent findings on CT scans. Bronchial narrowing was seen in 120 patients (60%) who had adjacent peribronchial lymphadenopathy. Hyperinflation of the lung with mediastinal lymphadenopathy was seen in 38 patients (19%). Bronchiectasis was found in 8 patient (4%). Pleural effusions associated with air-space consolidation were seen in 10 patients (5%), and it was bilateral in one of them. Pleural effusion was loculated in one patient. Pericardial thickening was detected in 4 patients (2%).

Table 1: Total number of pts.

Sex	Total	Percentage
Male	109	54.5%
Female	91	45.5%
Total	200	

Table 2: Chest Radiograph Findings.

X ray Diagnosis	No of cases	Percentage
Air-space consolidation	160	80%
Nodular lesions with ipsilateral or contralateral air-space consolidation	44	22%
Nodular lesions	56	28%
Disseminated nodules	48	24%
Cavitations within parenchymal lesions	42	21%
Mediastinal or hilar lymphadenopathy with normal X-ray.	144	72%
Hyperinflation of the lung	64	32 %
Bronchial narrowing	32	16%
Atelectasis	32	16%
Pleural effusion	38	19%
Parenchymal cacification	10	5%
Normal chest x ray with non significant mediastinal bulging	1	0.5%
Miliary spread.	2	1%

Table 3: HRCT Findings.

HRCT Diagnosis	No of cases	Percentage
Air-space consolidation	180	90%
Mass like consolidation	42	21%
Focal low attenuation areas	82	41%
Bronchogenic nodule	82	41%
Cavitary lesion with parenchymal lesions	58	29%
Pulmonary nodules	10	5%
Centrilobular nodules Tree in bud appearance	100	50 %
Bronchial narrowing	120	60%
Mediastinal nodes	160	80%
Hyperinflation of lung	38	19%
Pleural effusion with consolidation	10	5%
Pericardial thickening with parenchymal consolidation	8	4%
Miliary spread.	2	1%

Table 4: Assessment of diagnostic efficacy of HRCT and Chest X-Ray with the Microbiological findings.

Screening test	Matched diagnosis		Unmatched diagnosis	
	No. of patients	Percentage	No. of patients	Percentage
HRCT	182	91%	18	9%
Chest X-Ray	141	70.5%	59	29.5%
Total no. of patients	200		200	

Since all the persons included in the study are having Pulmonary Tuberculosis with positive sputum test, so to compare the efficacy of the HRCT and Chest radiograph, the agreement of diagnosis made by these two screening tests with microbiological examinations are shown as in the above table.
Diagnostic efficacy of HRCT is 91 %.
Diagnostic efficacy of CHEST X RAY is 70.5 %.
So diagnostic efficacy of HRCT is more Chest X-Ray.

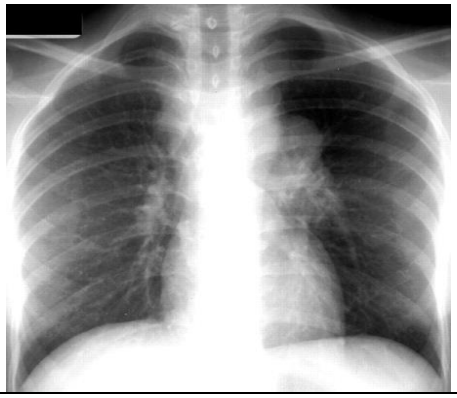

Figure 1a: Lymphadenopathy in a patient with primary tuberculosis. Chest radiograph shows a bulky left hilum and a right paratracheal mass.

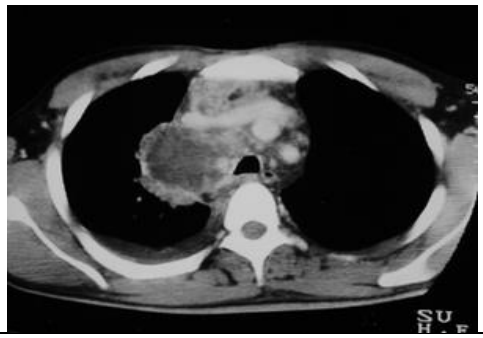

Figure 1b: showing HRCT axial image of a large necrotic node in right paratrachial region, findings that are consistent with lymphadenopathy and are typical in paediatric patients.

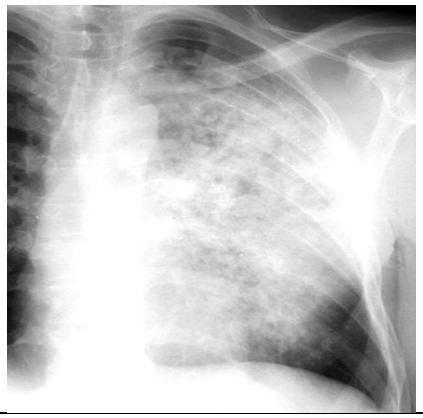

Figure 2a: Parenchymal primary tuberculosis in an adult. Radiograph of the left lung demonstrates extensive upper lobe and lingular consolidation.

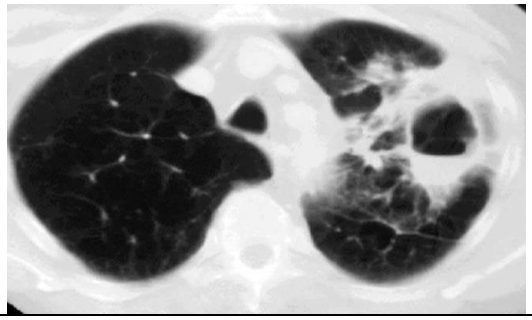

Figure 2b: High-resolution CT scan showing the typical apical cavitation in the same patients.

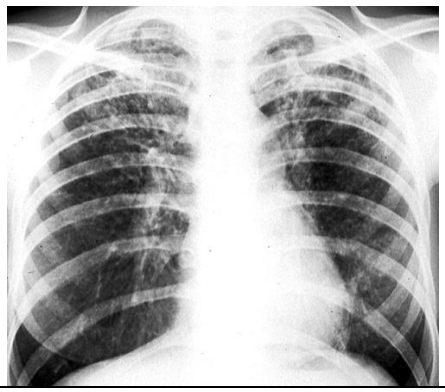

Figure 3a: Chest radiograph demonstrates the characteristic bilateral upper lobe consolidation associated with post primary tuberculosis.

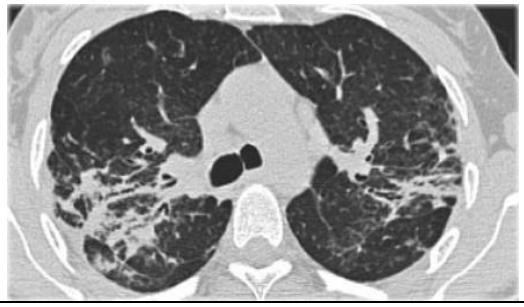

Figure 3b: Showing HRCT of same patient with fibroparenchymal lesions bilaterally and a precarienal node.

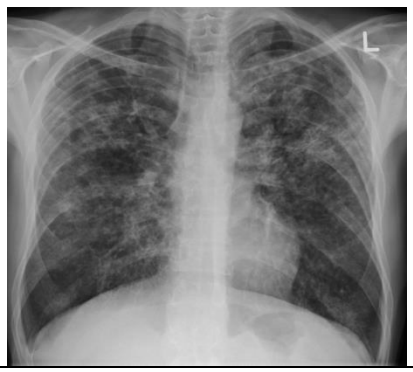

Figure 4a: Showing HRCT of same patient with fibroparenchymal lesions bilaterally and a precarienal node.

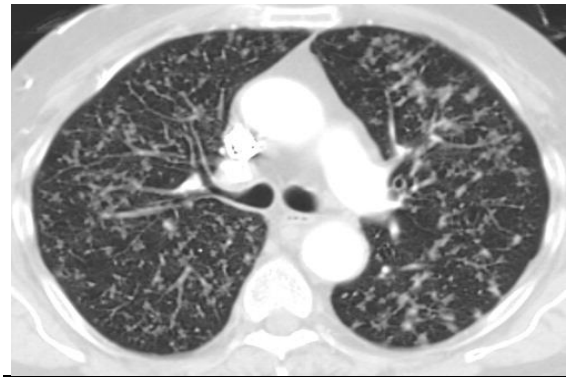

Figure 4b: Showing multiple small pulmonary lesions in bilateral lung fields.

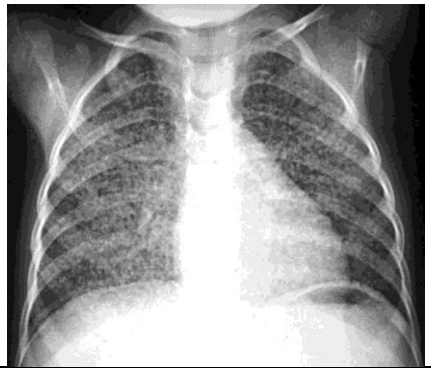

Figure 5a: Chest radiograph showing miliary nodules, which are uniform in size and uniformly distributed.

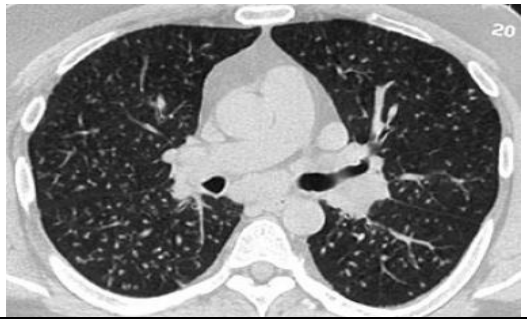

Figure 5b: Showing HRCT of the same patient with multiple small nodules in a case of Miliary tuberculosis.

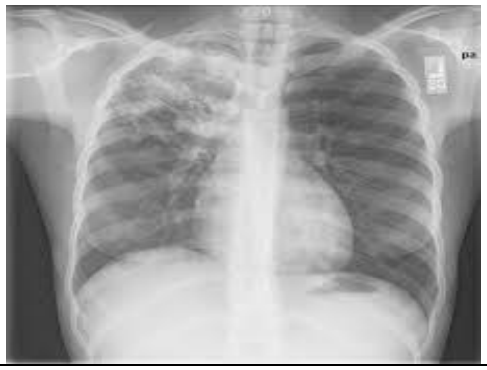

Figure 6a: Chest X-ray of a 32 years male showing consolidation in right upper zone.

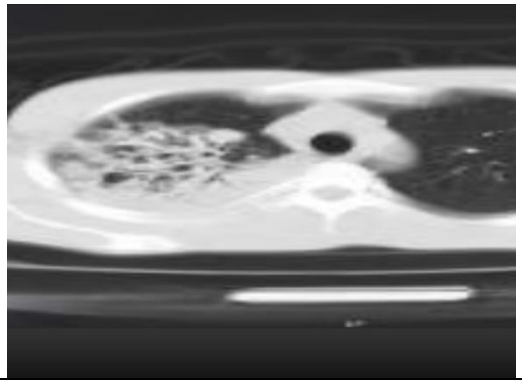

Figure 6b: Showing HRCT of same patient showing consolidation with air bronchogram in right upper lobe segments.

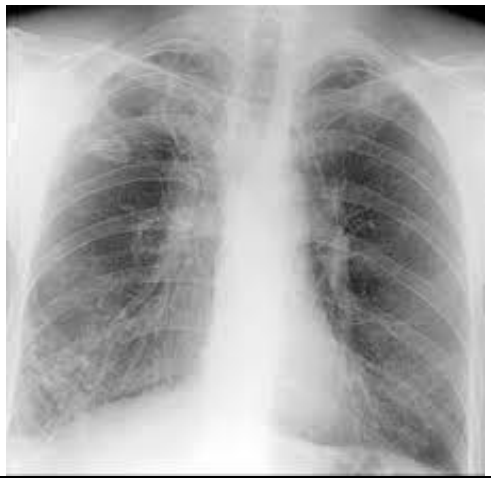

Figure 7a: Chest radiograph showing bilateral upper zone and right lower zone consolidation with a cavitory lesion on right upper zone.

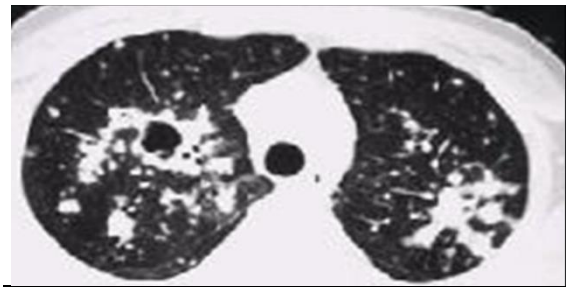

Figure 7b: Showing HRCT image with a cavitory lesion and multiple conglomerated acinar nodules on right upper lobe and on left upper lobe with patchy areas of consolidations.

DISCUSSION

Most pulmonary TB cases seen in infants are due to primary infection. It begins when the respiratory secretion from a patient with TB is inhaled and reaches the lung alveoli, which then causes parenchymal inflammation. This primary focus of TB is usually not visible on chest X-ray but may progress to involve a segment or an entire lobe.[11,12]

Infection then spreads to the central lymph nodes from the primary focus via draining lymphatic vessels (appearing as a linear interstitial pattern on chest radiographs) and results in regional lymphadenopathy. In most cases, these parenchymal lesions and the accompanying lymphadenopathy resolve spontaneously.[13] In some cases, especially in young infants, the involved lymph nodes continue to enlarge. Some studies report that mediastinal lymphadenopathy with or without parenchymal abnormality is a hallmark of primary tuberculosis in childhood.[11,12] Computed tomography was performed by Delacourt et al (1993) in 15 children with tuberculous infection and a normal chest radiograph to measure the size of their mediastinal lymph nodes. Ten control children without tuberculosis were also evaluated. When compared with controls it was found that nine of 15 (60%) infected children had enlarged lymph nodes.[14] Thus, it appears that many infected children with normal chest radiography have unrecognized active disease. In a study by Khalilzadeh et al in 2003 in 20% of children, bacteriological studies of gastric fluid or sputum were positive and in 46% children, radiological findings were positive. Chest x-ray was helpful in only 5% of cases and in 41% of children pulmonary CT along with simple chest x-ray showed positive results of tuberculosis involvement.[15] In the present study CT scan proved to be more accurate in detecting post-primary tuberculosis such as cavitation, bronchial wall thickening, collapse, centrilobular nodules, vertebral access and tree-in-bud appearance as compared to chest X-ray. Similarly, in a study by Karam et al (2002) cavitation was seen in chest radiography in 40% to 87% patients. The most common complication of tuberculous cavitation is endobronchial spread which was detected radiographically in 19% to 58% and by CT in up to 98% of cases.[16]

Though CT chest is a better diagnostic imaging technique as compared to X-ray chest, the ionizing radiation doses delivered by CT are higher than convention radiography and are in ranges that have been linked to an increased risk of cancer. The projected lifetime attributable risks of solid cancer were higher for younger patients, girls and for patients who underwent CT scans for abdomen/pelvis. Estimates show that 4,870 future cancers could be caused by the 4 million paediatric CT scans performed each year. Reducing the highest 25 percent of doses to the median (midpoint) may prevent 43 percent of these cancers.[17]

Post-primary or reactivated pulmonary tuberculosis in adolescences and adults begins with an acute necrotizing consolidation followed by Trans-bronchial spread.[18] Reactivation of dormant bacilli occurs during periods of immunosupression, malnutrition, and debilitation or as a result of aging.[19] Cavitation is the hallmark of Post primary TB and the cavity can rupture into the pleural space, resulting in empyema and bronchopleural fistula. Tubercle erosion into a pulmonary artery leads to pseudoaneurysm formation and potentially fatal hemoptysis. Erosion into smaller, systemic vessels or pulmonary veins results in symptomatic hematogenous dissemination and miliary TB. Healing of Post-primary TB typically occurs with fibrosis and calcification. Bronchial strictures, lobar or segmental collapse, and bronchiectasis can result from endobronchial disease. Tuberculomas also can result from post-primary disease.[19] Radio-graphically, post-primary TB is characterized by its predilection for the upper lobes, absence of lymphadenopathy, and a propensity for cavitation. Radiographic findings include patchy consolidation, streaky opacities or both (100%), primarily in the apical and posterior segments of the upper lobes (91%), cavitation (40% to 87%), bronchogenic spread of disease with ill-defined nodules (19% to 58%), evidence of fibrosis (29%), pleural effusion (18%).[20] The CT and HRCT findings seen in post-primary TB are numerous, varied and reflect the protean manifestation of this disease. Findings include (1) airspace consolidation of varying degrees; (2) cavitation; (3) centrilobular nodules and branching linear opacities "tree-in-bud appearance" - that reflect endobronchial spread of infection; (4) small, well defined, randomly distributed nodules that indicate miliary or hematogenous spread of infection (5) pleural effusion; (6) lymph node enlargement with central necrosis and (7) changes of pulmonary fibrosis.[21,22] A combination of these findings is most helpful in making a diagnosis of TB. HRCT findings in patients with TB sequel include distortion of broncho-vascular structures, bronchiectasis, emphysema, and fibrotic bands indicative of prior infection with scarring.[21,22]

CONCLUSION

Frequent radiologic findings of pulmonary tuberculosis in infants are mediastinal or hilar lymphadenopathy with central necrosis and air-space consolidations, especially mass like consolidations with low-attenuation areas or cavities within the consolidation. Disseminated pulmonary nodules and airway complications are also frequently detected in this age group. CT is a useful diagnostic technique in infants with tuberculosis because it can show parenchymal lesions and tuberculous lymphadenopathy better than chest radiography. CT scans can also be helpful when chest radiographs are inconclusive or complications of tuberculosis are suspected. HRCT is efficacious in detecting small foci of parenchymal cavitation, both in areas of confluent consolidation and in areas of dense fibrocalcific disease associated with distortion of the underlying lung parenchyma. HRCT is better than plain chest radiograph in identification of extent of pulmonary TB, especially subtle areas of

consolidation, cavitation, bronchogenic and miliary spread. CT scan chest have advantages over conventional radiographs in diagnosing chest TB in pediatric patients and can detect the disease in patients whose chest radiographs are normal or equivocal.

Effective radiation dose according to Grainger & Allison's.

Chest x ray - 0.02 mSv

CT Chest - 8 .8 mSv

1 CT Chest = 400 chest x- rays.

"No patients should be exposed to more radiation than they need at any age," says pediatric radiologist Marta Hernanz-Schulman, MD, chair of the American College of Radiology's Paediatric Imaging Commission.

Since Diagnostic efficacy of HRCT is 91 %. Diagnostic efficacy of Chest X-Ray is 70.5 %. So diagnostic efficacy of HRCT is more than the Chest X-Ray.

REFERENCES

1. Abbas KV, Fausto N, Mitchell RN. In: Robbins Basic Pathology. 8th edn. Saunders Elsevier. Philadelphia PA. 2007: 516–522.
2. Dolin PJ, Raviglione MC, Kochi A. Global tuberculosis incidence and mortality during 1900 to 2000. Bull World Health Organ. 1994; 72:213-220.
3. Raviglione MC, Snider DE Jr, Kochi A. Global epidemiology of tuberculosis. JAMA. 1995; 173: 220–226.
4. Donald PR. Children and tuberculosis–Protecting the next generation? Lancet. 1999; 353:1001
5. World Health Organization (WHO). Global Tuberculosis Control Report and WHO guidelines for National Tuberculosis programme on the management of Tuberculosis in Childhood, 2006.
   Available at
   http://www.who.int/tb/publications/global_report/2008/pdf/fullreport.pdf. Accessed on 26 Jun 2014.
6. IAP Working Group. Consensus statement of IAP working group: Status report on diagnosis of Childhood Tuberculosis. Indian Pediatr. 2004; 41:146-155.
7. Uzum K, Karahan OI, Dogan S, Coskun A, Topcu F. Chest radiography and thoracic computed tomography findings in children who have family members with active pulmonary tuberculosis. Eur J Radiol. 2003; 48:258–262.
8. Webb WR, Muller NL, Naidich DP.Diseases characterized by primarily nodular and reticulonodular opacities: High Resolution CT of Lung, third edition. Philadelphia Lippincott Williams and Wilkins, 2001, pp 315-325
9. Jung-Gi Im, Harumi Itoh, Young-Soo Shim, et al. Pulmonary Tuberculosis: CT Findings- Early active disease and sequential change with anti-tuberculous therapy. Radiology. 1993; 186:653-660.
10. Rom WN, Gray S. Tuberculosis. Boston, Little Brown company, 1996.
11. Kuhn JP, Slovis TL, Haller JO. Caffey's pediatric diagnostic imaging, 10th ed. Philadelphia, PA. Mosby. 2004:982-1039
12. McAdams HP, Erasmus J, Winter JA. Radiologic manifestation of pulmonary tuberculosis. Radiol Clin North Am. 1995; 33:655-678
13. Kim WS, Choi JI, Cheon JE, Kim IO, Yeon KM, Lee HJ. Pulmonary tuberculosis in infants: radiographic and CT findings. AJR Am J Roentgenol. 2006;187:1024-1033
14. Delacourt C, Mani TM, Bonnerot V, de Blic J, Sayeg N, Lallemand D, et al. Computed tomography with normal chest radiograph in tuberculous in fection. Arch Dis Child. 1993; 69:430 -432.
15. Khalilzadeh S, Baghaie N, Boloorsaz MR, Hakimi M, Arami S, Velayati AA. Screening of Tuberculosis in Symptomatic Close Contact Children. Tanaffos. 2003; 2: 51-56.
16. Karam MB, Masjedi MR, Fadaizadeh L, Dokouhaki P, Tahery SA, Tabatabaii SJ, et al. Role of HRCT in diagnosing active Pulmonary Tuberculosis.
    Available at URL:
    http://www.ams.ac.ir/AIM/0031/karam0031.html. Accessed on 2nd January 2015
17. Miglioretti DL, Johnson E, Williams A, Greenlee RT, Weinmann S, Solberg LI. The Use of Computed Tomography in Pediatrics and the Associated Radiation Exposure and Estimated Cancer Risk. JAMA Pediatr. 2013;167:700-707
18. Small PM, Shafer RW, Hopewell PC, et al. Exogenous reinfection with multidrug-resistant Mycobacterium tuberculosis in patients with advanced HIV infection. N Engl J Med. 1993; 328:1137-1144.
19. Ann N. Leung, MD. Pulmonary Tuberculosis: The Essentials, Radiology. 1999; 210:307-322.
20. McAdams HP, Erasmus J, Winter JA. Radiologic manifestations of pulmonary tuberculosis. Radiol Clin North Am. 1995; 33(4):655-678.
21. Jung-Gi Im, Harumi Itoh, Young-Soo Shim, et al. Pulmonary Tuberculosis: CT Findings- Early active disease and sequential change with anti-tuberculous therapy. Radiology. 1993; 186:653-660.
22. Kyung Soo Lee, Jung-Gi Im. CT in Adults with Tuberculosis of the Chest: Characteristic findings and role in management. AJR. 1995; 164:1361-1367.

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