

Tanaffos (2005) 4(16), 57-62

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Diagnostic Value of Lung CT-Scan in Childhood Tuberculosis

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ABSTRACT

Background: Many different methods and approaches have been applied for confirmation of tuberculosis in children. The diagnostic criteria being currently used for detection of childhood TB consist of clinical symptoms, history of close contact, radiological findings, PPD test and positive bacteriologic or pathologic findings. Since each of these methods may have false positive or negative results, it is necessary to find a better method for prompt diagnosis. This study was performed to determine the value of CT-scan as a sensitive method in detecting hilar, parenchymal and mediastinal involvements in early diagnosis of childhood TB and compare it with other diagnostic criteria.

Materials and Methods: This cross-sectional comparative study was carried out on 100 children, suspicious of having primary pulmonary TB between September 1999 and September 2000 in Masih Daneshvari Hospital. All patients had prior history of close contact with smear-positive patients having active pulmonary TB. Epidemiological factors as well as radiological and microbiological findings were evaluated.

Results: Of total 100 patients, 43 were female and 57 were male. The mean age was 7.5 ± 3.6 yrs ranging from 4 months to 14 years. Forty two were Iranian and 58 were Afghan. Thirty nine children had a positive PPD test. Bacteriological and simple chest x ray findings compatible with TB were positive in 11 and 36 patients, respectively. Pulmonary CT-scan without contrast revealed lung lesions in 55 patients while 25 of them (45.4%) had normal chest x rays. In 12 patients positive CT-scan was the only positive diagnostic finding.

Conclusion: Our results show the value of pulmonary CT-scan as a diagnostic criterion in pediatric tuberculosis and we recommend it for early diagnosis in suspicious cases with no other positive findings. (*Tanaffos* 2005; 4(16): 57-62)

Key words: Tuberculosis, Childhood, CT-scan

INTRODUCTION

Tuberculosis is a major cause of morbidity and mortality of children in developing countries. Although incidence of TB in developed countries

was descending till the previous two decades, this rate is increasing since 1985 due to various reasons such as increased prevalence of HIV, immigration, poverty and homelessness. Prevalence rate of TB in children had a 34% increase during 1985-1992 (1).

According to WHO report, 13 million new cases

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of TB and 5 million deaths due to tuberculosis were detected in children under 15 years of age during 1990-2000 (2).

Children are at great risk of being infected with this disease. Diagnosis and treatment of TB in childhood period can prevent the progressive form in children (tuberculous meningitis and miliary TB) and active TB in adults (2, 3).

Diagnosis of TB in children is difficult as the result of absence of specific clinical symptoms and pauci-bacilli in this period (4).

Using more accurate and simple methods of imaging such as lung CT-scan can result in a more accurate diagnosis (5).

In a retrospective study performed in 1995 on 14 children suspicions of having TB with normal chest x ray and lung CT-scan, primary lesion was detected in 8 children (6).

In another study in 1997, primary tuberculous lesions were detected by performing high resolution CT-scan on 27 children suspicious of having TB (7).

This study was conducted to determine the value of lung CT-scan in prompt and early diagnosis of primary tuberculous lesions in children suspicious of having TB and compare it with other diagnostic criteria.

MATERIALS AND METHODS

This was a cross-sectional comparative study performed on 100 children at the age range of 4 months to 14 yrs who were referred to pediatric ward of NRITLD for examination, having history of close contact with a smear-positive TB patient.

All children under study were examined by a paediatrician and all the required data along with the history, clinical examination, relationship of child with the TB patient, duration of time being in contact with the TB patient and history of BCG vaccination were recorded in special forms.

All the referred children were hospitalized for gastric lavage culture. At least three samples of gastric lavage or sputum were sent for direct smear examination, Ziehl Neelsen staining, and culture. For all patients PPD test was performed as injecting a 5-unit tuberculin as 0.1 cc in anterior part of the forearm and evaluating the result after 48-72 hours measuring the diameter of induration.

Simple chest x-ray (PA and lateral view) and chest CT-scan were obtained of all children (in 3 days after hospitalization without injecting the contrast media) using Siemens Somatom Plus device

Results of the CT-scan and chest x-ray were evaluated simultaneously by a radiologist. In some cases lung CT-scan with injection or HRCT was recommended if needed. Simple chest x-ray and lung CT-scan results along with other findings and diagnostic criteria were evaluated statistically using chi-square, and P-value, and then sensitivity and specificity of them were calculated.

RESULTS

Of a total of 100 patients, 57 (57%) were male and 43(43%) were female. Patients were at the age range of 4 months to 14 years and the mean age was 7.5 yrs. 42% were Iranian and 58% were Afghan. Fifty-one percent of patients had a history of BCG vaccination.

All children had a history of close contact with a smear positive TB patient (a family member). The TB patient was the father in 38%, the mother in 30%, brother in 7%, sister in 5% and of other relatives in 20% of the cases.

Clinical symptoms were present in only 10 children (10%) including failure to thrive (FTT) in 4 patients, cough in 4 patients and prolonged fever in 2 patients. PPD test was positive in 39 patients (39%). Induration was examined considering history of BCG vaccination (in case of positive history of

vaccination, induration ≥ 15 mm and in case of negative history, induration ≥ 10 mm was considered as positive).

In simple chest x-ray, positive findings were present in 36 patients (36%) (Table 1). There was no positive finding in chest x-ray of 64 patients (64%).

Table 1. Radiologic findings in simple chest X rays of 100 children suspicious of having primary pulmonary TB in Masih Daneshvari hospital 1999-2000.

Type of involvement	Number (Percentage)
Hilar adenopathy	16 (16%)
Parenchymal infiltration	6 (6%)
Calcification	6(6%)
Hilar adenopathy+ Parenchymal infiltration	4(4%)
Hilar adenopathy+ Calcification	4(4%)
Total	36 (36%)

Mycobacteriologic evaluation results were positive only in 11 patients (11%) out of which smear and culture were both positive in 2, smear was positive and culture was negative in 4, and smear was negative and culture was positive in 5 cases.

Abnormal findings were found in lung CT-scan of 55% of patients. Chest x-ray was abnormal in 30 (54.5%) and normal in 25 (45.5%) of them.

In 39 patients chest x ray and lung CT-scan were both normal.

In 6 patients, lung CT-scan was normal whereas chest x-ray had shown involvements. Abnormal findings in lung CT-scan of patients are demonstrated in table 2. The most prevalent positive finding was hilar adenopathy of the right lung (22%). Gastric lavage culture became positive after 2 months in 2 children in whom lung CT-scan showed the lesion with no other positive finding.

HRCT was obtained in 5 patients. In 3 cases, bronchiectasis; in one case, miliary tuberculosis; and in another one cavity were seen in the lung.

Table 2. Abnormal findings in lung CT-scan of 100 children suspicious of having primary pulmonary TB.

Abnormal findings	Number
Hilar adenopathy of the right lung	22
Parenchymal infiltration+ Adenopathy	19
Calcification+ Adenopathy	17
Hilar adenopathy of the left lung	13
Calcification	7
Parenchymal infiltration	5
Bronchiectasis	4
Parenchymal infiltration	5
Paratracheal adenopathy	2
Mediastinal adenopathy	1
Cavity	1
Miliary	1

In lung CT-scan with contrast, 3 cases of mediastinal and paratracheal adenopathy and 2 cases of hilar adenopathy as low attenuation nodes with rim enhancement were reported.

Comparison of CT-scan results with all diagnostic criteria, presence of 3 out of 4 criteria (contact history, clinical symptoms, radiology and tuberculin test) or presence of positive bacteriologic results with another criterion indicated 100% sensitivity and 40% specificity. Comparison of positive and negative findings of lung CT-scan with PPD, clinical symptoms and bacteriologic test results are shown in table 3, 4 and 5 respectively.

Table 3. Comparison of positive and negative findings in CT-scan with PPD of 100 children suspicious of having primary pulmonary Tb in Masih Daneshvari hospital- 1999-2000.

PPD	CT-scan	
	Positive	Negative
Positive	34	5
Negative	21	40

Table 4. Comparison of positive and negative findings in lung CT-scan with clinical symptoms in 100 children suspicious of having primary pulmonary TB.

PPD	CT-scan	
	Positive	Negative
Positive	10	0
Negative	45	45

Table 5. Comparison of positive and negative findings in lung CT-scan with mycobacteriologic tests results in 100 children suspicious of having primary pulmonary TB.

PPD	CT-scan	
	Positive	Negative
Positive	11	0
Negative	44	45

DISCUSSION

There are five diagnostic criteria in diagnosing childhood tuberculosis including: positive contact history, clinical symptoms, chest radiography, microbiologic findings, and tuberculin test. In this study, we evaluated the role of CT-scan as an accurate and quick way in detecting parenchymal and mediastinal lesions in TB.

In 55% of patients there were findings revealing pulmonary involvement in their CT-scan. This figure indicates that lung CT-scan has been positive in more than half of the patients. In 12 cases, it was the only positive factor except contact history. In other cases, there were more than one positive factors.

In a retrospective study by Kim et al., in South Korea in 1997, 41 children with TB, diagnosed with bacteriologic findings and chest x-ray were evaluated. Results of the lung CT-scan with contrast revealed hilar and mediastinal involvement in 90% of patients (8). In another study by Katakura et al. in 1999 in Japan, in 5 children under 6 years old

suspicious of having TB, normal chest x ray, lung CT-scan with contrast was obtained. In all 5 children, there were evidences of involvement as hilar adenopathy (9).

In comparison with this study, in regard to type of involvement the most common finding was hilar adenopathy which was observed in 70% of patients, while this finding was revealed in simple chest x ray of only 40% of them.

This finding (presence of adenopathy) is in accord with other studies, regarding primary childhood TB manifestations in CT-scan (8, 9, 10).

Results of this study indicated that in 55.4% of patients chest x ray and lung CT-scan were both abnormal. In 45.5% of cases chest x ray was normal but lung CT-scan clearly detected the lesion. Therefore, a normal chest x ray at initial stages of disease does not rule out primary childhood TB, and by performing CT-scan, primary lesion may be revealed (11).

In 6 patients, chest x ray was abnormal while lung CT-scan was reported to be normal. Out of these 6 patients, 4 were infants under one year of age in whom CT-scan was feasible only under general anesthesia but was performed without anesthesia as the result of parent's disagreement, so the results were not reliable.

According to radiologist, in 2 cases, CT-scan with contrast was necessary which was performed without it. Therefore, these 6 cases can not be used in disproving the value of CT-scan in early diagnosis of disease.

Lung CT-scan can show parenchymal involvement details precisely (12).

In 3 cases of the understudy population, bronchiectasis was detected through HRCT, which was not detectable in simple chest x ray. In a study performed on 48 patients including children and adults, HRCT was used to evaluate the presence and

size of lymph nodes and TB related parenchymal lesions and to distinguish it with other diseases showing the type of lesions present in lung parenchyma during active TB (7, 10). HRCT is capable of detecting small nodules (1-3mm) before being detectable in simple chest x ray (3, 7, 12).

Also there was one case of miliary TB, diagnosed through HRCT in our understudy patients.

In a study in South Korea by Im et al. performed on 41 active TB patients, HRCT results showed cavitation in 58% of cases whereas it was detectable in chest x ray of 22% of them (14, 15).

Although cavitation is rare in childhood pulmonary TB, in this study there was a case of cavitation along with calcification revealed by HRCT.

Lung CT-scan can be helpful in distinguishing TB from other causes of lymphadenopathy in children, because CT-scan findings in TB, are rarely seen in other diseases causing lung adenopathy including lymphoma, metastases, sarcoidosis, coxioidiomycosis and histoplasmosis (16). Comparing lung CT-scan with other diagnostic criteria such as tuberculin test shows that in 61.8% of cases, lung CT-scan and PPD test were both positive. This can be reassuring in evaluating tuberculin test value as a diagnostic finding.

In 38.2% of cases, PPD test was negative while CT-scan was positive, indicating the presence of pulmonary involvement. Therefore, tuberculin test alone can not be an accurate diagnostic mean while lung CT-scan can be helpful as a diagnostic criterion.

Comparing microbiologic findings regarding direct smear examination and gastric lavage culture in regard to acid fast bacilli indicated that in all cases with positive bacteriology, lung CT-scan showed involvement as well. Since the definite diagnosis is based on paraclinical proof and direct smear examination, this finding (association of positive

bacteriology with positive CT-scan) verifies the important role of CT-scan in diagnosis.

In 2 patients in whom the only positive finding was pulmonary involvement in CT-scan, smear culture was negative at first but turned into positive after two months. This also brings up the importance of lung CT-scan as a precise diagnostic mean.

Lung CT-scan results were positive in all patients who had significant clinical symptoms. But in 45 cases with positive CT-scan, there was no significant clinical symptom. This fact, confirms the important diagnostic value of CT-scan and difficult diagnosis of TB in children because the clinical symptoms are insignificant.

The important fact in comparison of CT-scan with all other diagnostic criteria is that in 12 patients in whom lung CT-scan was positive, the only diagnostic criteria except contact history (representing the child as a suspicious case) was evidences of pulmonary involvement in CT-scan. This emphasizes the role of CT-scan in diagnosing TB at initial stages when all other diagnostic criteria are negative.

CONCLUSION

In initial stages of TB, when the only positive factor, is history of close contact with a TB patient and other diagnostic criteria such as clinical symptoms, simple chest x ray, PPD and microbiologic findings are negative, lung CT-scan can reveal more details regarding type of pulmonary involvement, parenchymal, mediastinal and hilar lesions.

If performed with contrast or as HRCT, there will be an increased chance of positive result, showing the lesions precisely in details.

Although CT-scan can be a valuable diagnostic mean in diagnosing childhood TB, it is only recommended in suspicious cases with no other positive finding, because it is expensive and all therapeutic centers, are not able to performs it.

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