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Computerized Tomography Detects Pulmonary Lesions in Children with Normal Radiographs Diagnosed to have Tuberculosis

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This report is based on observations during the conduct of a larger study to develop diagnostic criteria for childhood tuberculosis (TB). Of 20l children confirmed to have pulmonary or lymph node TB, 84 had normal chest radiographs. Computerized tomography (CT) of the chest was performed in nine of them, seven of whom had normal chest radiographs while two had visible calcification. Eight of the nine children had definitive lesions detected by computerized tomography of the chest. While five children had primarily hilar lymph node enlargement, three had pulmonary parenchymal lesions. The use of more sensitive diagnostic tests like computed tomography helps to detect tuberculosis lesions not otherwise visualized on chest radiographs. This report highlights the difficulty in excluding active tuberculosis in children. More studies are required on the role of CT scans in the diagnosis of tuberculosis in children.

Key words: *Computerized tomography, Tuberculosis.*

TUBERCULOSIS (TB) in the pediatric population produces short-term morbi-dity and mortality and also serves as a reservoir for adult forms of the disease. The natural history of tuberculosis in any age group comprises of exposure, infection and disease. In children, the differentiation between infection and disease is not as clear-cut as in adults. The situation is compounded by the absence of signs and symptoms as well as the lack of specific

radiographic features at the stage of primary infection. The tuberculin reaction is the only known method of detecting TB infection but is known to be falsely negative in a variety of situations including malnutrition and in the presence of severe viral infections. Radiographic changes are often found later in the disease spectrum and are influenced by the host inflammatory reaction. Detection of acid-fast bacilli is rare and mycobacterial cultures take time(1). There is thus a need for better diagnostic methods to detect tuberculosis infection and disease in children. This report describes the computerized tomography (CT scan) findings in nine children who showed strongly reactive tuberculin reactions, had Mycobacterium tuberculosis in gastric lavage cultures but had chest radiographs that were normal. They were observed during the course of a larger study on diagnostic strategies for childhood tuberculosis in Chennai, South India.

Subjects and Methods

Children between the ages of six months and twelve years attending the outpatient department of the following hospitals were included in this study: (*a*) Institute of Social Pediatrics, Government Stanley Medical College, Chennai; (*b*) Department of Pediatrics, Sri Ramchandra Medical College and Research Institute, Porur, Chennai and (*c*) the Kanchi Kamakoti Child's Trust Hospital, Chennai.

Children presenting with cough or fever for more than two weeks, more than six episodes of respiratory infection in three months, failure to thrive or unexplained loss of weight were referred for the study. A strong clinical suspicion in the absence of these symptoms was also considered as sufficient grounds for investigation. Detailed history including all symptoms and a history of contact with TB was recorded. Clinical examination was conducted and findings recorded.

Chest radiographs and tuberculin tests were performed. The pediatrician and radio-logist reviewed radiographs independently–both were blinded as to the clinical status of the patient. In case of disagreement between the two, a third opinion was obtained from another pediatrician. Tuberculin test was done using 1TU PPD RT 23 with Tween 80 and induration was recorded after 48 to 72 hours. The diagnosis of tuberculosis was based on sputum or gastric lavage smear/culture (on two consecutive days early in the morning) or lymph node biopsies with histopathological examination and culture obtained from those who had significantly enlarged superficial nodes. CT scans could be performed only in nine children due to lack of availability. All scans were performed at the Government Stanley Medical College and Hospital, Chennai, after culture results had become available. All children with TB diagnosed were treated with a full course of anti tuberculous therapy. The study was approved by the Institute's Ethics committee and informed consent was obtained from the parents.

Results

2352 children were referred for the study; tuberculosis was confirmed in 201 either bacteriologically or histopathologically. The chest radiographs of 84 of these children were read as normal by the pediatrician and radiologist. We were able to perform CT scans in nine of these children and details of their investigations are shown in *Table I*. While seven of them had normal chest radiographs (confirmed by reading the films again), two had evidence of calcification. All were HIV-negative. Eight had Mycobacterium tuberculosis isolated from gastric lavage cultures while one child had a lymph node biopsy

TABLE I–*Findings in Nine Children with TB Disease and Normal Radiographs.*

Age (yrs)	Sex	Tuberculin reaction (mm)	Bacteriology	Chest *X*-ray	CT scan
5	M	24	Culture+	N	Right paratracheal gland with calcification.
11	F	15	Lymph node biopsy +	N	Righ tracheobronchial nodes with anterior mediastinal mass.
3	F	15	Culture+	N	Normal
3	F	17	Culture +	N	Calcification in left hilar gland
3	F	14	Culture	Calcific density right lower zone	Right retrocardiac patchy pneumonia including calcific density
11	M	15	Culture +	N	Right hilar node enlargement
5	M	15	Culture +	N	Right mediolateral calcific node with rounded opacity. Left lower lobe with varying density (consolidation leading to liquification)
8	F	0	Culture +	N	Right basal lateral segment nodular opacity at the level of diaphragm
6	M	15	Culture +	Calcification in hilar area	Bilaterial hilar adenitis producing obstructive emphysema

suggestive of tuberculosis. The CT scan was abnormal in eight of the nine patients. While five children had primarily hilar lymph node enlargement, the other three had pulmonary parenchymal lesions.

Discussion

The role of CT scans in pediatric TB has been explored in a few studies; none are from resource-restricted settings. Delacourt, *et al.*(2) performed CT scans in 15 children with positive tuberculin reactions and found evidence of enlarged intra-thoracic nodes in 60%. They suggest that CT scans could play a role in the early detection of tuberculosis where active disease has not been diagnosed due to absence of clinical findings and normal chest *X*-rays. Similarly Gomez Pastrana, *et al.*(3) detected intrathoracic lymphadenopathy in 14 of 22 (63%) children with tuberculous infection without disease. Kim, *et al.*(4) while desribing the CT findings of pulmonary tuberculosis in children noted that in 20% of patients the diagnosis was suggested only on CT scans; the characteristic CT finding was mediastinal or hilar lymphadenopathy with rim enhance-ment or calcification. Neu, *et al.* (5) also described six children in whom CT scans revealed hilar/ mediastinal adenopathy with equivocal or negative chest radiographs.

During the course of our study we observed that a fair proportion of children with gastric lavage culture positive for Mycobacterim tuberculosis had normal chest radiographs. CT scans done on a subset of these children picked up lesions in the majority. Only two of the nine children reported here had any abnormality detected on plain radiograph and both these

Key Messages

- Children with active tuberculosis may have normal chest radiographs.
- CT Scan is a sensitive diagnostic test to detect pulmonary lesions.

were calcifications. Pulmonary CT scans showed lymph node enlargement in five, consolida-tion in four (with liquefaction in one) and an anterior mediastinal mass in one patient. While there was no classical or universal feature diagnostic of tuberculosis, the CT scan was able to pick up significant abnormalities not detected by plain radiographs.

Our findings raise two important issues. Firstly, the role of CT scans in the diagnosis of pediatric TB. Though it is a more sensitive test than plain radiograph of the chest, it cannot be routinely recommended due to the cost and inaccessibility in developing countries where tuberculosis is most common. However, it can be used as an adjunct in high-risk groups where current modalities are inconclusive and clinical suspicion is high.

The other issue is regarding treatment. As more sensitive tests are developed, it is becoming easier to detect evidence of mycobacterial infection, where in the past it was not possible. It is clear that there is a continuum between tuberculous infection and disease, particularly in early childhood. Six of the nine children in this study were under the age of six years. The demonstration of unrecognized active disease in many infected children raises the question of adequate treatment for these children. Since it is impossible in many cases to differentiate clearly between infection and disease with the current diagnostic modalities, it may be advisable to treat infection also (preventive therapy) with two drugs. A two-drug regimen isoniazid and rifampicin) has been shown to be effective in treating uncomplicated pulmonary tuberculosis and can effectively be used for chemoprophylaxis also(6).

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