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Assessment of Cavitary Pulmonary Tuberculosis in Children

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Abstract

Background: Cavitary pulmonary tuberculosis (TB) is rare in children.
Objectives: The aim of this study was to evaluate the characteristics of cavitary pulmonary TB in children.
Patients and Methods: This retrospective study was conducted on 97 children less than 15 years old with pulmonary TB to assess the clinical characteristics and radiographic findings of patients with cavitary lesions.
Results: Seven (7%) out of 97 children had cavitary pulmonary TB. All patients were between 13 and 14 years old with a female/male ratio of 2.5/1. The most common symptom was cough. All patients had positive sputum smear results. Cavitary lesions were seen in the right upper lobe in six cases and multiple cavities were observed in two cases.
Conclusions: This finding strongly suggests that older children with pulmonary TB can be more at risk than younger ages. Special attention must be paid to the prevention and treatment of TB in older children, particularly females.

Keywords: Children, Cavitary Tuberculosis, Smear Positivity

1. Background

One million cases of tuberculosis (TB) are estimated in children worldwide; of whom 75% occur in 22 high-burden countries. Tuberculosis is among the 10 main causes of mortality in children with a universal estimation of 130,000 deaths per year (1). Cavitary pulmonary TB, adult type TB, is rare in children (2). However, cavities are related to a high mycobacterium load which act as a source of infection in these children and are often nonresponsive to therapy (2, 3). The proportion of adults with pulmonary TB who have a cavitary disease at the time of diagnosis has been recognized in the studies (4-6). However, the data available on cavitary pulmonary TB in children is sparse and inconclusive. Furthermore, TB varies between children and adults in different aspects such as pathophysiological and immunological responses that can affect the diagnosis, prevention, and treatment in children (7).

2. Objectives

The aim of this study was to evaluate the clinical and radiological findings of cavitary pulmonary TB in children.

3. Patients and Methods

This study was conducted on 97 children less than 15 years old with pulmonary TB who were admitted to TB wards of national research institute of tuberculosis and lung disease (NRITLD) in Masih Daneshvari medical center between March 2007 and March 2013 to identify cavitary pulmonary TB. Investigations for diagnosis of TB included history and physical examination, complete blood count, tuberculin skin test (TST), smear of sputum for acid fact bacilli (AFB), culture for Mycobacterium tuberculosis (MTB), and chest imaging (X-ray or computerized tomography (CT)). Cavitary pulmonary TB was defined by a medical history, clinical and laboratory findings compatible with TB, and a chest imaging showing cavitary lung lesion. Institutional review board approval was not required for this retrospective study.

4. Results

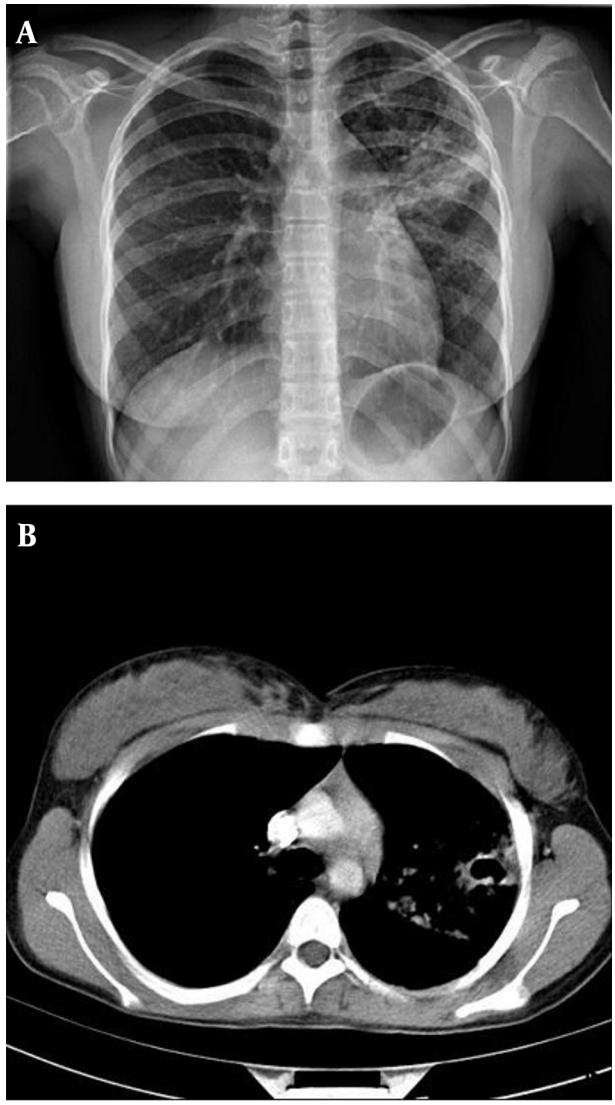
Seven children (five females and two males) who were hospitalized with impression of cavitary pulmonary TB were identified. The mean age of the patients was 13.7 (13 - 14 years). Their characteristics are listed in Table 1. Three patients were Iranian and four were Afghan. All patients were

symptomatic at the time of admission. The symptoms included cough in 7 patients, fever in 6 patients, weight loss in 6 patients, night sweats in 4 patients, and dyspnea in 1 patient. Examination of lung revealed crackle in 3 patients, wheezing in 1 patient and decreased sound in 2 patients. Only one patient had a close contact with a case of TB (case 7) who previously received chemoprophylaxis with isoniazid.

Complete blood count showed leukocytosis in two patients (cases 1 and 4). The mean value of ESR was 81 mm/hour. The HIV testing was performed in two patients, which was nonreactive. The tuberculin skin test was registered in six patients with positive results in 4 patients (cases 1, 2, 3, and 7). All 7 patients had positive sputum smear results. Positive cultures for M.TB were seen in 6 patients (Table 1). Radiological findings of the patients including chest X-Ray and chest CT are shown in Tables 2 and 3, respectively.

Treatment in all patients was started with the standard isoniazid (INH) and rifampin (RP) program for six months. During the first two months, pyrazinamide (PA) and ethambutol (EB) were also prescribed in all 7 patients. Treatment in six patients was completed during six months, who were finally cured. In case 1, sputum AFB was still positive after five months who was confirmed as a failure case. Drug susceptibility test was performed and resistance to RP and INH were recognized. The patient was received EB, PA, ciprofloxacin and protionamide that responded very well (Figures 1 and 2).

Figure 1. Case 6, a 14-Year-Old Female With Fever Associated With Night Sweat, Weight Loss and Cough



A, Chest radiograph shows cavitary consolidation in the right lower lobe, consolidation in the right middle lobe and hydropneumothorax; B, CT scans demonstrate cavitary consolidation in the right lower lobe, hydropneumothorax, plural thickening and chest tube placed in the right hemi thorax.

5. Discussion

Cavitary pulmonary TB appeared to be more common in females and children 13 - 14 years old in this report. Predominant site of this disease was the upper lobe of the right lung. All patients had positive sputum smear results.

It has been revealed that sudden changes occur in the nature of TB at the beginning of puberty. Adult type pulmonary TB which is characterized by cavitation that leads to sputum smear positivity and more infection spread is seen from this age onward (8) All seven patients of our study were 13 - 14 years old and five of them were female. In a recent study of pulmonary TB in adolescents in Brazil, it was detected that there was a slight predominance of cavitary pulmonary TB in adolescent females compared with adolescent males although the difference was not statistically significant (9). It has been shown that cavitary pulmonary TB is more frequently seen in females than males between the ages of 14 - 17 years (8).

Adolescents and older children can develop typical adult type reactivation TB. They are more likely to exhibit the typical symptoms of anorexia, fever, productive cough, weight loss, night sweats, and hemoptysis than younger children (10-12). In our study, all patients were symptomatic that their common symptoms were coughs, fever, and weight loss.

Cavitation is the hallmark radiographic feature in post-primary TB, which results from reactivation of an inactive focus of pulmonary TB (13). Chest CT findings in adult patients with active pulmonary TB are related to the number of AFB on the sputum smear. The frequency of cavitation

Table 1. Characteristics of Children With Cavitary Pulmonary Tuberculosis

Case	Sex	Age, y	Race	Clinical Features	Sputum Smear +/-AFB	Sputum Culture
1	M	13	Afghan	Cough, fever, weight loss, night sweats	+3	+3
2	F	14	Afghan	Cough, fever, weight loss	+3	+3
3	F	13	Afghan	Cough, fever, night sweats, weight loss	+3	NA
4	M	14	Afghan	Cough, fever	+3	+4
5	F	14	Iranian	Cough, fever, night sweats, weight loss, dyspnea	+ 3	+3
6	F	14	Iranian	Cough, fever, weight loss, night sweats	+2	+4
7	F	14	Iranian	Cough, weight loss	+3	+3

Abbreviations: AFB, acid-fast bacilli; F, female; M, male; NA, not available.

Table 2. Chest X-ray Findings of Children With Cavitary Pulmonary Tuberculosis

Case	Consolidation	Cavitary	Cavitary Consolidation	Infiltration	Loss Volume	Plural Effusion	Hydropneumothorax
1	LUL	NA	NA	NA	NA	NA	NA
2	NA	NA	RUL/LUL/LLL	RUL/RML/RLL	Left side	NA	NA
3	NA	NA	RUL	NA	NA	NA	NA
4	LUL	LUL/RUL	NA	RUL/LUL	NA	NA	NA
5	LLL/RLL	NA	RUL		NA	Left side	NA
6	NA	RLL	NA	LUL	NA	NA	Right side
7	NA	RUL/LUL	NA	LUL	NA	NA	NA

Abbreviations: LLL, left lower lobe; LUL, left upper lobe; NA, not availanle; RLL, right lower lobe; RML, right middle lobe; RUL, right upper lobe.

Table 3. Chest CT Findings of Children With Cavitary Pulmonary Tuberculosis

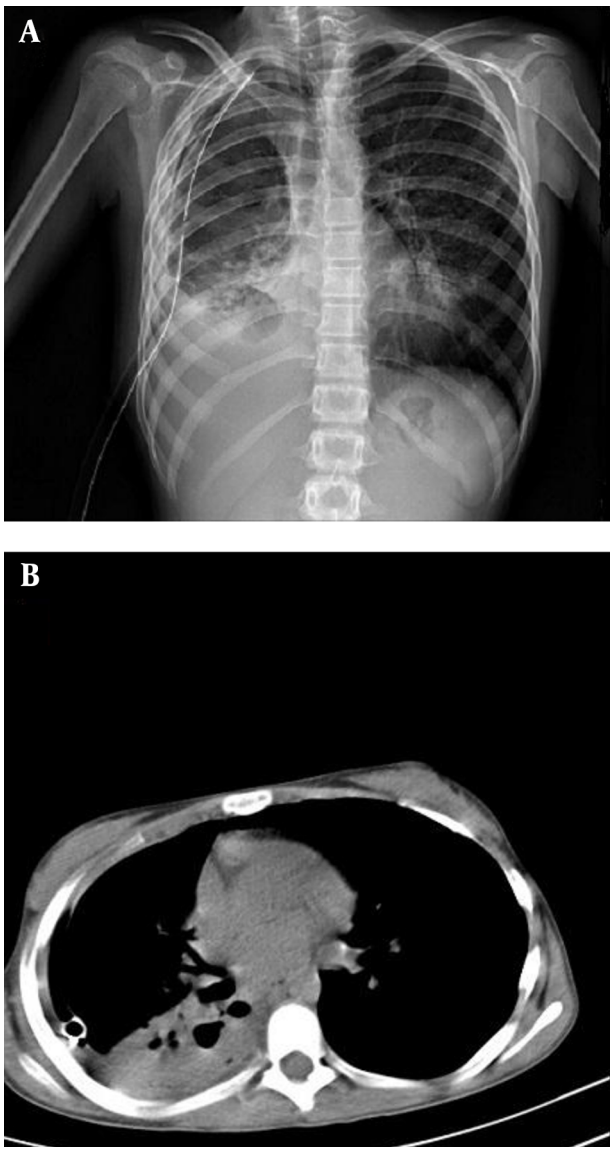
Case	Consolidation	Cavitary	Multiple Cavities	Cavitary Consolidation	Infiltration	Bronchiectasis	Loss volume	Plural Effusion	Hydro Pneu-mothorax	Calcified Node	Pleural Thickening
1	RUL/RML/RLL/LLL	LUL	RUL	NA	RUL/RML/RLL/LLL	RUL/RML/RLL/LLL	NA	NA	NA	NA	NA
2	NA	NA	NA	RUL/LUL/ LLL	LLL/RML/RLL	RML	Left side	NA	NA	NA	NA
3	RLL	RUL/LUL	NA	NA	RUL/LLL	RUL/LLL	NA	NA	NA	Mediastinal/hilar	NA
4	LUL	LUL/RUL	NA	NA	RUL/LUL	NA	NA	NA	NA	NA	NA
5	LLL/LUL	NA	NA	RUL/RLL	RUL/RLL	NA	NA	Both sides	NA	NA	NA
6	RLL/RML	RLL	NA	NA	LUL/RML	NA	NA	NA	Right side	NA	Right side
7	NA	NA	RUL/LUL/LLL	NA	Both lungs	NA	NA	NA	NA	NA	NA

Abbreviations: LLL, left lower lobe; LUL, left upper lobe; NA, not availanle; RLL, right lower lobe; RML, right middle lobe; RUL, right upper lobe.

on chest CT increases with the number of AFB on the sputum smear in adult patients with active pulmonary TB (14, 15). In our study, all patients had sputum smear positivity more than 2+ AFB. Nevertheless, no study has examined their correlation in children with pulmonary TB. In all of our patients, the cavitary lesion occurred frequently in the right lung. The upper lobes were involved in six patients. Shewchuk and Reed demonstrated that 100% of the children had cavitation in the upper lobes, while the right lung was involved in 80% of the cases (16). Isolated cavitary pulmonary TB of the lower lobe is rare while involvement of lower lobe along with upper lobe cavitation is not a rare finding (16). In agreement with these findings, we found that three patients had lower lobe cavitation in the presence of upper lobe cavitation while only one patient had cavitation in the isolated lower lobe.

The evidence of previous primary pulmonary TB includes calcified mediastinal or hilar lymph nodes, pleural thickening or calcification, calcified parenchymal foci, reticular scars, and volume loss. Shewchuk and Reed reported these findings on radiography in five of six patients with postprimary disease (16). The evidence of previous

Figure 2. Case 7, a 14-Year-Old Female With Weight Loss and Fever



A, Chest radiograph shows cavitary consolidation in the right upper lobe; B, CT scans demonstrated cavitary consolidation and multi micro nodule in the left upper lobe and left lower lobe.

primary pulmonary TB was present in 3 patients (cases 2, 3 and 6) in this study. Multiple cavities suggest an underlying immune compromised condition or the possibility of multidrug resistant tuberculosis (MDR-TB) (14, 15). We found two patients with multiple cavities, one of them had MDR-TB who was afghan immigrant and the other one received pervious TB chemoprophylaxis. The emergence and spread of MDR-TB can be linked to the increasing amount of international travel, migration and lost to follow-up after starting treatment (17, 18). Failure to recognize children in contact with infectious adult MDR pulmonary TB may lead to the delayed diagnosis of MDR- TB and progression of the disease.

In conclusion, children with cavitary pulmonary TB were older and more likely to have sputum smear positivity. These patients are highly infectious; therefore, the TB control programs should pay more attention to prevention and treatment of TB in older children especially females. Prompt detection and treatment can reduce the transmission of TB in the community.

Footnotes

Authors' Contribution: Study concept and design: Ferial Lotfian; acquisition of data: Ferial Lotfian, Payam Mehrian; analysis and interpretation of data: Ferial Lotfian, Payam Mehrian; drafting of the manuscript: Ferial Lotfian; critical revision of the manuscript for important intellectual content: Ferial Lotfian.

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