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Full Length Article

Determining the lymphadenopathy characteristics of the mediastinum in lung CT scan of children with tuberculosis

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ABSTRACT

Objective/Background: Most tuberculosis cases in children are primary infection, with difficult and imprecise diagnosis mainly based on the existence of mediastinal lymphadenopathy. Here, we investigated the characteristics of mediastinal lymphadenopathy in lung computed tomography (CT) scans of children with tuberculosis. *Methods:* This cross-sectional study was performed on 75 children with tuberculosis referred to Masih Daneshvari Hospital in Tehran, Iran, from 2009 to 2013. Their medical records were investigated, and CT-scan characteristics were extracted by a radiologist. *Results:* Mean ± standard deviation age of cases was 11.2 ± 4.6 years. CT-scan results indicated 94.7% of cases had lymphadenopathy, with lower paratracheal, upper paratracheal, hilar, and subcarinal forms observed in 81.7%, 69.1%, 53.5%, and 47.9% of cases as the most involved stations in lymph nodes, respectively. In 74.6% of patients with mediastinal lymphadenopathy, perilymph node fat inflammation (matting) was observed, with 52.11% exhibiting conglomeration. Bronchial pressure was observed in 4.23% of children with tuberculosis, and bilateral-, right-, and left-parenchymal involvement was observed in 42.7%, 25.3%, and 8% of these cases, respectively. Left- and right-pleural effusion and calcification was reported in 6.7%, 12%, and 5.6% of patients, respectively. Additionally, nearly 80% of patients exhibited mediastinal lymphadenopathy and lung-parenchyma involvement simultaneously. Lung-parenchyma involvement was significantly correlated with subcarinal ($p < .001$), hilar ($p < .001$), subaortic ($p = .030$), lower paratracheal ($p = .037$), and axillary ($p = .006$) stations.

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Conclusion: Situation of mediastinal lymphadenopathy and its synchronicity with lung-parenchyma involvement can help in differential diagnosis of pulmonary tuberculosis from other lung diseases.

Introduction

Tuberculosis (TB) is one of the most common infectious diseases in the world caused by *Mycobacterium tuberculosis* [1]. About one-third of the world population is infected with latent TB infection, and a new infection is occurring every second on a global scale [2]. According to reports, lifetime risk of changing TB infection to disease is estimated at 43% in newborns, 24% in children 1–5 years, 15% in teenagers, and 5–10% in adults. In comparison with adult patients, children are infected with more severe forms of TB, such as disseminated TB [3,4]. Approximately 1 million children <15-years old were infected with TB worldwide in 2015, and 136,000 children die due to the disease annually [5]. Records show that in regions with high TB prevalence, 15–20% of all TB cases occur in children [6].

Most TB cases are caused by primary infection that is mainly transmitted to children by one of the family members. Some of the infancy and early childhood common diseases, such as human immunodeficiency virus (HIV), measles, whooping cough, and protein-energy malnutrition associated with immunodeficiency, can accelerate TB-infection activation. In most cases, lung-parenchymal lesions and lymphadenopathy are self-limiting; however, in some cases, especially in infants, they lead to mediastinal lymphadenopathy with continuing involvement. As previously reported; mediastinal lymphadenopathy with or without parenchymal disorder is a clear sign of primary TB in childhood [7–10].

TB in children is a major challenge due to the lack of a standard definition, diagnostic problems, frequency of extrapulmonary cases, and little attention to public health [10]. Many children (65–95%) have no clinical symptoms. Therefore, the diagnosis of primary pulmonary TB is very difficult and inaccurate in children and is confirmed only in 40% of cases. Major diagnostic problems often lead to neglecting TB in children [11–15].

Most radiological findings of TB in children involve mediastinal and hilar lymphadenopathy with central necrosis and retention of airways. Simple radiography is unreliable in determining the existence, station, and characteristics of mediastinal lymphadenopathy, while computed tomography (CT) scan is considered as the gold standard [15]. CT scans have more benefits in diagnosis of TB in children as compared with radiography and can be used in cases of complex suspected TB to provide further details of airway, parenchyma, and lymph node involvement [16]. However, a limited number of studies of CT-scan findings exclusively reported mediastinal adenopathy in children. Usually, these studies were performed on a very limited sample size. Also, these studies are performed on suspicious TB cases according to the World Health Organization diagnostic criteria [15,17].

The health of children is among the main objectives of the health system in any community. Determination of the prevalence of lymphadenopathy in children with TB is an essential point in determining the policies of those involved in the healthcare field. However, correct diagnosis assures appropriate treatment and prevents the infection of other people. Therefore, this study evaluated mediastinal lymphadenopathy characteristics of lung CT scans of children having TB in order to determine a correct and efficient diagnostic method.

Materials and methods

This cross-sectional study was performed in Masih Daneshvari Hospital in Tehran, Iran, between 2009 and 2013. The ethics committee of Shahid Beheshti University of Medical Sciences, Tehran, Iran, approved this study. All parents provided informed written consent. In this study, a convenience-sampling method was used, and cases were selected from children <18-years old who had three of the following five points: (1) recent history of contact with an infected person with TB; (2) positive purified-protein derivative skin test ($\geqslant$10 mm in conditions of no contact and $\leqslant$5 mm in conditions involving contact with a person infected with TB); (3) radiographic signs related to TB; (4) clinical signs related to TB; and (5) pathology or bacteriology related to TB, referred to Masih Daneshvari Hospital during the aforementioned years, and having CT-scan results in their medical records. Considering type I errors (α) of 5%, bilateral hilar mediastinal lymphadenopathy ratios in children equal to 73% and accuracy of 10% around this proportion, the sample size was estimated to be 75 cases using one ratio-estimation formula [15].

Lung CT scan in the medical records of children with TB was evaluated by a radiologist, and characteristics of the CT scan were extracted and recorded in a checklist prepared by the researcher.

CT scans were evaluated for: (1) lymphadenopathy (have/have not), lymphadenopathy stations (upper paratracheal, prevascular, lower paratracheal, subaortic, paraaortic, subcarinal, paraesophageal, pulmonary ligament, hilar, and axillary), perilymph node fat inflammation (matting), conglomeration/discrete, calcification (have/have not), bronchial pressure (have/have not), lung-parenchyma involvement (right, left, bilateral, or without involvement), and pleural effusion (right, left, or without involvement).

In order to reduce interobserver bias, CT-scan results were interpreted by only an experienced radiologist. Also, to reduce