Pediatr Radiol (1999) 29: 153–157
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Complicated pleural tuberculosis in children: CT evaluation

Received: 29 August 1997
Accepted: 26 May 1998

Supported by a grant no. 02–97–348 from the SNUH research fund.

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Abstract *Purpose.* To describe the CT features of complicated pleural tuberculosis in children and to define the use of CT in children with pleural tuberculosis.
Materials and methods. The CT findings in 11 children with complicated pleural tuberculosis were retrospectively analysed. CT was performed to evaluate persistent pleural thickening ($n = 6$) or a mass-like lesion ($n = 5$) detected on plain radiographs. Chest radiographs and medical records were reviewed to determine whether additional information provided by CT had altered clinical management.
Results. On CT, more than one location was involved in five patients (45%) and in two patients (18%) the entire pleural spaces were involved. Pleural thickening was seen in all 11 patients and enhancement after administration of contrast medium occurred in ten patients (91%). Low-density fluid collections were seen in nine patients (82%) and in two, CT revealed fluid collections within calcified pleural lesions. In five patients with mass-like lesions on plain radiographs, CT showed a low-density pleural mass with peripheral enhancement in four and a calcified pleural mass with fluid collection in one. CT demonstrated parenchymal abnormalities on the same side as pleural lesions in all 11 patients and hilar or mediastinal adenopathy in four. Four patients (36%) underwent surgery because of fluid within a calcified fibrothorax ($n = 3$) and chest wall tuberculosis ($n = 1$) that were seen only on CT.
Conclusions. The CT features of complicated pleural tuberculosis in children were pleural thickening, enhancement and fluid collection with associated parenchymal abnormalities and lymphadenopathy. In the evaluation of children with pleural tuberculosis, CT can be useful for demonstrating fluid within a calcified fibrothorax or chest wall involvement, which usually requires surgical intervention.

Introduction

Pleural tuberculous is not a common feature of primary pulmonary tuberculosis in children. It is seen in about 10% of all new tuberculous infections and the frequency is higher in adolescents and adults than young children [1–4]. However, recognition of this disease in children is important because delayed or inappropriate treatment can cause extensive lung damage and serious extrapulmonary complications. It can also be the reservoir from which future cases will emerge.

The application of CT to the evaluation of abnormalities of the chest in children has been rapidly expanding due to its ability to display transverse anatomy and characterise tissues [5]. The CT findings of pleural tuberculosis have been described previously but mainly in adults with post-primary tuberculosis [6, 7].

We retrospectively reviewed the chest CT scans, chest radiographs, and medical records of 11 patients with complicated pleural tuberculosis to describe the CT features and to define the use of CT in this condition.

Materials and methods

Over an 8-year period (1987–1994), 31 children with pleural tuberculosis were treated at our institution and 11 consecutive patients who underwent CT formed the basis of this study. There were six boys and five girls, 2–14 years of age (mean, 9 years). During the same period, 281 children with tuberculosis were treated at our institution; the frequency of pleural tuberculosis was 11 % (31/281). CT was obtained 1–6 days after chest radiography to evaluate persistent pleural thickening despite antituberculous therapy in six patients and to evaluate a mass-like lesion detected on plain radiographs in five.

The other 20 patients not included in this study had a non-loculated pleural effusion on plain radiographs and the pleural lesions cleared promptly with appropriate therapy.

The diagnosis of pleural tuberculosis was established by surgical excision of a chronic loculated effusion or an empyema in four patients, by pleural biopsy in four patients and by sputum or pleural fluid culture in three patients. A tuberculin skin test with 5 TU of purified protein derivative showed an area of induration of 10 mm or greater in all patients. All but one patient had a history of diagnosed and treated tuberculosis at the time of CT scanning.

Five patients underwent follow-up CT at 3–7 months because of incomplete resolution of the disease despite antituberculous therapy. In one of the five patients, two follow-up CT scans were obtained after 7 and 17 months.

CT scans and chest radiographs were analysed by two radiologists with regard to pleural lesions, parenchymal lesions, lymphadenopathy and chest wall lesions. Medical records were reviewed to ascertain how the additional information provided by CT altered clinical management.

Results

Pleural lesions were seen in all patients. More than one location was involved in five patients (45 %) and in two patients (18 %) the entire pleural space was involved. The lesions were unilateral in seven (right-sided in four and left-sided in three) and bilateral in four.

Pleural thickening was seen in all 11 patients. The thickness was 1–5 mm in seven patients and over 5 mm in four (Fig. 1). Calcification of the thickened pleura was seen in four patients. Enhancement of the thickened pleura was seen in ten patients (91 %) and in five, both the visceral and parietal pleura enhanced. In four patients, septal enhancement was also seen (Fig. 2). Low-density fluid collections were seen in nine patients (82 %) and in two of these patients, CT revealed fluid within the calcified pleural lesions.

In five patients with a mass-like lesion on plain radiographs, CT showed a low-density pleural mass with peripheral enhancement in four patients (Fig. 2) and a calcified pleural mass with a low-density centre in one (Fig. 3). The mass was lenticular in three patients and round in two. The mass had a well-defined interface with lung in all patients. Adjacent or remote pleural thickening was seen in four patients.

CT demonstrated parenchymal abnormalities on the same side as the pleural lesion in all 11 patients and on the opposite side in four. There was a parenchymal nodule in five patients, air-space consolidation in four (Fig. 1) and segmental or lobar atelectasis in two. Hilar or mediastinal adenopathy was seen in four patients (36 %) (Fig. 1) and three of these patients had low-density nodes with peripheral enhancement. Increased attenuation of the extrapleural fat was seen in three patients. In one patient, CT showed vertebral and chest wall tuberculosis seen as a low-density soft-tissue mass with rim enhancement and bone destruction.

In one patient with diffuse thickening and enhancement of the entire pleural space, follow-up CT after 17 months showed localisation of the pleural lesion with central fluid and enhancement of the pleura (Fig. 1). In three patients with loculated effusion, complete resolution was seen in one patient and residual pleural thickening was seen in two. In one patient with a calcified paracardiac mass, the size of the lesion decreased but the low-density feature of the mass persisted on follow-up CT at 6 months.

In five patients (45 %), CT provided information that altered clinical management. Antituberculous therapy was started before bacteriological confirmation in one patient with clinically suspected tuberculosis. The diagnosis of tuberculosis was suggested after CT revealed low-attenuation nodes with rim enhancement in this patient. Surgical intervention was performed in four patients with fluid within a calcified fibrothorax ($n = 3$) and chest wall tuberculosis ($n = 1$) that were seen only on CT.

Discussion

Tuberculous effusion is frequently self-limiting and generally clears promptly with appropriate therapy. Uncomplicated cases of pleural tuberculosis have rarely been studied with CT but CT is highly efficient at confirming the presence of a lesion and determining its precise location and extent [8]. CT can reveal parenchymal foci abutting the pleura and mediastinal lymphadenitis in these patients [6, 7]. Although the pulmonary lesion is seldom seen on plain radiographs, single or multiple lung foci are always found on pathological examination [9]. In our study, CT demonstrated parenchymal abnormalities on the same side as pleural lesions in all patients. Tuberculous lymph nodes typically have central areas of low density and rim enhancement [10]. In HIV-positive patients, findings of low-attenuation

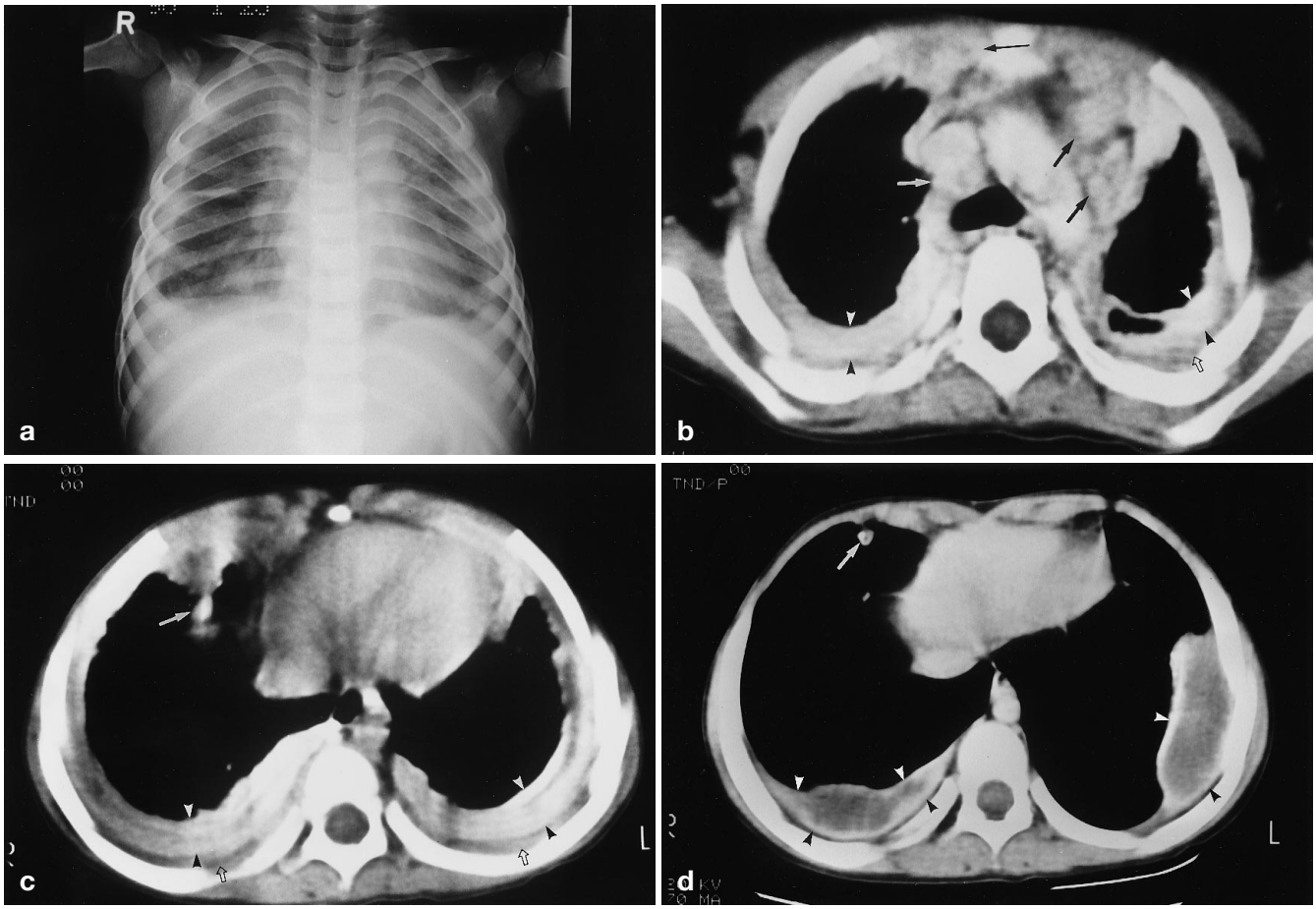

Fig. 1 a–d Pleural tuberculosis in a 4-year-old girl with dyspnoea. **a** Plain radiograph shows widening of the superior mediastinum and bilateral pleural thickening. **b,c** Contrast-enhanced CT shows marked thickening and enhancement of the pleura (*arrowheads*) and multiple small homogeneous nodes in the right paratracheal, left anterior mediastinal (*arrows* in **b**) and internal mammary (*long thin arrow* in **b**) areas. Presumed parenchymal tuberculous focus (*arrow* in **c**) abuts the visceral pleura in the right middle lobe. Note the increased attenuation of the extrapleural fat (*open arrows*). **d** Contrast-enhanced CT obtained after 17 months of antituberculous therapy shows localised pleural lesions in both hemithoraces with central fluid and peripheral enhancement of the visceral (*white arrowheads*) and parietal (*black arrowheads*) pleura. Calcification is seen in the parenchymal focus (*arrow*) in the right middle lobe

nodes are considered sufficient to warrant instituting empirical antituberculous therapy [11].

Patients with untreated or inadequately treated tuberculous effusion will commonly develop secondary disease [1]. Chronic tuberculous empyema is persistent and grossly purulent pleural fluid contains numerous tubercle bacilli. Tubercle bacilli may remain dormant within the calcified pleural space, only to be reactivated at a later stage. CT is useful for the evaluation of pleural thickening and calcification to determine if apparent pleural thickening on the plain radiograph is indeed true pleural thickening or whether it represents a chronic loculated effusion or empyema, which usually needs decortication (Fig. 3). Collections of pleural fluid within a calcified fibrothorax are the most accurate indicator of active infection [6]. In our study, surgical intervention was performed in three patients with chronic loculated effusion or empyema that were seen only on CT. CT may disclose extrapleural involvement such as vertebrae and chest wall, as it did in one patient in this study.

Loculated effusion, especially interlobular fluid or empyema can be confused with an intrapulmonary mass [8, 12]. About half of our patients underwent CT because a mass-like lesion was detected on plain radiographs. CT can differentiate tuberculous loculated effusion and empyema from a peripheral lung lesion. Characteristically, a lung abscess is round with a thick wall, while loculated effusion or empyema is lenticular, has a thin smooth wall and has a sharper interface with the lung. Empyema usually has the split pleura sign on enhanced CT that results from enhancement of the thickened parietal and visceral pleural layers surrounding the avascular fibrinopurulent exudate [8].

Fig. 2 a, b Tuberculous loculated effusion appearing as a mass-like lesion in a 13-year-old girl. **a** Plain radiograph shows a mass-like lesion (*arrow*) with a pleural effusion in the right lower lobe. A small lung nodule (*arrowhead*) is seen in left upper lobe. **b** CT shows a low-density pleural mass with adjacent pleural and fissural thickening (*arrows*) suggestive of loculated effusion. Diffuse peripheral and septal enhancement of the lesion (*arrowhead*) is also seen

Fig. 3 a, b Chronic tuberculous empyema in a 7-year-old boy. **a** Plain radiograph shows a paracardiac mass and calcified pleural thickening in the right hemithorax. These radiographic features had not changed for 1 year. **b** Contrast-enhanced CT shows a right paracardiac mass with a relatively low-density centre and peripheral calcifications (*arrowheads*). Dense pleural calcifications are seen in the lateral part of the right hemithorax. The decortication specimen showed a cystic mass with thickened fibrous wall and yellowish necrotic contents

We found a difference between the CT findings of pleural tuberculosis in children compared with adults. Pleural tuberculosis in children seems to be more extensive and diffuse. In our study, more than one location was identified in five patients (45 %), and in two (18 %) the entire pleural spaces were involved. Diffuse thickening and enhancement of the entire pleural spaces (Fig. 1) has not been reported as a CT finding in adults. This probably reflects greater hypersensitivity of children to tuberculoproteins. However, to verify this difference a comparative study with adult cases should be performed.

In summary, the CT features of complicated pleural tuberculosis in children are pleural thickening, enhancement and fluid collections with associated parenchymal abnormalities and lymphadenopathy. In the evaluation of children with pleural tuberculosis, CT can be useful for demonstrating fluid within a calcified fibrothorax or chest wall involvement of the disease, which usually requires surgical intervention.

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