

CME Article

Clinics in diagnostic imaging (I08)

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Fig. 1 (a) Frontal and (b) oblique radiographs of the right thumb.



Fig. 2 Frontal chest radiograph.

CASE PRESENTATION

A five-year-old Malay girl presented to our institution with a left-sided neck lump for one week and right thumb swelling for three weeks. She did not have any associated headache, cough, fever, night sweats, loss of weight, or appetite. On examination, the patient was cheerful, afebrile and non-toxic. There was a slightly tender, red and swollen lump at the left side of the neck with no discharging sinus. Bilateral cervical lymphadenopathy was present. The right thumb was noted to be red and swollen, but not tender. She was able to fully move her neck, upper limbs and her right thumb. A vague swelling was noted over the left upper anterior chest. Heart and lungs were clear.

The abdomen was soft and non-tender with no evidence of organomegaly.

The full blood count showed a normal total white cell count ($11.8 \times 10^9/L$). However, she had a hypochromic microcytic anaemia, with a haemoglobin level of 10.4 g/dL (normal range 12.0-15.0 g/dL), mean cell volume of 69.9 fL (normal range 75.0-87.0 fL) and mean cell haemoglobin of 22.9 pg (normal range 24.0-30.0 pg). The serum electrolytes were largely normal, except for hypoalbuminaemia with a value of 32 g/L (normal range 40-52 g/L). Radiographs of the right thumb (Fig. 1) and the chest (Fig. 2) were obtained. What do these images show? What is the diagnosis?

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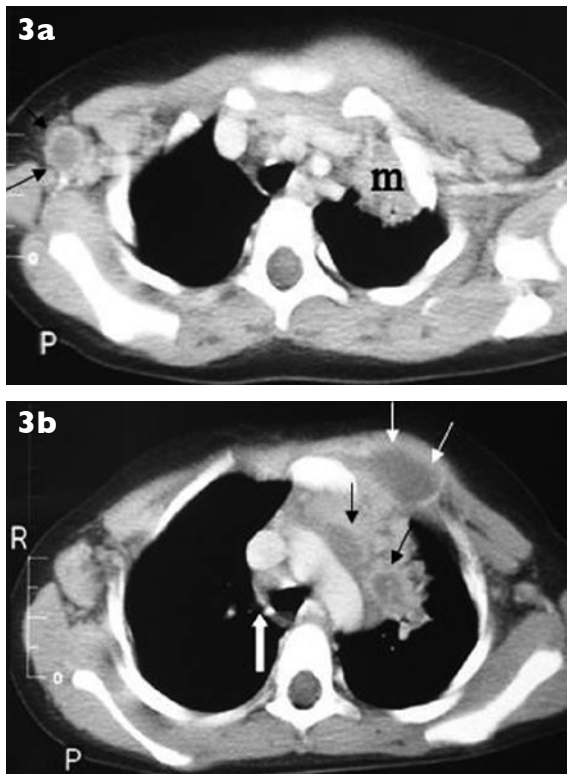


Fig. 3 Enhanced CT images of the chest show mediastinal and right axillary lymphadenopathy. (a) There is an enlarged right axillary node with a low-density necrotic centre (black arrows) and an anterior mediastinal mass (m). (b) At the level of the aortic arch, there are multiple enlarged rim-enhancing anterior mediastinal nodes with low-density centres, typically seen in tuberculosis (black arrows). These nodes have extended anteriorly to involve the anterior chest wall, resulting in development of an abscess in the left chest wall (thin white arrow). This image also shows a slightly enlarged non-necrotic right paratracheal node (thick white arrow).

IMAGE INTERPRETATION

Radiograph of the right thumb (Fig. 1) showed an expanded first metacarpal with areas of cortical destruction. There was marked surrounding soft tissue swelling. There was no involvement of the adjacent interphalangeal or metacarpophalangeal joints. The radiographical features are typical of tuberculous involvement of the short, tubular bones of the hands and feet, also known as tuberculous dactylitis. This form of tuberculous infection is especially common in children⁽¹⁾. With destruction of the underlying medulla, there is ballooning of the remaining cortex. The resulting expanded bone is termed tuberculous spina ventosa (“wind-filled sail”)⁽¹⁾. The chest radiograph (Fig. 2) showed a widened superior mediastinum (white arrows) and left hilar enlargement (thick arrow). There was no air space disease, no interstitial thickening, or pleural effusion. There was also soft tissue swelling over the left supraclavicular region.

DIAGNOSIS

Tuberculous dactylitis of the thumb, mediastinal and left hilar lymphadenopathy, and probable left cervical lymphadenopathy.

CLINICAL COURSE

The patient underwent surgical drainage of the left neck mass. Smears from the drained pus demonstrated the presence of acid-fast bacilli (AFB). Computed tomography (CT) of the thorax (Fig. 3) was performed in view of the mediastinal widening. This showed multiple enlarged, low density, rim-enhancing nodes in the anterior mediastinum and the right axillary region. Enlarged non-necrotic nodes were also present in the right paratracheal, left hilar and subcarinal regions. The anterior mediastinal nodes were continuous anteriorly with an abscess in the left anterior chest wall.

Ultrasonography of the neck (Fig.4) revealed a 3.0 x 1.4 cm abscess, with a lobulated superior margin at the region of the left neck swelling. Its infero-medial aspect was continuous with a “tail” that extended inferomedially beneath the sternocleidomastoid muscle. The appearance was typical of a “collar-stud” abscess. Other smaller nodes were present in both cervical regions.

DISCUSSION

Mycobacterium tuberculosis (*M. tuberculosis*) is still a common disease in Singapore. The incidence of tuberculosis (TB) in 2003 was 40.8 new cases per 100,000 people. In 2004, there were 1,360 new cases locally⁽²⁾. Worldwide, it is still the number one infectious disease killer. The World Health Organisation estimates that two billion people in the world have latent TB, and up to 3 million people die of TB every year. We have presented a case of disseminated tuberculous infection in a child with a number of characteristic features. She had massive mediastinal, right axillary, and left cervical lymphadenopathy, as well as right thumb tuberculous dactylitis. The infection had spread from the anterior mediastinal nodes into the anterior chest wall, forming an abscess.

Paediatric tuberculous infection is usually acquired via droplet transmission, with pulmonary TB being the commonest form. Other modes of infection occur rarely and include ingestion of the organism (*Mycobacterium bovis*), vertical transmission (congenital TB), and direct inoculation of the skin or other tissues. Symptoms are frequently non-specific and subtle compared to adults. Many older children, like adults, when infected with

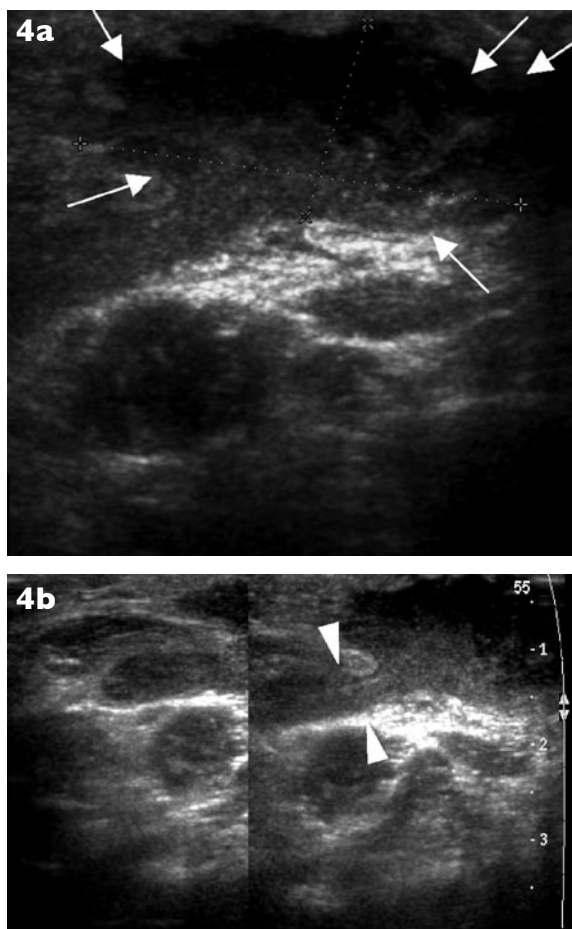


Fig. 4 US images of the left neck swelling. (a) There is a 3.0 x 1.4 cm hypoechoic semi-circular mass (arrows) with a lobulated superior margin at the region of swelling. (b) Its infero-medial aspect is continuous with a tail (arrowheads) that extended infero-medially. This appearance is typical of a “collar-stud” abscess. Other smaller nodes are also present.

M. tuberculosis, manage to mount a successful immune response and do not progress to active TB. The likelihood that a child will develop active disease is related primarily to the child’s age. Babies younger than one year of age have a 42% chance of developing active TB if infected, while 24% of children aged between one to five years will develop TB⁽³⁾.

Mediastinal and/or hilar lymphadenopathy, with or without lung parenchymal lesions, is considered the radiological hallmark of pulmonary TB in children. The adult-type disease with involvement of the apical and posterior segments of the upper lobe or the apical segment of the lower lobe is usually seen in older children more than ten years of age⁽⁴⁾.

Frontal and lateral chest radiographs are recommended for evaluation of children suspected of having pulmonary TB. However, in young children with a prominent thymus, radiographs may not demonstrate underlying mediastinal lymphadenopathy. Indeed, the chest radiograph

may be normal in up to 75% of children with TB anywhere in the body⁽⁵⁾. Thus, a normal chest radiograph in a child suspected of TB can be misleading.

The finding of characteristic mediastinal and/or hilar lymphadenopathy on CT in the appropriate clinical scenario is essentially diagnostic of paediatric TB, given the notoriously low yield in microbiological samples from children. CT is thus recommended for the demonstration of intrathoracic lymphadenopathy in clinically suspect patients. It has been found to detect lymphadenopathy in up to 60% of cases with normal chest radiographs⁽⁶⁾. Low attenuation areas within an anterior mediastinal mass are typical findings of tuberculous lymphadenopathy, and probably represent foci of caseous necrosis. Calcification is an uncommon feature of tuberculous lymphadenopathy in children⁽⁶⁾. Other causes of anterior mediastinal masses in children include malignancies such as leukaemia, lymphoma, germ cell tumours, thymomas (very rare), and benign lesions such as lymphangiomas.

CT is also useful for the demonstration of bronchial compression as well as pleural disease. Bronchial compression has been shown to affect up to 28% of children with TB mediastinal lymphadenopathy⁽⁵⁾. Pleural involvement is considered by many to represent extra-pulmonary disease and is uncommon in children, seen in about 10% of all new tuberculous infections⁽⁷⁾. It occurs due to direct spread from a subpleural Ghon’s focus or haematogenous dissemination. Signs of pleural tuberculosis include thickening, fluid collection and abnormal enhancement. When present, pleural tuberculosis in children seems to be more extensive and diffuse compared to adults and can involve entire pleural spaces⁽⁷⁾.

The TB organism gains access to the bloodstream and can spread haematogenously to virtually any organ in the body, thereby manifesting in a variety of clinical and radiological entities. TB is known for being the great “mimicker”, and will present differently, depending on the organ site involved. Extrapulmonary TB is the term used to describe TB involving any organ in the body other than lung parenchyma. It may occur together with pulmonary TB or in isolation. A quarter to a third of paediatric cases develop extrapulmonary manifestations^(3,8).

Extrathoracic lymphadenopathy is the commonest extrapulmonary site of TB, both in children and in adults^(8,9). TB lymphadenopathy is typically painless, unless there is superimposed

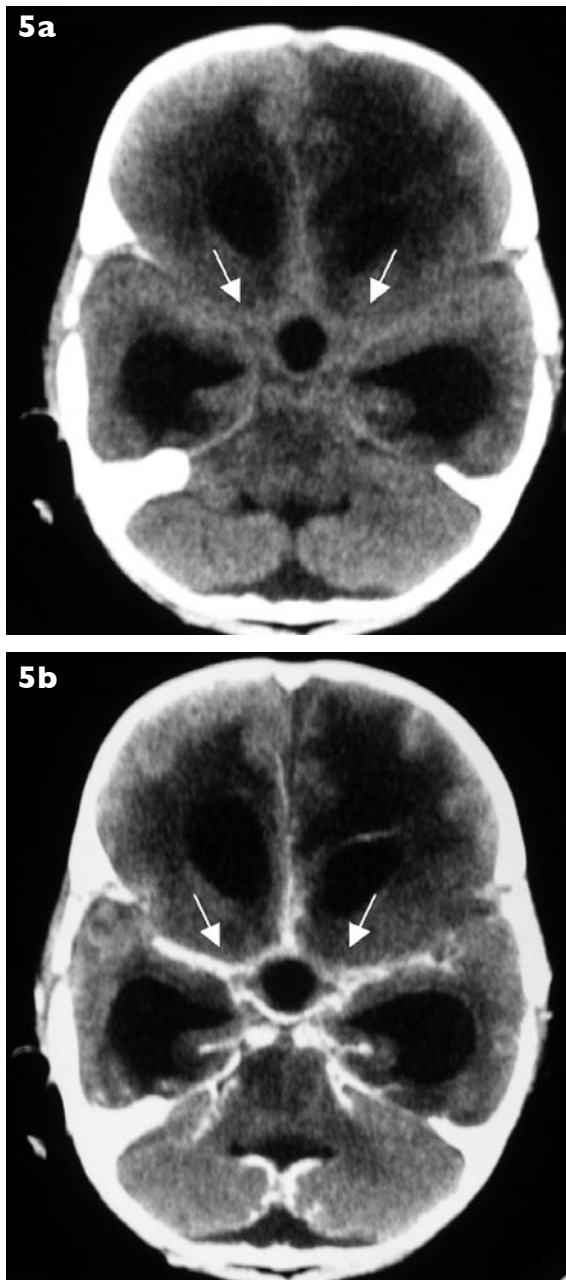


Fig. 5 Seven-month-old girl with TB meningitis who presented with fever and fits for nine days. (a) Unenhanced CT image of the brain shows dense exudates in the basal cisterns (white arrows) and hydrocephalus. (b) Enhanced CT image of the brain shows enhancement of the exudates in the basal cisterns (white arrows). These CT features are typical for tuberculous meningitis and the patient was started on anti-tuberculous therapy. The patient died eventually despite supportive therapy in the intensive care unit.

bacterial infection. In a study of 102 children with extrapulmonary TB, almost 50% of cases had peripheral lymphadenopathy⁽⁸⁾. 50% of these children had a concurrent site of infection. The cervical nodes are the most commonly affected, such as in this case. Cervical lymphadenopathy is also termed “scrofula”, meaning “glandular swelling” in Latin. The nodes coalesce, break down and perforate the deep fascia, resulting in

the characteristic collar-stud abscess, which this case resembles. Collar-stud abscesses have also been described in branchial cleft cysts.

Tuberculous involvement of the central nervous system (CNS) is the most severe and debilitating form of extrapulmonary TB. It is the third most common form of extrapulmonary TB after lymphatic and pleural disease, occurring in 15.5% of cases in a study of 102 children with extrapulmonary TB⁽⁸⁾. CNS TB manifests most commonly as tuberculous meningitis. CT features include hydrocephalus, hyperdensity in the basal cisterns, basal enhancement and parenchymal ischaemia or infarcts. The presence of hyperdensity in the basal cisterns on non-contrast enhanced studies have been reported to have a 100% specificity, with basal enhancement being most sensitive (89%) in a study of 32 children, for tuberculous meningitis⁽¹⁰⁾. The presence of typical CT findings is helpful in the diagnosis of tuberculous meningitis as obtaining a positive cerebrospinal fluid (CSF) AFB smear or culture can be difficult and variable, with reported percentages ranging between 3-50% and 10-80%, respectively⁽¹⁰⁾. Tuberculomas are an uncommon manifestation of CNS TB and in children, tend to be solitary and infratentorial in location⁽⁹⁾. Neurological deficits are common, even with treatment, and mortality rate is high, estimated to vary from 15% to 32%⁽¹¹⁾. Thus, early diagnosis and specific treatment are crucial when dealing with CNS TB (Fig. 5).

Skeletal TB is uncommon, comprising 10% to 20% of all cases of extrapulmonary TB⁽¹²⁾. In children, skeletal TB occurs through haematogenous spread. Tuberculous spondylitis (TBS), arthritis and osteomyelitis are the most common manifestations. TBS has been reported to be the most common form of osseous TB, accounting for up to 50% of cases⁽¹²⁾. Kyphosis, contiguous involvement of two or more vertebral bodies, intraspinal or paraspinal soft tissue masses, or abscesses, and subligamentous spread are all common findings in TBS. The thoracic spine is the commonest site of involvement in children, compared to the classical TBS in adults where the thoracolumbar junction is most frequently affected⁽¹³⁾. Magnetic resonance (MR) imaging is a suitable imaging modality for both diagnosis of TBS and its follow-up. TB arthritis is the second commonest form of involvement after TBS. Monoarticular involvement is typical, usually affecting the hips and knees⁽¹²⁾.

TB arthritis usually occurs due to metaphyseal TB crossing the physis into the joint. As the

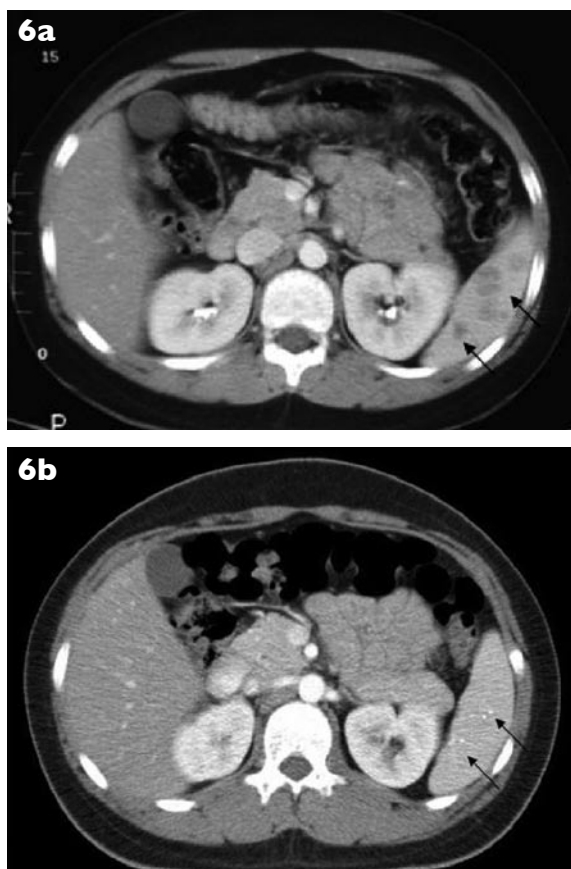


Fig. 6 14-year-old boy with biopsy-proven TB of the spleen. He was treated for appendicitis and developed recurrent fever 3 weeks after surgery. CT was performed to exclude an intraperitoneal abscess or other collections. (a) Enhanced CT image of the abdomen at presentation shows multiple hypodense lesions in the spleen (black arrows). The patient's Mantoux test was strongly positive. Blood and CSF cultures were negative for AFB. Eventually, a biopsy of the splenic lesions was performed and polymerase chain reaction (PCR) of the tissue samples was positive for TB. The patient was treated with one year of anti-tuberculous therapy (b) Enhanced CT abdomen taken three years later after complete anti-tuberculous therapy shows resolution of the hypodense splenic lesions with small foci of calcifications (black arrows) within the spleen.

transepiphyseal vessels disappear after the age of 1.5 years, TB arthritis becomes less common. Radiographical findings include the Pheister triad, which is made up of juxta-articular osteoporosis, peripheral osseous erosion and narrowing of the joint space. MRI is useful for detection of TB arthritis but is not specific. TB osteomyelitis is the least common and has been reported to occur in only 11% of children with skeletal TB⁽¹²⁾. However, in a study of tuberculous osteomyelitis in young children, involvement of the limbs outnumbered that of the vertebrae⁽¹⁴⁾. Common sites include the skull vault, hands, feet and ribs. Several radiographical patterns are seen, with the cystic form being the most commonly reported⁽¹²⁾.

Unlike adults, little data exists in the literature on abdominal TB in children. It is uncommon,

occurring in approximately 10% of children⁽¹⁵⁾. Lymphadenopathy is a common finding on CT, which typically demonstrates lymph nodes with a low-density centre and an enhancing rim. Calcification may be present but does not imply inactivity. In a study of 22 children with abdominal TB, lymphadenopathy was present in 50% of cases⁽¹⁵⁾. Other features include solid organ involvement (Fig. 6), omental thickening, bowel wall thickening (usually at the ileocaecal region) and ascites. These features are by no means specific, and the differential diagnoses include lymphoma, inflammatory bowel disease and other gastrointestinal infestations like *Yersinia* and amoebiasis.

Genitourinary TB, a common extra-pulmonary manifestation of TB in adults, is very rare in children (Fig. 7). It has been estimated to occur in less than 3% of all cases of paediatric TB⁽¹⁶⁾. Presentation is insidious and non-specific, with more than 50% of children with positive urine cultures being asymptomatic. Haematuria and epididymo-orchitis are the commonest presenting features⁽¹⁶⁾.

Directly observed therapy (DOT) is strongly recommended for all children with active TB. Various drug regimens have been utilised for paediatric pulmonary TB, including cervical lymphadenopathy. These include an initial intense daily therapy (of varying duration) of isoniazid, rifampin and pyrazinamide for the initial period, followed by intermittent isoniazid and rifampin for the rest of the treatment period totaling six months. The American Academy of Pediatrics recommends the use of an empiric four-drug regimen for children who reside in an area of >4% resistance⁽⁸⁾. Drug regimens remain similar for patients with extrapulmonary TB, but should be prolonged to a minimum of nine to 12 months⁽⁸⁾. Corticosteroids are beneficial in patients with CNS involvement.

Currently, both locally and worldwide, where human immunodeficiency virus (HIV) infection is on the rise, it is all the more important to be aware of the clinical presentation of both pulmonary and extrapulmonary TB. HIV-positive patients are more susceptible to both tuberculous as well as atypical mycobacterial infection. In immunocompetent patients, extrapulmonary TB is observed in 15-20% of cases. In HIV-positive patients, extrapulmonary TB is seen in >50%⁽⁹⁾. The commonest extrapulmonary manifestation of TB in both immunocompetent and HIV-positive patients is still lymphadenopathy⁽⁹⁾.

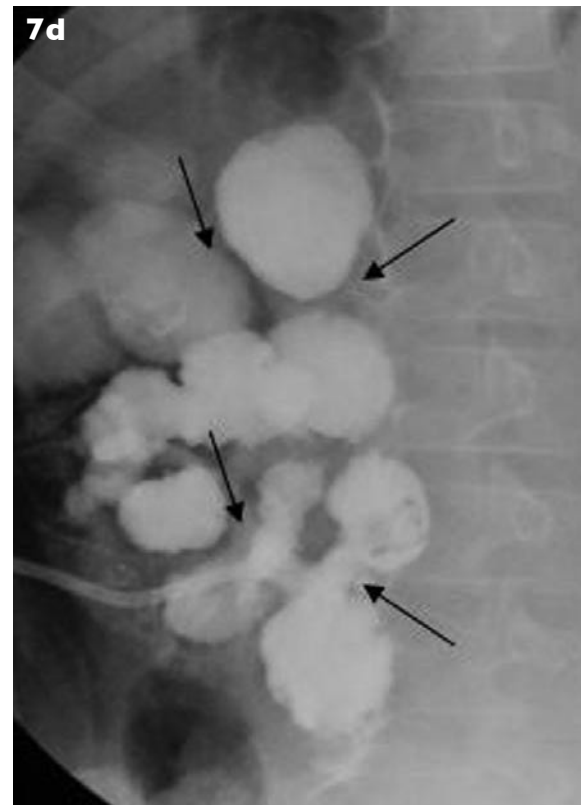
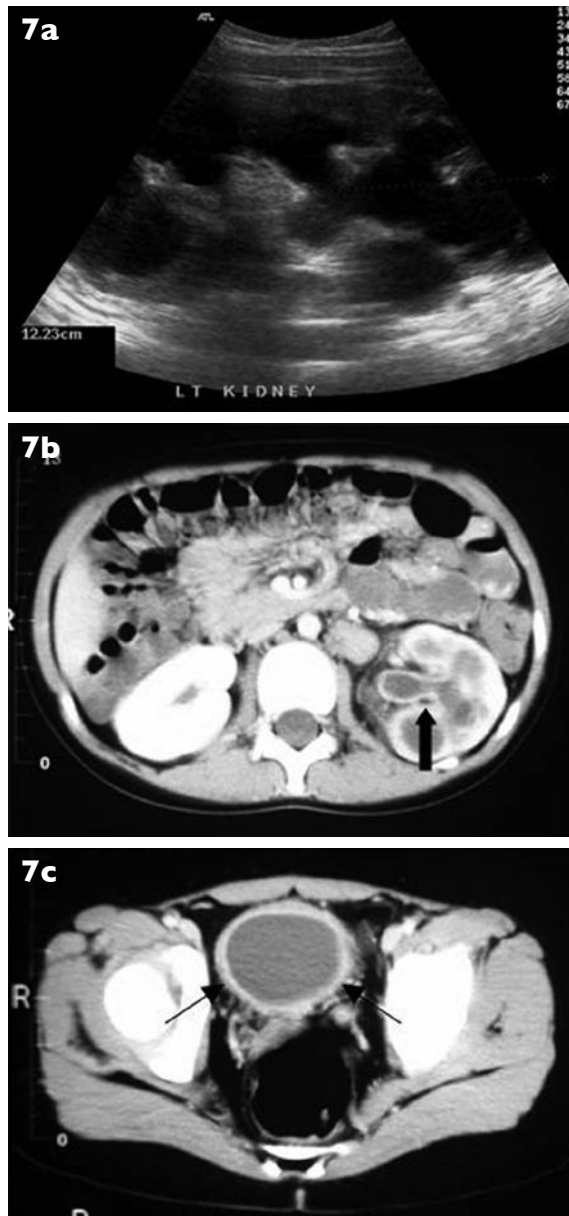


Fig. 7 11-year-old girl with urinary TB who presented with recurrent dysuria for six months. She had been treated with multiple courses of antibiotics, but urine tests revealed persistent pyuria. (a) Longitudinal US image of the left kidney shows moderate dilatation of the pelvis and all the calyces, consistent with moderate hydronephrosis. (b) Enhanced CT image taken at the level of the left renal hilum shows thickening and enhancement of the mucosa of the left renal pelvis (black arrow). The left kidney is poorly-enhancing compared to the right. (c) Enhanced CT image of the bladder shows diffuse thickening and enhancement of the bladder wall (black arrows). A percutaneous nephrostomy was performed to relieve her hydronephrosis. Urinary cultures were positive for TB. (d) Antegrade nephrostogram of the left kidney shows marked left hydronephrosis. There are multiple calyceal strictures (black arrows), typical of renal TB. The ureter was deemed unsuitable for stenting and a left nephrectomy was eventually performed.

Although the usual bacterial and viral infections are common in children, one must be vigilant when encountering a paediatric patient with unusual signs/symptoms. Familiarity of the various manifestations of TB and a high index of clinical suspicion are necessary for rapid and accurate diagnosis. A child with TB is often infected by someone close to him or her, usually by an adult. Thus, good contact tracing is essential.

In conclusion, TB is still a common and important disease in Singapore. It may present in a myriad of ways depending on the organ(s) involved. One should be aware of the various clinical presentations of both pulmonary and extrapulmonary TB. Although pulmonary TB is the commonest form of tuberculous infection, a normal

chest radiograph does not exclude the diagnosis. With the rise of HIV infection, extrapulmonary TB is becoming more common. Children are at a greater risk of infection and when diagnosed, indicate a recent transmission, necessitating vigilance in contact tracing.

ABSTRACT

A five-year-old girl presented with a history of left neck swelling for one week and right thumb swelling for three weeks. Imaging studies revealed a “collar-stud” abscess in the left side of the neck, massive mediastinal lymphadenopathy with a left anterior chest wall abscess, and right thumb dactylitis that was typical of tuberculosis

(TB). Surgical drainage of the left neck swelling revealed acid-fast bacilli. Young children are more susceptible to tuberculous infection, and at greater risk of extra-pulmonary spread. A child infected with TB indicates recent transmission, usually from an adult. Good contact tracing is essential. Individuals with HIV infection are also at greater risk of TB and atypical mycobacterial infection as well extrapulmonary TB. The clinical and radiological features of both pulmonary and extrapulmonary TB are discussed, with additional illustrative cases.

Keywords: children, dactylitis, lymphadenopathy, tuberculosis

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SINGAPORE MEDICAL COUNCIL CATEGORY 3B CME PROGRAMME

Multiple Choice Questions (Code SMJ 200603B)

	True	False
Question 1: Regarding pulmonary tuberculosis (TB):		
(a) Mediastinal lymphadenopathy is commonly seen in children with pulmonary TB.	<input type="checkbox"/>	<input type="checkbox"/>
(b) Intrathoracic lymphadenopathy is seen on CT in up to 60% of patients with pulmonary TB.	<input type="checkbox"/>	<input type="checkbox"/>
(c) A normal chest radiograph excludes active pulmonary TB.	<input type="checkbox"/>	<input type="checkbox"/>
(d) Calcified mediastinal nodes are a hallmark of pulmonary TB in children.	<input type="checkbox"/>	<input type="checkbox"/>
Question 2: Regarding paediatric TB:		
(a) The chance of a paediatric patient developing active tuberculous disease after being infected is inversely proportional to the patient's age.	<input type="checkbox"/>	<input type="checkbox"/>
(b) Pleural TB, when present in children, tends to be less extensive compared to adults.	<input type="checkbox"/>	<input type="checkbox"/>
(c) Extrapulmonary tuberculous infection occurs in about 30% of paediatric patients with TB.	<input type="checkbox"/>	<input type="checkbox"/>
(d) The cervical region is the most common site of peripheral lymphadenopathy in paediatric patients with extrapulmonary TB.	<input type="checkbox"/>	<input type="checkbox"/>
Question 3: Regarding central nervous system (CNS) TB:		
(a) TB of the CNS is the most severe form of extrapulmonary TB in children.	<input type="checkbox"/>	<input type="checkbox"/>
(b) Tuberculomas are common findings in CNS TB.	<input type="checkbox"/>	<input type="checkbox"/>
(c) CNS involvement is the commonest manifestation of extrapulmonary TB in HIV-positive patients.	<input type="checkbox"/>	<input type="checkbox"/>
(d) Brain infarcts can occur in patients with CNS TB.	<input type="checkbox"/>	<input type="checkbox"/>
Question 4: Regarding TB of the musculoskeletal system:		
(a) Tuberculous arthritis is more common in older children.	<input type="checkbox"/>	<input type="checkbox"/>
(b) Tuberculous spondylitis in children tends to involve the thoracolumbar junction.	<input type="checkbox"/>	<input type="checkbox"/>
(c) MR imaging is a suitable modality for the diagnosis and follow-up of patients with tuberculous spondylitis.	<input type="checkbox"/>	<input type="checkbox"/>
(d) Expansile cystic lesions of the bone is a feature of skeletal TB.	<input type="checkbox"/>	<input type="checkbox"/>
Question 5: Regarding abdominal/genitourinary TB:		
(a) Tuberculous lymphadenopathy commonly demonstrate low-attenuation centres on CT.	<input type="checkbox"/>	<input type="checkbox"/>
(b) Calcification within enlarged intra-abdominal nodes in patients with abdominal TB suggest inactivity.	<input type="checkbox"/>	<input type="checkbox"/>
(c) Haematuria is a common presenting feature of genitourinary TB in children.	<input type="checkbox"/>	<input type="checkbox"/>
(d) Abdominal and genitourinary TB are uncommon manifestations of extrapulmonary TB in children.	<input type="checkbox"/>	<input type="checkbox"/>

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Submission instructions:**A. Using this answer form**

1. Photocopy this answer form.
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3. Fill in your professional particulars.
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1. Answers will be published in the SMJ May 2006 issue.
2. The MCR numbers of successful candidates will be posted online at <http://www.sma.org.sg/cme/smj> by 20 May 2006.
3. All online submissions will receive an automatic email acknowledgment.
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