

Orthopaedic manifestations of tuberculosis

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An estimated 1 million people will be infected with tuberculosis worldwide in the first 20 years of the 21st century. If the disease is not recognized and treated early the morbidity and mortality of this condition will rise. This article highlights the varying manifestations of tuberculosis from an orthopaedic perspective.

Tuberculosis affects approximately one third of the world's population (Kochi, 1991) and about 1% of those will have skeletal involvement. In the developed world the prevalence of tuberculosis is increasing, particularly in large urban areas. Part of this resurgence in American cities is related to the human immunodeficiency virus (HIV) causing reactivation of latent tuberculous infection (Small et al, 1991; Coker, 1998). An ageing population, other causes of immunosuppression and an influx of immigrants from endemic areas also appear to be important factors (Davies et al, 1984; Watts and Lifeso, 1996).

Skeletal tuberculosis is an indolent disease whose diagnosis is often delayed (Vohra et al, 1997). Evidence of pulmonary tuberculosis is present in less than 50% of cases. Tuberculosis has been reported in all bones of the body (Yao and Sartoris, 1995) but the most frequent site of skeletal infection is the spine. Involvement of the bones and joints by this chronic granulomatous infection is most often secondary to haematogenous spread, but occasionally local extension from the lungs, kidneys or lymph nodes may occur.

All health professionals, not just orthopaedic surgeons, working in cities in developed countries will be encountering tuberculous osteomyelitis more frequently. They may have little experience or training in the management of this condition and may overlook the diagnosis with consequent catastrophic results.

Tuberculosis is uncommon nationally within the UK, however, clusters occur in urban areas with ageing populations and large immigrant groups. Often the diagnosis is not considered, leading to significant delay before the onset of treatment. Careful examination of the axial

skeleton, particularly in the confused elderly patient or immigrant from an area where tuberculosis is endemic, may reveal a gibbus deformity and so lead to tuberculous infection being included in the differential diagnosis. Suspicion of tuberculous infection is key to early diagnosis and early treatment. Even in the UK a high index of suspicion is required for prompt diagnosis and early referral to an orthopaedic surgeon may improve outcome.

PATHOGENESIS

In nearly all cases the first infection with *Mycobacterium tuberculosis* is pulmonary in nature. This is known as primary tuberculosis. It is usually subpleural, often in the mid to upper zones. Within an hour of reaching the lung, tubercle bacilli reach the draining lymph nodes at the hilum of the lung and a few escape into the bloodstream. After 3–8 weeks the classical tuberculous granulomas have formed, and most subsequently heal and calcify (*Figure 1*). It is the reactivation of these 'dormant' pockets of bacilli that leads to the typical post-primary tuberculosis when immunity to the mycobacterium has developed. Primary tuberculosis appears symptomless in the great majority, whereas the post-primary disease bears the hallmarks of its local destruction – collapse, bronchiectasis or effusions in the lung, meningitis, and joint destruction in bony involvement.

Treatment is primarily based on chemotherapy. Bed rest does not affect outcome (although it may enforce drug compliance if in hospital). The most important factor in the successful treatment of tuberculosis lies in the continual self-administration of drugs for 6 months. Treatment of bony involvement should continue for a total of

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9 months, however. A combination of rifampicin (600 mg daily) and isoniazid (300 mg daily), and pyrazinamide (1.5 g daily for the first 2 months only) is recommended. Surgery, where indicated, is aimed at removing the focus of infection. In bone this involves curettage for bony lesions or excision of soft tissues, for example synovium, that have become involved in the disease process.

Tuberculosis affecting the skeleton has a higher incidence in the spinal column. It affects the following sites in decreasing order of frequency:

- Knee
- Hip
- Ankle
- Wrist
- Sacroiliac joint
- Pubic symphysis
- Small bones of the hand and foot.

It can be difficult if not impossible to differentiate clinically and radiologically between tuberculosis and ordinary pyogenic osteomyelitis of the bone. Laboratory studies suggest chronic disease and include anaemia and a mild erythrocyte sedimentation rate elevation. Skin testing is not diagnostic.

There are a number of novel diagnostic techniques that have been developed to aid diagnosis and gain sensitivities from tissue or culture. The use of polymerase chain reaction to amplify specific tuberculosis DNA sequences permits rapid confirmation of the diagnosis and an estimation of drug sensitivity (Telenti et al, 1993; Shah et al, 1998). There are no radiographic or scintigraphic findings that are pathognomonic for tuberculosis. However, common radiographic features include rarefaction of vertebral end plates in the spine, bone loss, lytic areas and new bone formation. Computed tomography (CT) and magnetic resonance imaging (MRI) are helpful in delineating extent but will not reliably differentiate tuberculosis from other infections or neoplasms (Liu et al, 1993). In virtually all cases the first clinical signs are of pain, fever, chills, night sweats, anorexia and/or cachexia, and local swelling with a decrease in or loss of function of affected joints.

SKELETAL TUBERCULOSIS

Stages of infection

It is important to understand how tuberculosis infection occurs. This can be divided up into stages as follows:

Invasion: Infection usually commences in subchondral bone near the periphery of the joint and occasionally in the metaphysis close to the epi-

physeal line. A focus near a joint is seldom restricted to bone and almost invariably spreads to the joint within a short time.

Activity: Bacilli multiply and form tuberculous giant cells which coalesce and increase in size, destroying and replacing normal tissue. The tuberculous nodule formed is avascular so the centre degenerates and becomes necrotic (caseating). The articular cartilage is eroded allowing yet more extensive invasion of the underlying bone, and both bone and joint are progressively destroyed.

Abscess formation: A tuberculous abscess (cold abscess) forms after the surface of the bone or joint capsule is perforated and the tuberculous material passes outside. The abscess is initially contained by fascia or muscle sheaths and the material tracks along these. When the pressure of the abscess rises the fascial planes may be perforated and the abscess becomes subcutaneous – if left untreated a sinus develops.

Repair: Tuberculous granulation tissue is converted into fibrous tissue but active tubercles may be encapsulated in it and remain quiescent more or less indefinitely. If these tubercles are liberated from their encapsulating fibrous tissue as a result of injury reinfection can occur.

As repair is by fibrous tissue formation the ultimate result in most cases is fibrous ankylosis of the joint. In some regions, particularly the spine, slow ossification of the fibrous tissue may occur over a period of years, but as a rule a bony ankylosis occurs only when there has been a secondary infection.

Spinal tuberculosis

Delayed or missed diagnosis is particularly common in spinal tuberculosis. Slowly progressive constitutional symptoms are predominant in the



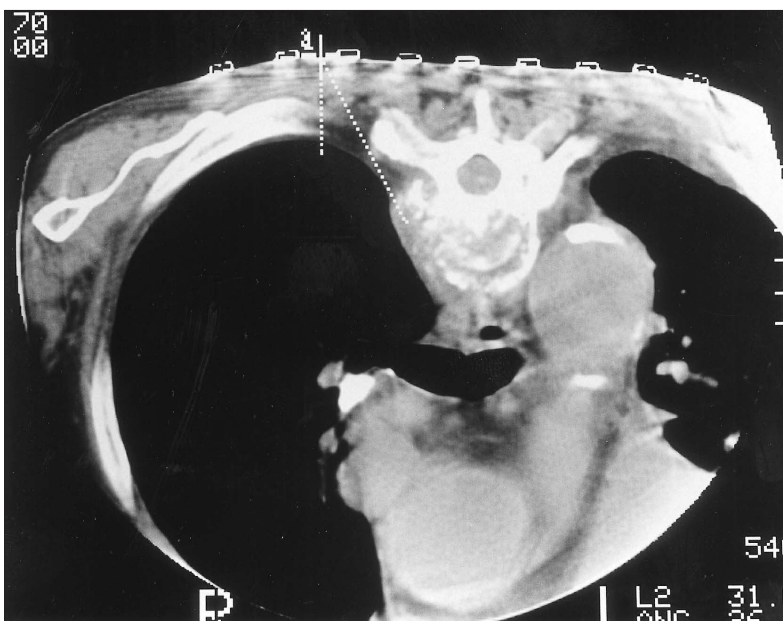
Figure 1. Pulmonary tuberculosis.

Figure 2. Axial skeleton involvement shown on magnetic resonance imaging.



Figure 3. Lumbar spine involvement misdiagnosed as a slipped disc.

Figure 4. Computed tomography-guided percutaneous biopsy of thoracic tuberculous spine lesion.



early stages of the disease including weakness, malaise, night sweats, fever and weight loss. Pain is a late symptom associated with bone collapse and paralysis (Figure 2). Cervical spine involvement may cause hoarseness because of recurrent laryngeal nerve palsy or dysphagia and respiratory stridor from abscess formation in the neck (Fang et al, 1983). Neurological signs usually occur late and may vary, with the presence of motor function and rectal tone as good prognostic factors. The development of neurological deficit is a strong indication for surgical treatment. Seddon (1935) noted that 70–95% of patients with Pott's paralysis recover. Poor prognosis for neurological recovery is associated with penetration of the dura by infection, vascular embarrassment and cord pressure from a bony ridge (Figure 3). Hodgson et al (1964) outlined two types of Pott's paraplegia on the basis of whether the paraplegia occurred during active disease or as a consequence of the healing process. He recommended early surgery to prevent dural invasion by infection that would cause irreversible paralysis.

The general indications for surgical intervention in spinal tuberculosis have been outlined by Rezaei et al (1995). These include more than 5° of kyphosis segmentally, more than 50% of vertebral body destruction, neurological compromise, unresponsiveness to medical treatment and in cases where a non-diagnostic percutaneous biopsy sample has been obtained (Figure 4).

Younger patients present with localized back pain, truncal rigidity, muscle spasm associated with fever and weight loss. Diagnosis in the elderly is difficult and the presentation of disease often involves non-localized constitutional symptoms.

Tuberculosis of the hip

In children the diagnosis can be hard to distinguish from Perthes' disease. Clinically the hip is found fixed in flexion, adduction and external rotation; muscle wasting tends to be considerable. These findings depend on the stage of presentation as to whether the muscle wasting is evident, but because of exquisite pain in the hip joint, relaxation of the capsule when the leg is held in flexion, adduction and external rotation provide some relief.

Generalized rarefaction and a diminished joint space may be seen on radiographs (Figure 5). If diagnosed early and the disease is limited to the synovium, as with the knee, chemotherapy and rest may suffice (again this is more common in children). However, if the disease

extends into the articular cartilage and bone, operative intervention such as synovectomy and curettage, abscess drainage near a joint, diagnostic biopsy or sequestrectomy may be required.

Tuberculosis of the knee

In children it is more common to find tuberculosis confined to the synovium when an obvious painful swollen joint will present itself. This manifestation often settles with only rest and chemotherapy, although if the disease fails to respond then a synovectomy would be indicated. If bone and cartilage are also involved then sequestrectomy and curettage of the bony lesions may be indicated. If the articular surfaces and adjacent bone are severely involved, then arthrodesis is advocated by some.

If an extra-articular abscess is discovered in the distal femur or proximal tibia then these can be drained through an incision directly over it, although it is important to differentiate the lesion from others such as Brodie's abscess, bone cyst, non-ossifying fibroma and enchondroma. Therefore it is recommended that a biopsy specimen be taken in all cases to confirm the diagnosis of tuberculosis by histopathological evaluation. After definitive curettage, if there is no evidence of secondary infection then the cavity can be filled with autogenous cancellous bone graft if required.

Figure 5. Tuberculous focus in the femoral neck.



Tuberculosis of the ankle

This can arise as a result of foci of tuberculosis in the distal tibia or fibula (*Figure 6*) or from the talus, although a chronic infection of the foot can lead to spread to the ankle joint. The patient presents with the described pain and swelling, and does not wish to weight bear on the affected ankle. The ankle may be warm to the touch and range of motion is often decreased and painful. If left untreated or undiagnosed, destruction of the talo-crural joint results in a severely disabled joint, preventing normal mobilization.

Tuberculosis of the ankle is often best treated by arthrodesis.

Tuberculosis of the foot

Tuberculosis of the bones of the foot can occur at any age. In neglected infections many bones may become involved, and a delay in diagnosis increases the risk of joint involvement. It is often the case that the initial manifestation of the disease (localized pain and swelling) was treated by anti-inflammatory drugs for a presumed non-infective cause. This is particularly so as radiological signs often precede such symptoms by weeks or months, and therefore a clinician's diagnosis of 'sprain' is not without basis. However, in chronic cases a discharging



Figure 6. Tuberculous focus in the medial malleolus.

sinus or ulcer can develop leading to further investigations and hopefully the correct diagnosis (Yeun and Tung, 2001). If present, isolated lesions usually involve the calcaneus or talus.

Tuberculosis of the wrist

The wrist is involved in 1–2% of patients with skeletal tuberculosis (Figure 7). Tenosynovitis of both the extensor and flexor tendons may result;



Figure 7. Distal radial involvement on plain radiograph.



Figure 8. Metacarpal head involvement of the middle finger by tuberculous osteomyelitis.

there is also the risk that secondary to this carpal tunnel syndrome may occur.

CLOSED CYSTIC TUBERCULOSIS

This is characterized by a well-defined cystic lesion in the bone without surrounding sclerosis or generalized osteopaenia (Babhulkar and Pande, 2002). Patients present with pain and swelling of the bone away from a joint. The lesions are closed without sinus formation. It is noted that this is more common in children and young adults (Murray, 1954; Cremin, 1971; Rasool et al, 1994). It occurs more frequently in the long bones, followed by the short bones and finally the flat bones – the commonest sites being humerus, tarsal bones and pelvis for each area respectively (Babhulkar and Pande, 2002). Lesions in the small bones of hands and feet lack any periosteal new bone formation, which is seen in the usual tubercular dactylitis. The traditional tubercular dactylitis (spina ventosa) (Figure 8) presents with four different radiological features:

1. Soft tissue swelling with marginal cortical erosion
2. Small central destruction with marked periosteal reaction and fusiform appearance
3. Cystic expansile lesion
4. Multiloculated cystic honeycomb appearance.

In closed cystic tuberculosis radiographs reveal an area of destruction without any evidence of sclerosis, periosteal reaction or sequestration.

After treatment with multidrug chemotherapy repeat radiographs will reveal sclerosis of the margins suggesting healing of the lesions.

EXTRA-AXIAL TUBERCULOSIS

A ‘cold’ abscess secondary to tuberculous spondylitis or osteomyelitis is a well-recognized entity. The commonest of these is the psoas abscess which is seen in relation to spinal tuberculosis. The abscess tracks down the psoas fascia and can eventually form a discharging sinus in the groin. Patients will have the signs and symptoms of skeletal tuberculosis but will also find movement of the affected side painful – particularly flexion of trunk and leg and adduction of leg. Plain radiographs may suggest a soft tissue swelling but the abscess is better visualized on CT or MRI (Figure 9).

Tuberculosis is also known to affect other organs of the body, and involvement of sections of the gastrointestinal tract is seen in up to 25% of patients with tuberculosis (Anand et al, 2003). The ileum and colon are most commonly affected and have been shown to demonstrate obstructive symptoms caused by strictures (Figure 10).

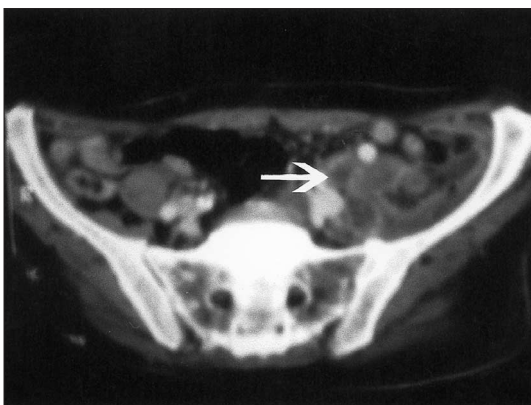
CONCLUSIONS

In our ever-changing multicultural society, with increasing movements of populations and a higher natural incidence of tuberculosis, the doctor training and working in the UK should always remind him-/herself that tuberculosis is a possible diagnosis. Tuberculosis can be a challenging diagnosis to make but it should be included in the differential, as missing the diagnosis can have serious repercussions for the patient.

Conflict of interest: none.

- Anand M, Reddy J, Khan A (2003) Gastrointestinal tuberculosis. *eMedicine* (online journal) www.emedicine.com/radio/topic885.htm
- Babhulkar SS, Pande SK (2002) Unusual manifestations of osteoarticular tuberculosis. *Clin Orthop* **398**: 114–20
- Cremin BJ (1971) Chronic bone infection in the young. *J Bone Joint Surg* **53B**: 561
- Coker R (1998) Lessons from New York's tuberculosis epidemic. *BMJ* **317**: 616
- Davies PDO, Humphries MJ, Byfield SP et al (1984) Bone and joint tuberculosis: a survey of notifications in England and Wales. *J Bone Joint Surg (Br)* **66B**: 326–30
- Fang D, Leong JCY, Fang HSY (1983) Tuberculosis of the upper cervical spine. *J Bone Joint Surg (Br)* **65B**: 47–50
- Hodgson AR, Yau A, Kwon JS, Kim D (1964) A clinical study of 100 consecutive cases of Pott's paraplegia. *Clin Orthop* **36**: 128
- Kochi A (1991) The global tuberculosis situation and the new control strategy of the World Health Organisation. *Tubercle* **72**: 1–6
- Liu GC, Chou MS, Tsai TC, Lin SY, Shen YS (1993) MR evaluation of tuberculous spondylitis. *Acta Radiol* **34**: 554–8
- Murray RO (1954) Observation on cystic tuberculosis of bone. *Proc R Soc Med* **47**: 133
- Rasool MN, Govender S, Naidoo KS (1994) Cystic tuberculosis of bone in children. *J Bone Joint Surg* **76B**: 113–17
- Rezai AR, Lee M, Cooper PR et al (1995) Modern management in spinal tuberculosis. *Neurosurgery* **36**: 87–98
- Seddon HJ (1935) Pott's paraplegia: prognosis and treatment. *Br J Surg* **22**: 769–99
- Shah S, Miller A, Mastellone A et al (1998) Rapid diagnosis of tuberculosis in various biopsy and body fluid specimens by the AMPLICOR *Mycobacterium tuberculosis* polymerase chain reaction test. *Chest* **113**: 1190–4
- Small PM, Schechter GE, Goodman PC, Sande MA, Chaisson RE, Hopewell PC (1991) Treatment of tuberculosis in patients with advanced human immunodeficiency virus infection. *N Engl J Med* **324**: 289–94
- Telenti A, Imboden P, Marchesi F et al (1993) Detection of rifampicin-resistance mutations in *Mycobacterium tuberculosis*. *Lancet* **341**: 647–50

Figure 9. Computed tomography scan of a tuberculous psoas abscess.



- Vohra R, Kang HS, Dogra S, Saggarr RR, Sharma R (1997) Tuberculous osteomyelitis. *J Bone Joint Surg (Br)* **79B**: 562–6
- Watts HG, Lifeso RM (1996) Tuberculosis of bones and joints. *J Bone Joint Surg (Am)* **78A**: 288–98
- Yao DC, Sartoris DJ (1995) Musculoskeletal tuberculosis. *Radiol Clin North Am* **33**: 679–84
- Yeun MC, Tung WK (2001) An uncommon cause of foot ulcer: tuberculosis osteomyelitis. *Emerg Med J* **18**: 140–1

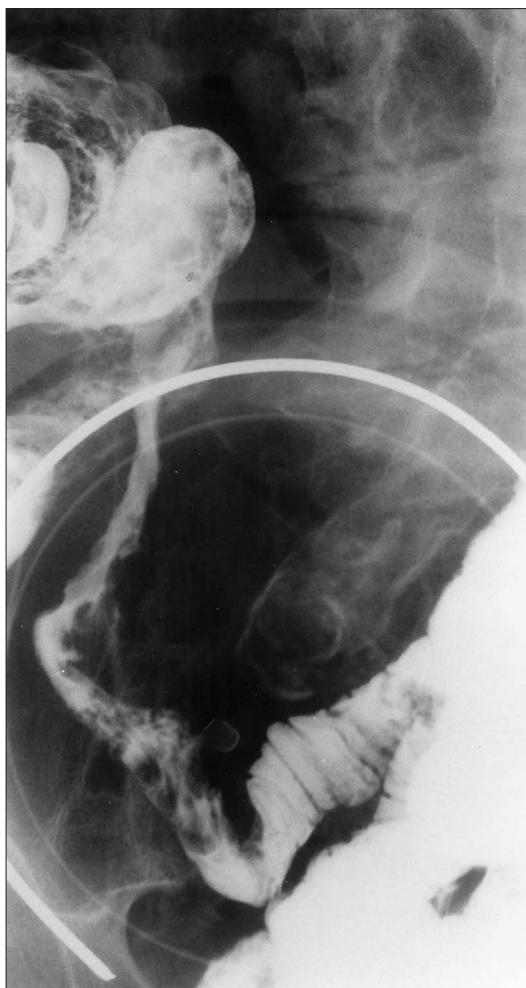


Figure 10. Terminal ileal involvement (Kantor's string sign) on barium enema.

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KEY POINTS

- The prevalence of tuberculosis in the developed world is increasing.
- The diagnosis of skeletal tuberculosis is often delayed or missed.
- It can be difficult to differentiate between tuberculous and ordinary pyogenic osteomyelitis both clinically and radiographically.
- In the majority of cases the first clinical signs are vague, but include pain, fever, chills or night sweats, and local swelling.
- The highest incidence of bony involvement is in the spinal column, but any bone or joint can be affected.
- The mainstay of treatment is prolonged chemotherapy, but surgery has a place in the management of more chronic disease.
- Always contemplate the possibility of tuberculous disease as part of the differential diagnosis.