Musculoskeletal Tuberculosis Manifestations. A pictorial review

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Purpose

The prevalence of tuberculosis in nonendemic populations appears to be rising in recent years due to factors like increased migration, increasing number of immunocompromised patients (ie chemotherapeutic agents used to treat other diseases or AIDS), development of drug-resistant strains of Mycobacterium, aging population, number increase of healthcare workers exposed to the disease. It is with this in mind that we would like to present a pictorial review of the varying musculoskeletal manifestation of tuberculosis (skeletal TBC) with references to plain X-rays, MRI and CT.
Methods and Materials

We present images (plain X-rays, CT and MRI) from patients referred to our department who were diagnosed with skeletal TBC either by histologic analysis and culture of mycobacteria from bone tissue or synovial fluid (minority of cases) or by treatment response and/without a positive tuberculin skin test.

Wikipedia: Plus-minus is an ice hockey statistic that measures a player's goal differential.
Results

Skeletal TBC, constituting 1 to 3% of TBC cases, can occur at any age with equal frequency in both sexes. Although almost any part of the skeleton can be involved, the spine, hip, knee and pelvis are most frequently affected. The multifocal skeletal form is rare even in endemic countries (<5% of all skeletal TBC).

Note that:

- There are no pathognomonic radiologic features of skeletal TBC.
- Any individual with a skeletal lesion suspicious to be tuberculous must be evaluated for the possibility of other involved sites (lungs, intestinal tract, and kidneys).
- Only about 1/3 of patients with skeletal TBC have a history of pulmonary disease.

Although the imaging features are suggestive, but not pathognomonic, their knowledge may help reduce diagnosis time (16-19-months average delay between symptoms onset and reported diagnosis) and, hence, the associated morbidity.

Spinal TBC

- Vertebral lesion is the commonest skeletal lesion (responsible for 50% of all bone & joint TBC)
- Lower thoracic and upper lumbar spine are the most commonly affected levels (involvement of cervical spine and sacrum is less common)

Infection usually begins in the anterior part of the vertebral body adjacent to the end plate with subsequent demineralization resulting in **loss of definition of the end plate dense margins on conventional radiographs**. These end plate changes allow the spread of infection to the adjacent intervertebral disk. The combination of vertebral body and disc destruction in TBC is similar to that occurring in pyogenic spondylitis., although the TBC process is not usually rapidly progressive. The loose internal structure of the disk allows the infection to disseminate more widely into additional spinal segments, resulting in **the classic pattern of involvement of more than one vertebral body together with the intervening disks**. It also allows spread into the paraspinal tissues, resulting in the **formation of a paravertebral abscess (Pott abscess)**. In the lumbar spine, a psoas abscess may extend into the groin and thigh and may simply manifest as **lateral bowing of the psoas shadow on conventional radiographs**. An abscess that lies more anteriorly or the subligamentous spread of infection may result in **anterior scalloping of the vertebral bodies** (similar to paravertebral lymphadenopathy, secondary to metastases or lymphoma, or to abdominal aortic aneurysm). **Calcification within the abscess** is virtually diagnostic for TBC. If left untreated, the infection eventually results in **vertebral collapse and anterior wedging**, leading to **kyphosis**.
and** **gibbus formation.** With healing, **ankylosis of the vertebral bodies occurs with obliteration of the intervening disk space.** The involvement of a single vertebral body with sparing of the adjacent disks has also been described. Whatever the spread of infection, TBC is characteristically associated with **little or no reactive sclerosis or local periosteal reaction,** a feature that helps distinguish it from spine pyogenic infections (other radiologic features that favor the diagnosis of TBC over pyogenic infection include **involvement of one or more segments, a delay in intervertebral disks destruction and a large, calcified paravertebral mass**).

TBC rarely affects the posterior vertebral elements (including the pedicles), in contrast to metastatic disease.

MR imaging is the preferred imaging modality in the diagnosis and assessment of TBC spondylitis because of its sensitivity to soft-tissue abnormalities and multiplanar capability.

T1-weighted images typically show **decreased signal within the affected vertebral bodies, loss of disk height** and **paraspinal soft-tissue masses.**

T2-weighted images often show **nonspecific increased signal within the areas of osseous and soft-tissue changes.**

Contrast-enhanced sequences are helpful in distinguishing between TBC spondylitis (presence of a thick rim of enhancement around paraspinal and intraosseous abscesses) and other granulomatous spinal infections. Involvement of paraspinal soft tissues and subligamentous spread of infection often are best evaluated with coronal contrast-enhanced images.

Differential diagnosis includes: metastatic disease, low-grade pyogenic infection (eg, brucellosis), fungal infection, and sarcoidosis, all of which have similar imaging characteristics.

**Isolated tuberculous osteomyelitis** (in the absence of associated TBC arthritis)

- relatively rare
- femur, tibia, and small bones of hands and feet most commonly affected
- typically, metaphyses are involved

Radiographic features include **osteopenia** and **poorly to well defined lytic lesions with minimal surrounding sclerosis.** In the immature skeleton, the **spread of infection across the epiphyseal plate** is a feature that helps distinguish tuberculosis from pyogenic infection.

**Cystic tuberculosis**
• an unusual pattern of osteomyelitis (more common in children)
• long bones metaphyses tend to be affected in children, whereas axial skeleton (skull, shoulder, pelvis) is involved in adults

Radiographic features include **multiple small, well-defined oval lytic lesions of variable size that usually lack sclerotic margins.**

**Tuberculous dactylitis**

• painless involvement of the short tubular bones of hands and feet (more common in children)

Radiographic features include **pronounced fusiform soft-tissue swelling with or without periostitis** (the most common finding), **coarsening of the trabecular pattern** and **acro-osteolysis with reactive sclerosis and joint involvement.** Chronic untreated infection may lead to sinus tracts formation.

Differential diagnosis includes: pyogenic or fungal infections, leukemia, sarcoidosis, hemoglobinopathies, hyperparathyroidism, and syphilis.

**Tuberculous arthritis**

• characteristically a gradually worsening monoarthritis affecting large weight-bearing joints
• Systemic and pulmonary symptoms are frequently absent

Radiographic features are similar to those of other infectious and inflammatory arthritides and are, therefore, nonspecific. These include: **osteopenia, synovitis** and **other soft-tissue swellings, marginal erosions** and **varying degrees of cartilage destruction.**

With progression of infection, **bone sequestration** and **sinus formation** can develop. The end result is usually **fibrous ankylosis of the joint. Bone ankylosis** occasionally occurs but is more commonly seen with pyogenic infections.

MR imaging is more sensitive than conventional radiography in assessing the extent of bone and joint involvement but the findings are again nonspecific, particularly in early disease. This fact reinforces the importance of joint aspiration for microscopic analysis and culture.

Differential diagnosis includes: pyogenic and fungal infections. Factors favoring a diagnosis of TBC include insidious onset, minimal sclerosis, the relative absence of periosteal reaction and bone proliferation, and relative preservation of joint space in the early stages.
Fig. 1: X-ray and CT image show a well defined lytic lesion with minimal surrounding sclerosis and no periostitis in the region of lesser trochanter.

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Fig. 2: Sagittal T1-weighted image of lumbar spine: TBC spondylodiscitis producing vertebral and disc destruction. Note the anterior lesions of the vertebral bodies with bowing of adjacent anterior longitudinal ligament and mild encroachment on the spinal cord.

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Fig. 3: Sagittal T2-weighted image of lumbar spine of the same patient with Fig.2: TBC spondylodiscitis producing vertebral and disc destruction. Note the anterior lesions of the vertebral bodies with bowing of adjacent anterior longitudinal ligament and mild encroachment on the spinal cord.

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Fig. 4: Erosions of discovertebral junctions on axial CT and adjacent paravertebral inflammatory soft tissue mass. CT-guided biopsy revealed TBC spondylitis.

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Fig. 5: Extensive vertebral body destruction and paravertebral inflammatory soft tissue mass. CT-guided biopsy revealed TBC spondylitis.

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**Fig. 6:** Axial CT scan delineated the degree of osseous erosion and extent of paravertebral soft tissue mass. CT guided drainage showed TBC infection.

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**Fig. 7:** Vertebral body destruction and a psoas muscle abscess. CT guided drainage revealed TBC infection

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Fig. 8: Vertebral body erosions and a psoas muscle abscess. CT guided drainage confirmed the diagnosis of TBC spondylitis.

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Fig. 9: CT guided aspiration of a paravertebral abscess in an immigrant revealed TBC infection.

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**Fig. 10:** A large prespinal abscess at the level of cervical spine. Note the presence of an epidural abscess as well. CT guided drainage revealed TBC infection.

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Conclusion

A prompt diagnosis can limit the long term sequelae and devastating effects of untreated TBC. TBC, a potentially lethal condition if left untreated, has an excellent prognosis if diagnosed and treated early. In many cases biopsy or culture specimens are required to make a definitive diagnosis given that skeletal TBC radiologic features may mimic many other diseases. However, it is imperative that radiologists and clinicians are aware of the typical distribution, patterns and imaging manifestations and appearances of skeletal TBC which can present when least expected.
References