Pott disease (spinal tuberculosis): MR and CT imaging

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Learning objectives

To go through the main imaging findings and differential diagnostic considerations of spinal tuberculosis on Magnetic Resonance Imaging (which is the imaging method of choice) and Computed Tomography, using cases from our Department.
Background

Tuberculosis (TB) used to be a major public health problem. Its incidence has decreased significantly since the middle of the 20th century, owing to the use of anti-mycobacterial drugs. However, the disease remains endemic in many developing countries, due to socio-economic factors (poverty, malnutrition, lower hygiene standards) and the appearance of multiple drug-resistant mycobacterium strains. During the last decades, there has been a resurgence of TB in developed countries too, mainly because of the rise in the number of immunosuppressed patients, but also massive immigration from endemic countries and increased availability of travel. The incidence of TB is particularly high in AIDS patients and it is often the first clinical manifestation of HIV infection.

While pulmonary manifestations are the commonest clinical presentation of TB, in a large number of cases (20-50%) there are extra-pulmonary manifestations as well. Musculoskeletal manifestations are present in 1-3% of all TB patients, with the commonest being tuberculous spondylodiscitis or "Pott disease", occurring in about half of the cases. This condition was named after Percivall Pott, an English surgeon, who first described spinal tuberculosis in 1779. Other musculoskeletal manifestations of TB include arthritis, osteomyelitis, tenosynovitis, bursitis and myositis.

Pott disease is usually caused by hematogenous spread of mycobacterium infection of lung or genitourinary origin. It has no sex predilection and it is more common in children in the developing world, whereas in the developed world it affects adults more often (especially young immunosuppressed adults). It initially involves a granulomatous lesion in the vertebra with central caseating necrosis, followed by the formation of granulation tissue.

The course of the disease usually (but not necessarily) begins at the anterior part of the vertebral body, proximally to the end plate. It progresses slowly, showing relative preservation of the intervertebral disc height and lack of sclerosis. It causes trabecular destruction and progressive demineralization of the vertebral body, which is seen as lytic bone lesions with distinct margins and without periosteal reaction on imaging studies.

In the majority of cases, the disease spreads to the intervertebral disc, to adjacent (or non-adjacent) vertebrae and to the adjacent soft tissues, via the disc or the ligaments. The aforementioned spread usually occurs anterolaterally to the vertebral body and often manifests as epidural, paraspinial or soft tissue abscesses. These large paraspinial abscesses, which tend not to have frank pus or cause severe pain, are called "cold abscesses", and may extend into the groin or thigh.
Non-contiguous (skip) lesions, involving multiple non-adjacent vertebrae are commonly seen in Pott disease, contrary to pyogenic spondylodiscitis. Posterior vertebral elements are less often involved in Pott disease than in pyogenic or fungal infections.

Possible complications of Pott disease are **vertebral body fractures**, which may lead to anterior wedging of vertebral bodies and focal kyphosis ("gibbus deformity") or to vertebral body collapse ("vertebra plana"), **cord compression** leading to myelopathy (caused by epidural abscesses, bony fragments caused by fractures or angulation caused by focal kyphosis), which in severe cases may lead to paraplegia or quadriplegia, and **meningomyelitis** (an intense pachymeningitis).
Findings and procedure details

Typically, Pott disease progresses indolently, without acute pain and leukocytosis. It most commonly involves the thoracolumbar junction of the spine. Typically, it presents with involvement of contiguous vertebrae, whereas atypical (but not uncommon) presentations include skip lesions or involvement of posterior spinal elements. Single-vertebra involvement may occur, too.

There are several different patterns of vertebral involvement in Pott disease, with the commonest being the anterior (subperiosteal) type, in which the infection begins at the anterior vertebral margin and spreads subligamentally. Other patterns are: the paradiscal (marginal) type, in which infection begins at the endplate and progresses to involve the vertebral body, the central type, which manifests as a central lytic lesion and may progress to cause vertebral body collapse (vertebra plana), and the posterior (neural arch) type, which is the rarest.

MRI and CT imaging are both of great value in imaging Pott disease, as they can demonstrate small foci of bone infection and the extent of disease. MRI is the imaging method of choice, being superior in demonstrating bone marrow pathology and lesions within the spinal canal, whereas CT is superior in demonstrating bone lesions.

The MRI protocol used in our Department for imaging patients with Pott disease covers the whole spine and consists of the following sequences:

- Sagittal T1w FSE
- Sagittal T2w FSE
- Sagittal STIR
- Axial T2w
- Axial T1w
- Post-Gd Sagittal T1w

- Post-Gd Axial T1w

**MRI imaging findings are:**

- high signal on T2wI and STIR of the bone marrow of the affected vertebral bodies

- low signal on T1wI in the affected vertebral bodies, with irregular vertebral endplates

- in chronic disease there is high signal on T1wI, which is specific for Pott disease

- high signal on T2wI and STIR in the involved intervertebral discs (not as often as in pyogenic infections) and adjacent soft tissues

- affected vertebral body (bone marrow) enhancement after intravenous gadolinium administration

- peripheral rim enhancement after intravenous gadolinium administration, in case of abscesses

- high signal on T2wI within the spinal cord, in case of compressive myelopathy

- subligamentous inflammation spread with a smooth margin (in contrast to the irregular margin which characterizes pyogenic infections).

The CT protocol used in our Department for imaging patients with Pott disease comprises scanning the whole spine with low slice thickness (1 mm), using multiplanar reconstructions and both bone and soft tissue window.

**CT imaging findings are:**

- end plate destruction
- vertebrae fragmentation

- absence of sclerosis or new bone formation

- pre- / para- vertebral abscesses, with peripheral rim enhancement after intravenous contrast medium administration

- calcification within the abscesses is virtually pathognomonic of tuberculosis

- extension of bony fragments and epidural abscesses into the spinal canal.

Imaging signs of disease healing are:

- lesion regression

- sclerosis and fusion of contiguous vertebral bodies

- size reduction of the inflammatory soft tissues

Main differential diagnoses of Pott's disease are other causes of infectious spondylodiscitis. **Pyogenic infections** are the commonest, usually caused by Staphylococcus aureus or gram-negative bacteria. Unlike Pott disease, they tend to cause severe back pain and constitutional symptoms. The characteristic rapid destruction and intense enhancement of the intervertebral disc, along with the absence of skip lesions are useful criteria for diagnosing this entity.

**Fungal infections** causing spondylodiscitis may imitate Pott disease. They are common in immunosuppressed patients and they may be endemic in certain areas of the world. Some fungal infections spare the intervertebral disc, like coccidioidomycosis, while others like blastomycosis and actinomycosis tend to destroy it.

**Brucellosis** may present as granulomatous osteomyelitis of the spine and is usually indistinguishable from Pott disease on imaging studies. However, some unique characteristics of brucellar spondylitis are gas within the intervertebral disc, a minimal
associated paraspinal mass, absence of kyphosis, and predilection for the lower lumbar spine.

**Spinal metastases** may mimick Pott disease on imaging studies, as they cause similar bone marrow signal changes on MRI, cause pathologic fractures, spare the intervertebral disc, may have accompanying soft tissue masses and may involve multiple non-contiguous vertebrae. Nevertheless, the diagnosis can be reached by the patient’s history, the fact that metastases tend to involve the posterior spinal elements in the majority of cases and that they cause diffusion restriction in the bone marrow on DWI.

Finally, **osteoporotic** fractures are easily diagnosed, as they do not cause abnormal bone marrow signal.
Fig. 1: MRI, STIR image, cervical spine, sagittal plane, showing high bone marrow signal of the 3rd and 5th cervical vertebrae in a 25 year-old man with Pott disease

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Fig. 2: MRI, T1wI, cervical spine sagittal plane, of the same patient, showing low bone marrow signal of the affected vertebrae, as well as deformity of the 3rd cervical vertebral body

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**Fig. 3:** MRI, T1wI post gadolinium administration, sagittal plane, of the same patient, showing an epidural abscess with peripheral enhancement, posteriorly to the C1-C4 vertebral bodies, as well as peripherally enhancing abscesses in the prevertebral space.

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Fig. 4: MRI, T1wI post gadolinium administration, axial plane, of the same patient, showing the epidural abscess compressing the spinal cord

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Fig. 5: CT, axial image, post intravenous contrast administration, in a 52 year old woman with Pott disease, showing an L1 osteolytic lesion, with an accompanying rim-enhancing abscess in the left psoas muscle

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**Fig. 6:** CT, axial image, post intravenous contrast administration, of the same patient, showing extension of the abscess into the thigh

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Fig. 7: MRI, T1wI post gadolinium administration, sagittal plane, in a man with Pott disease, showing a rim-enhancing abscess in the posterior elements of the L5 vertebra.
Fig. 8: MRI, T1wI, lumbar spine, sagittal plane, of a 60 year-old man with pyogenic spondylodiscitis, showing pathologically low signal in adjacent L3-L4 vertebral bodies, with destruction of the intervertebral disc

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Fig. 9: MRI, T1wI, lumbar spine, sagittal plane, of a 65 year-old woman with vertebral metastases, showing pathologically low signal in several non-contiguous vertebral bodies (mainly L2 and L4), with intervertebral disc sparing

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Fig. 10: MRI, DWI, coronal plane, in a man with vertebral metastases, showing restricted diffusion (high signal) in the affected vertebrae

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Conclusion

Spinal tuberculosis is an imaging diagnosis which has become common lately, and one that should not be missed so that patients can receive prompt and proper treatment and possible complications are avoided.
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