SPINAL TUBERCULOSIS
A REVIEW

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Key Contents
- Pathology of spinal tuberculosis
- Clinical features of spinal tuberculosis
- Investigations for spinal tuberculosis
- Management of spinal tuberculosis
- Complications of spinal tuberculosis

Learning Objectives
- To explain pathophysiology of spinal tuberculosis
- To describe clinical and radiological features of spinal tuberculosis
- To discuss management methods of spinal tuberculosis
- To enlist complications of spinal tuberculosis

Key words: Pott’s Disease, Paraplegia, Cold Abscess, Bone Scan.

Introduction
Spinal tuberculosis is a frequently encountered extrapulmonary form of the disease. In developed nations, most cases of spinal tuberculosis are seen primarily in immigrants from endemic countries. Despite its common occurrence and the high frequency of long-term morbidity, there are no straightforward guidelines for the diagnosis and treatment of spinal tuberculosis. Early diagnosis and prompt treatment is necessary to prevent permanent neurological disability and to minimize spinal deformity.1,2

Spinal tuberculosis is popularly known as Pott's spine. The name traces back its origin from the description of tuberculous infection of the spine by Sir Percival Pott in his monograph in 1779.3 The majority of his patients were infants and young children. The classic destruction of the disk space and the adjacent vertebral bodies, destruction of other spinal elements, severe and progressive kyphosis subsequently became known as Pott's disease. Currently, the term 'Pott's disease/Pott's spine' describes tuberculous infection of the spine and the term 'Pott's paraplegia' describes paraplegia resulting from tuberculosis of the spine.

Epidemiology
Tuberculosis is a disease of poverty that affects mostly young adults in their most productive years. The risk of developing tuberculosis is estimated to be 20–37 times greater in people co-infected with HIV than among those without HIV infection. Although multidrug-resistant tuberculosis is not common in spinal disease, there have been a few recent case reports.4

The exact incidence and prevalence of spinal tuberculosis in most parts of the world are not known. In countries with a high burden of pulmonary tuberculosis, the incidence is expected to be proportionately high. Approximately 10% of patients with extrapulmonary tuberculosis have skeletal involvement. The spine is the most common skeletal site affected, followed by the hip and knee. Spinal tuberculosis accounts for almost 50% cases of skeletal tuberculosis.5

Multi-level noncontiguous vertebral tuberculosis
Multi-level noncontiguous spinal tuberculosis is an atypical form of spinal tuberculosis that affects two noncontiguous vertebrae without destruction of the adjacent vertebral bodies and intervertebral disks. However, in one study, the incidence of multi-level noncontiguous vertebral tuberculosis was observed as high as 71% and a large proportion of the patients with affected noncontiguous vertebral sites were asymptomatic. In this retrospective analysis, patients were included if spinal infection was identified by whole spine magnetic resonance imaging (MRI) and confirmed as tuberculosis by a combination of histology and microbiology.6 In another study, authors identified 16 cases of noncontiguous spinal tuberculosis from a single surgeon series of 98 patients. Most noncontiguous lesions were evident on plain radiology and noncontiguous tuberculosis was not associated with HIV infection, multidrug-resistant tuberculosis or with chronicity of the disease.7

Pathogenesis and pathology
Predisposing factors for tuberculosis include poverty, overcrowding, illiteracy, malnutrition, alcoholism, drug abuse, diabetes mellitus, immunosuppressive treatment, and HIV infection. Genetic susceptibility to spinal tuberculosis has recently been demonstrated.8
Spinal involvement is usually a result of hematogenous spread of M. tuberculosis into the dense vasculature of cancellous bone of the vertebral bodies. The primary infection site is either a pulmonary lesion or an infection of the genitourinary system. Spread occurs either via the arterial or the venous route. An arterial arcade, in the subchondral region of each vertebra, is derived from anterior and posterior spinal arteries; this arcade form a rich vascular plexus. This vascular plexus facilitates hematogenous spread of the infection in the paradiskal regions. Batson's paravertebral venous plexus in the vertebra is a valve-less system that allows free flow of blood in both directions depending upon the pressure generated by the intra-abdominal and intrathoracic cavities following strenuous activities like coughing. Spread of the infection via the intraosseous venous system may be responsible for central vertebral body lesions. In patients with noncontiguous vertebral tuberculosis, again it is the vertebral venous system that spreads the infection to multiple vertebrae.

Spinal tuberculosis is initially apparent in the anterior inferior portion of the vertebral body. Later on it spreads into the central part of the body or disk. Paradiskal, anterior, and central lesions are the common types of vertebral involvement. In the central lesion, the disk is not involved, and collapse of the vertebral body produces vertebra plana. Vertebra plana indicates complete compression of the vertebral body. In younger patients, the disk is primarily involved because it is more vascularized. In spinal tuberculosis, there is involvement of more than one vertebra because its segmental arteries bifurcate to supply two adjacent vertebrae. Spread of the disease beneath the anterior or posterior longitudinal ligaments involves multiple contiguous vertebrae. In spinal tuberculosis, characteristically, there is destruction of the intervertebral disk space and the adjacent vertebral bodies, collapse of the spinal elements, and anterior wedging leading to the characteristic angulation and gibbus (palpable deformity because of involvement of multiple vertebrae) formation. The upper lumbar and lower thoracic spine are most frequently involved sites. More than one vertebra is typically affected, and the vertebral body is more frequently affected than the posterior arch. Distortion of spinal column leads to spinal deformity.

Paraplegia is the most devastating complication of spinal tuberculosis. These two groups were paraplegia of active disease (early-onset paraplegia) and paraplegia of healed disease (late-onset paraplegia).

Early-onset paraplegia develops in the active stage of spinal tuberculosis and requires active treatment. This type of paraplegia has a better prognosis and is frequently seen in adults with Pott's spine. Late-onset paraplegia is a neurological complication that develops after a variable period in a patient with healed tuberculosis. Late-onset paraplegia may develop two to three decades after active infection. It is often associated with marked spinal deformities.

**Clinical features**
The characteristic clinical features of spinal tuberculosis include local pain, local tenderness, stiffness and spasm of the muscles, a cold abscess, gibbus, and a prominent spinal deformity. The cold abscess slowly develops when tuberculous infection extends to adjacent ligaments and soft tissues. Cold abscess is characterized by lack of pain and other signs of
inflammation (Fig. 1).

'Gibbus formation' in the thoraco-lumbar region of a patient with spinal tuberculosis (left). The magnetic resonance shows spinal tuberculosis at T10–T12. Spinal tuberculosis causes the destruction, collapse of vertebrae, and angulation...

The progression of spinal tuberculosis is slow and insidious. The total duration of the illness varies from few months to few years, with average disease duration ranging from 4 to 11 months. Usually, patients seek advice only when there is severe pain, marked deformity, or neurological symptoms.¹⁴⁻¹⁵

Constitutional symptoms are present in approximately 20–30% of cases of osteoarticular tuberculosis. The classical constitutional features of tuberculosis indicating presence of an active disease are malaise, loss of weight and appetite, night sweats, evening rise in temperature, generalized body aches, and fatigue.

Back pain is the most frequent symptom of spinal tuberculosis. Pain is typically localized to the site of involvement and is most common in the thoracic region.

Neurologic deficits are common with involvement of thoracic and cervical regions. Left untreated, early neurologic involvement may progress to complete paraplegia or tetraplegia. Formation of a cold abscess around the vertebral lesion is another characteristic feature of spinal tuberculosis. Abscess formation is common and can grow to a very large size. The site of cold abscess depends on the region of the vertebral column affected. In the cervical region, the pus accumulates behind prevertebral fascia to form a retropharyngeal abscess. In the thoracic spine, the cold abscess usually presents as a fusiform or bulbous paravertebral swellings and may produce posterior mediastinal lumps. The cold abscesses formed at lumbar vertebrae most commonly present as a swelling in the groin and thigh.

Spinal deformity is a hallmark feature of spinal tuberculosis. Kyphosis, the most common spinal deformity, occurs with lesions involving thoracic vertebrae.¹⁶

Diagnosis
Diagnosis of spinal tuberculosis depends on presence of characteristic clinical and neuroimaging findings. Etiological confirmation requires the demonstration of acid-fast bacilli on microscopy or culture of material obtained following biopsy the lesion. Polymerase chain reaction is also an effective method for bacteriological diagnosis of tuberculosis. Screening of the whole spine should be done to look for noncontiguous vertebral lesions.

Imaging
Plain radiographs
In resource-poor countries, vertebral radiography still remains the cornerstone of spinal imaging.¹⁷⁻¹⁸ The characteristic radiographic findings include rarefaction of the...
vertebral end plates, loss of disk height, osseous destruction, new-bone formation and soft-tissue abscess. Often, multiple vertebrae are involved and late fusion or collapse of vertebrae is not uncommon. Tuberculous cold abscesses may also be seen on plain radiographs as soft tissue shadows adjacent to the spine.

**Computed tomography**
CT demonstrates abnormalities earlier than plain radiography. The pattern of bone destruction may be fragmentary in 47% of the cases; osteolytic in 34%, localized and sclerotic in 10%, and subperiosteal in 30% cases. Other findings include soft tissue involvement and paraspinal tissue abscess. CT is of great value in the demonstration of any calcification within the cold abscess or visualizing epidural lesions containing bone fragments. CT is of the greatest value in the delineation of encroachment of the spinal canal by posterior extension of inflammatory tissue, bone or disk material, and in the CT-guided biopsy.

**Magnetic resonance imaging**
MRI is the neuroimaging of choice for spinal tuberculosis. MRI is more sensitive than x-ray and more specific than CT in the diagnosis of spinal tuberculosis. MRI allows for the rapid determination of the mechanism for neurologic involvement.

MRI readily demonstrates involvement of the vertebral bodies, disk destruction, cold abscess, vertebral collapse, and spinal deformities. In the early stages, however, only disk degeneration with alteration of bone marrow signal intensity of vertebra is seen, which may not be sufficiently diagnostic of spinal tuberculosis. Abscess formation and collection and expansion of granulation tissue adjacent to the vertebral body is highly suggestive of spinal tuberculosis. MRI is also useful in detecting intramedullary or extramedullary tuberculosis, spinal cord cavitation, spinal cord edema, and possibly unsuspected noncontiguous lesions of the spine. The subligamentous spread of a paraspinal mass and the involvement of multiple contiguous bones and intramedullary spinal changes can be very well demonstrated by MRI.

**Bone scan**
There are no pathognomonic scintigraphic features of spinal tuberculosis. Infection usually causes a hot spot, but avascular bone fragments may produce a cold spot. Bone scan is, however, helpful in differentiating from metastatic lesions, which usually show uptake of radioactive substance at multiple sites. The technetium 99m bone scan was negative in 35% of a series of patients.

**Cytological and microbiological confirmation**
Etiological confirmation can be made either by demonstration of acid-fast bacilli on pathological specimen or histological evidence of a tubercle or the mere presence of epithelioid cells on the biopsy material. CT-guided needle biopsy usually yields sufficient material either from the spine itself or from an adjacent abscess. Open biopsy of the spine is usually performed when either closed techniques have proved insufficient or other procedures, such as decompression and possibly arthrodesis, are planned. The most common cytological findings observed are epithelioid cell granulomas (90%), granular necrotic background (83%), and lymphocytic infiltration (76%). Scattered multinucleated and Langhans' giant cells may be seen in up to 56% of cases.

**Polymerase chain reaction and other immunological test**
Polymerase chain reaction has shown very
promising results for the early and rapid diagnosis of the disease. This technique is able to detect as few as 10–50 tubercle bacilli in various clinical samples. This test offers better accuracy than a smear and can be performed at greater speed than cultures.

Other Tests
Erythrocyte sedimentation rate (ESR) is generally raised many folds in the majority of patients with spinal tuberculosis. ESR declines to normal or near normal when the active tuberculous lesion is controlled. In pyogenic infection, leucocytosis parallels with raised ESR, while in patients with spinal tuberculosis, there is markedly elevated ESR with a normal white blood cell count.

Differential Diagnosis
Spinal tuberculosis should be considered in the differential diagnosis of chronic back pain (with or without constitutional, neurological, or musculoskeletal manifestations) and in young persons. The spinal tuberculosis should also be considered in immigrant patients of chronic back pain coming from endemic countries. Several spinal diseases need be differentiated from spinal tuberculosis. Common differential diagnosis includes pyogenic spondylitis, brucellar spondylitis, sarcoidosis, metastasis, multiple myeloma, and lymphoma.

Treatment
In patients with spinal tuberculosis, antituberculous treatment should be started as early as possible. Antituberculous treatment often needs to be instituted empirically, much before an etiological diagnosis is established. In resource-poor countries, etiological diagnoses may not be established at all. In patients with established complications of spinal tuberculosis, surgery may also be required. Sequelae like kyphosis require surgical intervention.

Antituberculous Regimen
Spinal tuberculosis falls under category-1 of the WHO treatment category. The category-1 antituberculosis treatment regimen is divided into two phases: an intensive (initial) phase and a continuation phase. In the 2-month intensive phase, antituberculous therapy includes a combination of four first-line drugs: isoniazid, rifampicin, streptomycin, and pyrazinamide. In the continuation phase, two drugs (isoniazid and rifampicin) are given for 4 months. Because of the serious risk of disability and mortality and because of difficulties of assessing treatment response, WHO recommends 9 months of treatment for tuberculosis of bones or joints. Although 6 months of treatment is considered sufficient, many experts still prefer a durations of 12–24 months or until radiological or pathological evidence of regression of disease occurs.

Supportive Measure
The majority of patients with bone tuberculosis are treated with ambulatory care without prolonged recumbency and rest as previously practiced. Although cast or brace immobilization was a classic form of treatment, it was found to be inefficient and has generally been abandoned.

Surgery
SURGICAL INDICATIONS:
1. No sign of neurological recovery after trial of 3-4 weeks therapy
2. Neurological complications develop during conservative treatment
3. Neuro deficit becoming worse on drugs & bed rest
4. Recurrence of neurological complication
4. Prevertebral cervical abscess with difficulty in deglutition & respiration
5. Advanced cases- Sphincter involvement, flaccid paralysis or severe flexor spasms

OTHER INDICATIONS:
1. Recurrent paraplegia
2. Painful paraplegia—d/t root compression, etc
3. Posterior spinal disease
4. Spinal tumor syndrome resulting in cord compression
5. Rapid onset paraplegia (due to thrombosis, etc)
6. Doubtful diagnosis & for mechanical instability after healing, & Cauda equina paralysis

Types of surgical procedures:
1. Debridement in which only debridement of the diseased area done and there is no stabilization of the spine.
2. Debridement, decompression and stabilization in this procedure debridement and decompression and spine is stabilized with bone graft or with titanium cages.
3. Anterior transposition of cord
4. Laminectomy

Management of Complications
Measures that are helpful in minimizing the increase in kyphosis include recumbency in the early active stage of the disease and prolonged protection of the spine with suitable braces in later stages. Most experts believe that kyphosis greater than 30° is likely to generate back pain and may deteriorate further, and hence, requires surgical correction. Aspiration or surgical drainage was carried out for some patients with large cold abscesses because it was thought to improve the patient's general condition, and prevent rapid progression of the abscess along the spine. This has been shown to be ineffective, however, and surgical drainage of a cold abscess alone is no longer recommended. Abscesses usually resolve with medical therapy as antituberculosis drugs penetrate very well.

Prognosis
Prognosis is generally good in patients without neurological deficit and deformity. Various studies show that 82–95% cases respond to medical treatment alone in the form of pain relief, improving neurological deficit, and correction of spinal deformity. In a recently published study among patients with neurologic deficit, significant recovery occurred in 92%, with 74% improving from nonambulatory to ambulatory status. This study included 82 patients; 52% of patients presented in a nonambulatory state, 21% had mild neurologic deficits, and 27% had intact neurological function. In a study from an endemic country, the majority (79 patients, 61%) of patients had severe motor and sensory impairment. Imaging revealed multiple vertebral involvements in 90 patients (80%). All patients were managed using antituberculous treatment; however, 33 patients required operative treatment as well. Marked clinical improvement was seen in 91 patients (70%) within 6 months of treatment.

Conclusion
The prognosis for spinal tuberculosis is improved by early diagnosis and rapid intervention. A high degree of clinical suspicion is required if patients present with chronic back pain, even in the absence of neurological symptoms and signs. Medical treatment is generally effective. Surgical intervention is necessary in advanced cases with marked bony involvement, abscess formation, or paraplegia.
Spinal tuberculosis affects young people, so efforts should be made for its effective prevention. Controlling the spread of tuberculosis is only way available to prevent spinal tuberculosis.

References
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