

TREATMENT OF SPINAL TUBERCULOSIS: ROLE OF SURGICAL INTERVENTION

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The treatment of tuberculosis of the spine (Pott's disease) is essentially conservative and a vast majority of patients can be successfully managed on antituberculous therapy (ATT) alone.¹ Surgery is indicated in a few specific cases where deformity of spine, pain, or neurological compromise is becoming a serious issue. In cases where surgery is indicated the benefits are almost immediate and excellent.

Tuberculosis (TB) is one of the leading causes of infectious disease-related deaths in under-developed countries and it has had a resurgence in developed countries as well. The most common site of bony dissemination of this disease is in the spine. It may be present in about 1% of TB cases.^{2,3} Those who present with spinal TB may have pulmonary TB in one-third to two-thirds of cases.^{4,5} The most important route of dissemination of TB to the spine is hematogenous.⁶ Spinal TB usually develops insidiously, and there is thus a gap of several months between onset of symptoms and appropriate medical attention.

Spinal TB patients present with various signs and symptoms which may include back or leg pain, kyphotic deformity, palpable mass in the paraspinal region, and neurological compromise, which if not treated appropriately may lead to paraplegia or quadriplegia.^{5,7} Constitutional symptoms such as night sweats and weight loss are not as common as in pulmonary TB. The two most important sequelae of spine TB are kyphotic deformity of the spine and neural compromise. Neural deficits occur due to kyphotic deformity, spinal abscess and/or granulation tissue compressing the spinal cord or cauda equina.

Erythrocyte Sedimentation Rate (ESR) usually reflects the severity of the disease, and may return to normal ranges with effective treatment within a few months, but as much as 9% of patients may have a normal ESR on initial

presentation.⁴ Imaging studies, particularly MRI and CT scans, are crucial to detect early TB before enough bony damage is done to become evident on plain X-rays. CT and MRI can also help in deciding the mode of treatment (surgical or non-surgical) and the kind of approach (anterior or posterior) if surgical treatment is opted for. In the lumbosacral region up to three-quarters of the spinal canal may be compromised before the patient develops neurological symptoms.⁸ The margin of safety is much less in cervical and thoracic spinal canals.

WHEN TO OPERATE

The indications for surgical intervention are few and specific. However, in patients who do require surgery, the benefits are almost immediate in terms of neurologic deficit and pain.⁴ Since the majority of patients have involvement of the dorsal spine, any surgical procedure aimed at anterior decompression is a substantial undertaking and therefore the indication for intervention must be well defined.

Advanced paraparesis (motor strength less than 3/5 on MRC scale) at presentation, especially in a young patient, warrants surgical treatment.⁹ Such patients are emaciated and have pressure sores. However, if the upper motor neuron signs turn into lower motor neuron signs due to a delay in surgical intervention, the opportunity to benefit from treatment is lost. Those patients whose neurological deficit is progressing despite adequate ATT would benefit from anterolateral spinal cord decompression and instrumentation. In these patients, the histological diagnosis also needs to be established beyond doubt.¹

Kyphotic deformity, either progressive or established, is a major indication for surgical intervention.¹ This is most commonly seen in the cervical and dorsal spine. In these regions the spinal cord has to negotiate the extra curve

and becomes vulnerable to compression by the retro-pulsed vertebral body, leading to neurological deficits. Furthermore, kyphotic deformity, particularly with pseudoarthrosis, can be a source of significant pain to the patient. Kyphosis is however unusual in lumbar spine where there is a tendency for telescoping of collapsed vertebral bodies, which is a determining factor in minimizing residual spinal deformity.¹⁰ Late-onset paraplegia and pseudoarthrosis in healed tuberculosis may require decompression and correction of deformity by instrumentation.¹¹

Intractable pain is mainly due to presence of epidural mass compressing the theca and nerve roots, along with spinal instability. Both can be dealt with effectively by anterior debridement, decompression and spinal instrumentation.¹²

Some patients with cervical and lumbar spine involvement may present with large palpable cold abscesses in the neck and groin. Large abscesses need to be drained. This reduces pain and conservative management becomes more effective as bulk of the disease is reduced.

Most patients with advanced disease have already received ATT for several weeks without benefit and can undergo surgery almost immediately. Although the spine is infected, instrumentation poses no additional hazard in terms of tuberculous discitis. In selected patients, early operative treatment with instrumentation, when indicated, combined with chemotherapy, minimizes neurological deterioration and spinal deformity, allows early ambulation, and results in excellent neurological

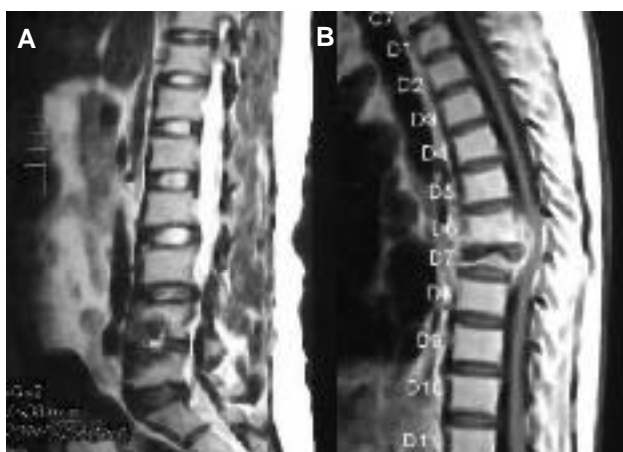


Figure 1: Examples of TB spine that should be treated conservatively (A) or surgically (B). The patient in (A) had no neurological compromise and the spine biomechanics were not altered either. The extension of the abscess into the spinal canal is also minimal. The patient in (B) was getting progressively paraparetic despite taking oral anti-TB medications. The abscess extends into the canal and is compressing the spinal cord. There is extensive destruction of vertebral body as well as the intervertebral disk and kyphotic deformity is developing in its initial stages.

recovery.^{12,13,14} Figure 1 shows an example of spinal TB that was a candidate for conservative management, alongside a case that required surgical intervention.

ROLE OF IMAGING IN DECISION TO OPERATE

Radiology remains essential in Pott's disease evaluation, providing precious information for the diagnosis and prognosis of spinal tuberculosis.¹⁵

Plain radiographs may show involvement of adjacent vertebrae with erosion of end-plates. There may be significant kyphosis and a paraspinal shadow, occasionally with involvement of posterior elements. An atypical form of tuberculosis without disc involvement is increasing in frequency and may mimic other bacterial, fungal, inflammatory and neoplastic diseases.¹⁶

MRI is preferred over CT for it shows soft tissues, including the spinal cord and its distortion by the epidural collection. It may also show asymptomatic 'skip' lesions away from the main disease. CT is useful for appreciation of bony destruction and for needle aspiration or biopsy.¹⁶

Once imaging studies show a lesion in the spine that looks suspicious for TB, a biopsy should be done to confirm it. It will be unwise to proceed empirically with ATT even in endemic areas. A biopsy is essential to confirm that the abnormality seen on imaging studies is due to TB and not due to any neoplastic growth. In non-endemic areas the contrary is more possible; tuberculous spine may be misdiagnosed as malignant spine and patients may be subjected to unnecessary radiation therapy with its deleterious effects on the affected vertebrae. The yield of CT-guided biopsy depends on the expertise of the radiologist and other facilities at the medical center. If CT-guided biopsy is non-conclusive, open surgical biopsy of the lesion is essential before proceeding to any kind of treatment.

CONSERVATIVE MANAGEMENT

In the absence of major neurological involvement and deformity, the patient is treated conservatively with a standard 4-drug regimen. A brace or a collar is also advised if the disease involves the cervical or lumbar regions, or the thoracolumbar junction. Rifampicin, isoniazid (INH), pyrazinamide and ethambutol are given for the first three months followed by rifampicin, INH and pyrazinamide for the next three months. Rifampicin and INH are then given for the remaining period. In the pediatric age group, streptomycin (for two months) replaces ethambutol to avoid optic neuropathy.

Individual drug treatment is preferred over proprietary combination drugs. Treatment is given for 6-18 months and drug toxicity is monitored continuously.¹⁷

The Medical Research Council Working Party's thirteenth report on spinal tuberculosis in Korea and Hong Kong reported in 1998 that short course regimens based on isoniazid and rifampicin for 6 months are as effective as 18-month regimens.^{13,19} We advise the shorter duration for uncomplicated tuberculosis; for complicated cases (patients with deformity, neurological deficit, medical comorbidity, or TB beyond the spine), longer regimens are more appropriate. In short, 9 to 12 months of treatment is safer and appropriate.

SURGICAL APPROACH AND THE NEED FOR INSTRUMENTATION

As noted, treatment of spine TB is preferably non-surgical unless problems of deformity, significant neurologic deficit, pseudo-arthrosis, pain or failure of chemotherapy is an issue. When a decision is made for surgical intervention, the next question is through what approach and to what extent. Surgical approach may be anterior or posterior. Surgical intervention may be limited to debridement, or radical resection with autografting and instrumentation.

Drainage and debridement of tuberculous abscess in spine has been carried out since the middle of the last century.²⁵ Although these patients showed quite remarkable recovery, problems of spine deformity, pseudo-arthrosis with resultant pain, and persistence of neurological deficit due to kyphotic deformity continued to be a significant problem. For this reason instrumentation after debridement or radical excision of the infected mass was suggested.

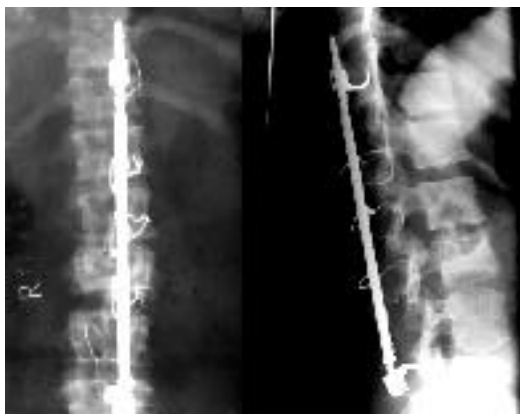


Figure 2: Posterior instrumentation using metal rod and sub-laminar wires. Note the metal instrument construct spans several levels (T-11 to L-5) for a disease at L2-L3.

Initial aggressive surgical intervention involved radical debridement through an anterior approach with posterior instrumentation if needed¹⁴ (Figure 2). Posterior instrumentation has been associated with clearly improved overall treatment outcome, as it corrects the deformity and prevents any further worsening. However, it was soon realized that posterior instrumentation seems to carry greater morbidity, and the fear that instrumentation in the infected surgical field may result in persistent infection was baseless. Consequently, anterior instrumentation following anterior debridement became more popular (Figure 3).

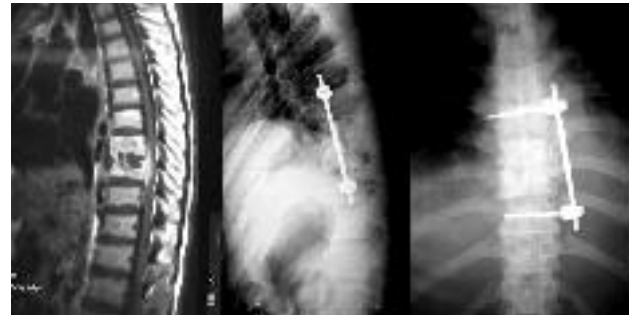


Figure 3: Anterior debridement, autograft from iliac rest and anterior instrumentation in a patient with thoracic spine TB. Although the instrumentation that works best for these cases consists of a plate with two screws at each level, the construct improvised here by the surgeon works as well.

A minimum 5-year follow up of anteriorly instrumented patients after radical debridement and grafting showed excellent results with about 80% deformity corrected in all patients.¹² Neurological recovery was full in more than 80% of patients and the rest showed partial recovery. In another study, where an anterolateral approach was used without instrumentation, 15% of patients showed a significant worsening of kyphotic deformity and in 5% the deformity was more than 20°. One of the larger series in this regard (n=91 patients) showed that anterior instrumentation after anterior debridement, and autografting provided a correction of deformity of about 20° and a fusion at the site of arthrodesis was achieved in less than 4 months.²⁶

In a randomized controlled trial (albeit with a small number of patients; n=22) on patients undergoing anterior debridement and autologous bone transplantation, anterior instrumentation was found as effective as posterior instrumentation in correcting the kyphotic deformity and maintaining the correction.²⁷ Therefore, since anterior instrumentation is technically easier if debridement and autografting is being done through an anterior approach, it stands as a better choice than posterior instrumentation. Anterior instrumentation does not require extra incision and extensive tissue dissection as is required in posterior instrumentation. An

anterior approach for debridement, autografting and instrumentation has now been widely accepted in the surgical treatment of tuberculous spine.

There are a few caveats in the anterior approach, nevertheless. Not all patients may be reasonable candidates for extensive surgical exposure as required in radical excision and debridement of the tuberculous material anteriorly. These patients may be best served by limited approaches if surgery is at all necessary. Some of the less intrusive methods include transpedicular approach to drain the material from a posterior approach and without entering the pleural cavity. Similarly, thoracoscopic anterolateral decompression has been described to be effective in achieving some goal of decompressing the mass surgically if needed.²⁸ It has been suggested that if only a single level is involved without much deformity, anterior debridement and bone grafting may be enough.²⁹ Additional posterior instrumentation was only indicated in multiple-level spondylodiscitis, and extensive kyphotic deformity in this study of 22 patients with instrumentation compared to 49 without instrumentation.

FOLLOW UP

Progress of the disease and response to treatment is followed fortnightly for the first 2 to 3 months and then on a monthly basis once improvement has set in. Improvement in pain and fever is a welcome sign. This is usually followed by neurological recovery and reduction of previously raised ESR. Imaging studies may demonstrate reduction in disease burden and the beginning of a healing process by as early as 2 to 3 months. A plain lateral and AP x-ray of the affected spine is advised to monitor the progress every month for the first 3 months and then every other month for as long as ATT is being used. After that x-rays should be repeated with flexion and extension views every 3 to 6 months for 2 years. Eventually an MRI at the end of the medication, and then 6 months to a year after that, may be repeated to assess

the response to treatment and to get early warning of any relapse.

SPECIAL CONSIDERATIONS

Tuberculosis of the cervical spine is rare, comprising only about 3-5 % of cases of tuberculosis of spine.²⁰ Stiffness and tenderness over upper cervical vertebrae should raise suspicion.²¹ In patients with mild deficits (grade I & II), conservative neck stabilization and ATT is given whereas severe deficits require anterior decompression and posterior fusion.²²

Patients with cranio-vertebral junction tuberculosis with features of cervical myelopathy are ideally managed with transoral decompressive procedures followed by occipito-cervical fusion.²³ Patients with persistent reducible atlanto-axial dislocation are candidates for direct posterior fusion.²² Anterior decompression with autologous bone graft leads to a good clinical and radiological outcome in patients with cervical spine tuberculosis below the level of C2.²⁴ For pathology and surgical debridement that extends more than one level, use of anterior fixation plates is advisable. Instrumentation may be avoided in cervical spine cases if the bony destruction is not extensive and curvature has not already deformed to severe kyphosis. In those situations where the infectious process extends from lower cervical to upper thoracic vertebra (up to D2 level), a transclavicular approach with titanium plate stabilization has been recommended.³²

For thoracic spine TB with main mass of infectious material lying anteriorly, the surgical approach for decompression may depend on the medical condition of the patient. These approaches are:

1. Costotransversectomy, in which the proximal part of the rib(s) and adjacent transverse process of the vertebra are removed to gain access to the spinal canal for decompression.
2. Anterolateral decompression, in which along with the removal of the proximal part of the rib, the

TABLE 1:
Surgical recommendations for patients with TB of thoracic spine

Group	Definition	Recommendation
A	Patients with no kyphosis	Only anterior debridement and strut grafting
B	Patients with global lesions, kyphosis, and instability	Posterior instrumentation in addition to anterior debridement and strut grafting
C	Patients with anterior or global lesions but with high medical/surgical risk	Posterior decompression with approach to anterior infectious mass by trans-pedicular route without any instrumentation
D	Patients with isolated posterior lesions	Posterior decompression only without instrumentation

Modified from Mehta et al³⁰

portion of the vertebral column anteriorly (intervertebral disc space and vertebral bodies) are reached for decompression by drilling down the pedicle.

3. Anterior decompression requiring thoracotomy. Radical excision of the infectious mass can only take place through an anterior approach. Extensive or radical debridement then also necessitates placement of a graft and in many cases rods or plates with screws to stabilize the spine and achieve a solid fusion.

Mehta et al³⁰ have divided patients with thoracic spine TB into four groups, to help determine the need for instrumentation. Their recommendations are based on location of pathology, presence of kyphotic deformity, and extent of surgical and medical risks (Table 1).

The other situation that requires special consideration when considering fusion and instrumentation in the surgical treatment of spine TB is disease in children. In a study of 117 children (age 2-6 years) with spine TB, those with anterior debridement and fusion showed worse result in terms of kyphosis.³¹ For surgical intervention in pediatric spine TB cases it is therefore recommended to perform posterior fusion or a combination of anterior and posterior fusion.

DURATION OF ANTI-TB MEDICATION AFTER SURGERY

The British Medical Research Council has published several reports on the efficacy and duration of chemotherapy for spine TB patients who have undergone surgery. One of the initial reports was based on data from Hong Kong.¹³ In this report, 114 patients with a mean follow-up of more than 14 years were assigned to one of three regimen combinations (6, 9 or 18 months) after radical debridement and anterior arthrodesis. A 6-month course of rifampicin and INH with streptomycin for the first 3 months was as effective as the rest, with no difference in deformity between various groups and any recurrence or reactivation during follow-up. In three other randomized controlled trials carried out in Hong Kong, Madras and Korea, the conclusion was same, i.e., 6 or 9 months of rifampicin and INH, with streptomycin in first 6 months, was as good as longer therapy.³³

A similar conclusion of short-term course of chemotherapy was found in a randomized controlled trial over 33 patients in India.³⁴ These patients had Pott's paraplegia and received either chemotherapy alone, or in combination surgery where indicated. Ninety percent of the patients showed complete recovery by 6 months and all patients had neurological recovery by 9 months. The

trend towards chemotherapy for a short period (6 months) has been challenged recently.¹⁸ These authors reported a very high rate of relapse (5 out of 8) if only 6 months of chemotherapy was used, whereas none showed any relapse if the ATT was continued for 9 months or more.

OUTCOME OF CONSERVATIVE VERSUS SURGICAL MANAGEMENT

Although the indications for surgical management are few, conservative management of surgical cases is less likely to yield results comparable with surgical treatment. There is no dispute that for milder cases and those cases where TB spine is detected earlier in the course, treatment should be conservative.³⁵ In those cases where disease has progressed, conservative medical-only management may not give as good a result as in surgical treatment combined with ATT. A meta-analysis of 694 cases based on a Turkish population showed good neurological outcome if surgical decompression is carried out early in the course of the disease.⁷

Once the disease has progressed and the kyphotic angle has deteriorated, conservative management will not be as helpful as surgical management in correcting, at least partially, or halting any further progression of the kyphotic deformity. In a study of 22 patients who received ATT and a spinal brace, 18% had deterioration of the angle of kyphosis, and 23% had progressive vertebral loss.³⁶ In another study in which conservative management was used for all patients (including those with paraparesis), about 31% (of 16 patients) did not show any neurological improvement⁵ whereas anterolateral decompression in severe cases of Pott's paraplegia showed recovery in 90% of cases.³⁷ Not only is there a better chance of recovery in paraparetic patients when treated surgically, the time to recovery and pain relief is also significantly improved. In two studies, one with 63 patients³⁷ who were treated surgically and another study with 67 patients³⁸ who were either treated surgically or conservatively, recovery started in less than 2 months of the operation, whereas conservative management took longer, up to 6 months.

CONCLUSION

If patients have milder forms of spinal TB and are diagnosed earlier, conservative management consisting of anti-tuberculous medication and orthosis is the treatment of choice. In those cases where conservative management has failed, and the patient is developing kyphotic deformity and/or neurological deficits, surgical treatment is superior. In cases with significant pain due to pseudo-

arthrosis, surgery should be considered even if the underlying TB infection has healed. In surgical treatment, since the pathology is usually anterior, an anterior approach with wide debridement, autologous bone grafting and instrumentation is appropriate in most of the cases.

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