

## Review Article

# Recent Diagnosis and Treatment Progress of Spinal Tuberculosis

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### Abstract

Spinal tuberculosis is an old and harmful disease caused by mycobacterium tuberculosis. With the improvement of diagnostic technology and the application of surgical technique, spinal tuberculosis treatment has improved significantly. However, the number of patients with spinal tuberculosis is on the rise, especially in poor areas because of the current situation of population growth, drug-resistant bacteria, HIV transmission, and so on. The public is not aware of the rise in the incidence of spinal tuberculosis yet. According to the pathological characteristics of spinal tuberculosis most of the lesions are located in the vertebral body and easily involve the spinal canal resulting in spinal cord and nerve compression, which causes patients to have neurological symptoms or residual spinal nerve sequelae

that are difficult to recover, and it has a specific impact on individuals and society. If spinal tuberculosis are not diagnosed and treated on time, it will lead to severe consequences. This article reviewed the recent progress of the diagnosis and treatment of spinal tuberculosis.

**Keywords:** Research; Diagnosis; Spinal Tuberculosis; Treatment

### 1. Introduction

Spinal tuberculosis was first reported by Pott in 1782 and accounted for approximately 50% of all bone and joint tuberculosis [1-2]. Vertebral TB depends on the lesion. The development of spinal TB from the onset is significantly different by cases. Due to its insidious onset, prolonged treatment time, increase in drug-

resistant tuberculosis and other factors, the prevention and treatment work has also become relatively difficult. The most commonly affected spinal segments are thoracic vertebrae (48.03%), and lumbar vertebrae (42.36%), followed by thoracolumbar vertebrae (29.58%), cervical vertebrae (5.39%) and sacral vertebrae (4.22%) is relatively rare [3]. But the majority of patients with disease progression can appear spinal instability, spinal deformity, cold abscess or sinus formation; severe cases can appear neurological dysfunction. In many parts of the developing countries, TB remains endemic and increases due to migration. A total of 1.3 million people die annually from TB. Spinal TB represents about 1 to 2% of all cases of TB, and it's the most common musculoskeletal manifestation of TB. Its common clinical manifestations include back pain, constitutional symptoms, spinal tenderness and deformities, and paraplegia. This review study focuses on the various aspects of spinal TB, currently available surgical techniques, diagnosis development, and the outcomes.

## **2. Materials and Design**

The formal review was done of all published literature from the last 15 years related to spinal tuberculosis in internet-based journals and PubMed. Was performed to optimize and capture all relevant studies. The strength of evidence was then graded for spinal tuberculosis measure. Level of evidence for our studies collected from different author's institution research papers. We analyzed the clinical and surgical information according to our designed plan.

## **3. Diagnosis of Spinal Tuberculosis**

### **3.1 Laboratory examination**

Biochemical examination of patients with spinal tuberculosis often showed an elevated erythrocyte

sedimentation rate (ESR) and C-reactive protein (CRP), mild anemia, and no significant changes in white blood cell count. However, due to the lack of specificity, some non-specific spinal infection and spinal tuberculosis can also appear above changes. Some studies pointed out that after mycobacterium tuberculosis infection, C-reactive protein's reactivity would not increase, and C-reactive protein would only increase when acute mycobacterium tuberculosis was infected. The tuberculin test is rarely used in the examination of spinal tuberculosis. T-spot (ELISA spot test) is characterized by high sensitivity and has become an important diagnostic method for spinal tuberculosis, but it is unable to distinguish whether tuberculosis infection is active or not [5]. The "gold standard test" use for diagnosing spinal tuberculosis, and it is a bacteriological examination. This bacterial examination method is gradually increased. Acid-resistant staining smear is the most widely used and oldest method of testing because it is fast, simple, and cheap. The mycobacterium tuberculosis culture method is divided into solid and liquid culture according to the different media. Both are more sensitive than the smear method, and the solid medium can also be observed. Check the colony morphology to help identify the bacteria, but the culture time is longer, which may delay early diagnosis and treatment. With the continuous research and technology development of molecular biologies, such as the PCR-direct sequencing identification method, PCR-DNA probe identification method, Xpert MTB / RIF, PCR-gene chip identification method, etc. have been applied in clinical practice. Especially Xpert MTB / RIF technology has high value for the early rapid diagnosis of spinal tuberculosis, and it can simultaneously detect its rifampicin resistance. New RNA tests for Mycobacterium tuberculosis are being developed to diagnosing infections.

### 3. 2 Imaging examination

At present, imaging examination of spinal TB mainly includes X-ray, CT, MRI, and PET-CT. In recent years, thanks to the comprehensive medical technology in hospitals at all levels, the accuracy of spinal tuberculosis diagnosis has steadily improved. Imaging techniques reveal if the vertebral body and intervertebral space are damaged. The disadvantage is the lack of early specific manifestation in spinal TB patients. There are 5 types of spinal tuberculosis CT findings [6]: bone fragment type, osteolytic type, focal destruction sclerosis type, subperiosteal type, and mixed type. The 3D function of CT can be used from axial, sagittal, and coronal full-scale display of the lesion range. CT scans defining treatment plans. MRI is highly sensitive to changes in water and proteins in tissues. MRI shows intervertebral disc involvement, lesion range, abscess formation, intraspinal lesions, and degree of nerve compression. PET-CT is a non-invasive examination. After intravenous injection of 18F-FDG (*fluorodeoxyglucose*), CT examination was used as an auxiliary system. 18f-FDG PET combined with CT is nowadays getting more and more relevant for the diagnosis of several infectious and inflammatory diseases. 18f-FDG-PET scan with CT component images the whole body and provides a metabolic map of the infection. So it helps to enable doctors to assess the disease burden and see tissues or cells changes in the affected area. 18f-FDG uptake is not specific for tuberculosis infection, but multiple studies currently believe that PET-CT scan can early diagnose of spinal TB differentiation. It can also monitor anti-tuberculosis drug effects and can identify atypical spinal tuberculosis [7].

## 4. Treatment of Spinal Tuberculosis

### 4.1 Drug treatment of spinal tuberculosis

The fundamental method to treat spinal tuberculosis is anti-tuberculosis drug therapy and should run through the entire treatment process of spinal tuberculosis; even if the lesion was removed by surgery, but anti-tuberculosis therapy should also be continued postoperatively. The cause of spinal tuberculosis is the same as for tuberculosis. Chemotherapy programs can be used for the treatment of spinal tuberculosis [8]. Through anti-tuberculosis drugs, kill the tuberculosis bacilli in the lesion, control or clear the infection, prevent bone destruction and further aggravation of spinal cord nerve involvement, and gradually restore its functionality. The standard chemotherapy for bone and joint tuberculosis requires a total of 9-18 months of treatment. Due to the long duration of chemotherapy, the incidence of non-adherence is high. Besides, due to the toxic and side effects of long-term medication, irregular or interrupted medication, the effect of chemotherapy is poor, so drug-resistant of tuberculosis is increasing. Therefore, short-range chemotherapy (> 6 months and  $\leq 9$  months) and ultra-short-range chemotherapy ( $\leq 6$  months) is gradually applied to treat tuberculosis of the spine, which can also achieve better treatment effect [9]. The effects of short-course chemotherapy and ultra-short-course chemotherapy are not different from standard chemotherapy. But it can shorten the chemotherapy time, reduce adverse drug reactions, and reduce the burden on patients.

### 4. 2 Surgical treatment of spinal tuberculosis

Surgical treatment is not necessary for spinal tuberculosis, but if there are serious complications, surgical treatment should be performed. When the sclerotic wall exists in the lesion, it needs to be completely removed because anti-tuberculosis drugs

enter the lesion to kill tuberculosis bacteria. The presence of a sclerotic wall causes the drug difficult to penetrate inside and reducing the therapeutic effect. The main purpose of surgical treatment of spinal tuberculosis is to completely remove the tuberculosis lesion, reduce the pathogen, create the favorable conditions for recovery, relieve the compression of nerve and spinal cord to reduce symptoms, facilitate the recovery of nerve function, reduce the occurrence of spinal kyphosis deformity, and restore the stability of the spine.

**4. 2. 1 Surgical indication:** Currently, generally accepted surgical indications are: (1) cold abscess, dead bone formation in the vertebral cavity and prolonged tuberculosis sinus; (2) kyphosis with progressive aggravation of spinal instability; (3) tuberculosis lesion compresses the spinal cord nerves, resulting in similar symptoms, even paralysis.

**4. 2. 2 Surgical methods:** The combined application of lesion removal, bone graft fusion, and internal fixation has become the mainstream surgical treatment of spinal tuberculosis. In spinal tuberculosis, the majority of the infected lesions are located in the vertebral body, and only 5% to 10% located in the adnexal structures at the back of the spine. Few surgical approaches are widely applicable, such as anterior approach, Posterior approach, combined anterior-posterior approach, and minimally invasive surgeries. Therefore, anterior approach surgery is easier to expose and clear the lesions and is also convenient for bone grafting and other operations. However, anterior approach surgery is easy to damage the thoracic and abdominal organs, large blood vessels, etc., because tuberculosis lesions often cause spinal nerve compression, kyphotic deformities. The relief of spinal nerve compression and

kyphosis correction effects of anterior approach surgery is not ideal. Therefore, combined anterior-posterior approaches or posterior approaches have been gradually applied in the surgical treatment of spinal tuberculosis [10]. Due to the long-time of the combined anterior-posterior approach causes intraoperative body movement, massive trauma, and a large amount of bleeding. So the combined anterior-posterior approach is relatively less applied for spinal tuberculosis. Studies have found [11] that, compared with the anterior approach, the posterior approach alone can also achieve lesion removed, bone graft fusion and internal fixation in the treatment of thoracic and lumbar spinal tuberculosis with a good therapeutic effect. Also, the postoperative bedtime and bone fusion time are shorter, and surgical complications and recurrence rates are significantly reduced. However, some scholars believe that posterior surgery has damaged the posterior column of the spine. In addition, the front, middle column has been damaged by the tuberculosis lesion, which further aggravates. Not only the spinal instability, but also bring the front pathogens into the back, Diffuse spread and not conducive to the healing of the lesion. Simple posterior surgery has the advantages of simple operation, short operation time, less blood loss, fewer complications, and good neural decompression effect, but it also has its disadvantages: removing the anterior lesions from the posterior approach; the difficulty of large bone graft is increased, and the risk of spinal cord injury is increased. Therefore, it is necessary to evaluate the general situation of the patient before surgery fully, combine imaging, determine the size and location of the lesion, and select a reasonable surgical method after careful consideration, rather than a fixed anterior or posterior approach. With the rapid development of minimally invasive spine surgery, recently, minimally invasive surgeries have been widely used for spinal

tuberculosis. Patients with lumbar tuberculosis accompanied by abscess formation, b-ultrasound or ct-guided puncture, and catheter drainage, followed by internal fixation to stabilize the lumbar spine after treatment is a safe and effective treatment with little trauma. But this method cannot completely remove the lesions, and there is a risk of inaccurate efficacy and recurrence. With the development of thoracic and laparoscopic techniques, thoracic laparoscopy for the treatment of thoracolumbar vertebral tuberculosis has become an alternative surgery, and it has a fast recovery rate [12]. Spinal endoscopy has also been developed for the treatment of infectious diseases of the spine, facilitating the removal of local lesions, avoiding the introduction of anterior abscesses into the sterile areas of the back, and reducing the probability of postoperative incision infection [4, 13]. However, minimally invasive treatment still has certain limitations, such as high requirements for hardware equipment and operators, a narrow range of adaptive signs, and long-term efficacy remains to be observed, etc. Therefore, mastering the adaptive signs of minimally invasive surgery and consistent application is a blessing for the treatment of patients and the development of spinal surgery.

## **5. Conclusion**

Spinal tuberculosis is caused by mycobacterium tuberculosis infection, which progresses slowly, but will bring serious complications in the later stage. Spinal tuberculosis early diagnosis and early treatment can effectively prevent its occurrence. At present, there are many examination methods, including combining symptoms, signs, biochemistry, and various imaging examinations. Especially the diagnosis of spinal tuberculosis infection and bacterial culture is very necessary. For the treatment of spinal tuberculosis, drug

therapy is the leading role, whether or not surgical treatment performs. Regular and appropriate anti-tuberculosis drug treatment should continue preoperative to postoperatively until the patient cured. There are many surgical methods, but the lesions should be thoroughly removed, sufficient decompression of nerves, reconstruction of spinal stability, etc. At present, the number of patients with spinal tuberculosis in China is on the rise, and drug-resistant tuberculosis is increasing. Early diagnosis and treatment of spinal tuberculosis can reduce the incidence of complications, and further research should conduct spinal tuberculosis.

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## **Conflicts of Interest**

There are no conflicts of interest.

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## **Abbreviations**

Not applicable.

## **Authors' Contributions**

SJ, SAJ, and SAM design the manuscript; SAJ & SAM collected literature; SJ gives instructions, and LCH revised the manuscript; SAJ and SAM write different parts; SAJ drafts the manuscript. All authors approved the final manuscript.

## Statement of Informed Consent

Research-informed consent was obtained from per institutional protocol.

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