Tuberculosis (TB) is an international problem despite advances in the methods of diagnosis and treatment. China has the second highest TB burden in the world. The latest report was approximately 9 million new cases of TB and 1.4 million TB deaths in the world in 2011.1 The number of new extrapulmonary TB patients in 2011 was 6540, which included Pott’s disease.1-4 Approximately 10% of patients with extrapulmonary TB have skeletal involvement. The spine is the most common skeletal site affected. Spinal TB accounts for approximately 50% of cases of skeletal TB.5 Spinal TB accounts for 1% to 3% of all TB infections.6

There are published studies on spinal TB in other countries,7-10 but only a few studies have been conducted on spinal TB in China.11 The purpose of the current 15-year retrospective study was to characterize the demographics, symptoms, clinical manifestations, multidrug resistance, extensive drug resistance, and incidence of complications in patients with spinal TB in Southwest China.

**Materials and Methods**

This retrospective study was approved by the ethics committee of Southwest Hospital, Third Military Medical University. All patient records were anonymized and deidentified prior to treatment and analysis.

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The authors have no relevant financial relationships to disclose.

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Patients

The medical records of consecutive patients with spinal TB who were admitted to the authors’ institution from March 1999 to December 2013 were retrospectively reviewed. The diagnosis of spinal TB was established when the following criteria were met: (1) presence of osteomyelitis at 1 or more vertebral segments; (2) presence of Mycobacterium tuberculosis isolated from the abscess of a tissue biopsy specimen; and (3) histology of tissue specimens demonstrating caseating granuloma or granulomatous inflammation with positive acid-fast bacillus smear. Patients who fulfilled criterion 1 and criterion 2 or 3 were included in this study. Demographic data, symptoms, clinical manifestations, laboratory results, radiographic findings, treatment, and outcomes were analyzed.

Evaluation of Clinical Outcomes

The medical records and follow-up data of the study population were reviewed. Clinical presentation and radiography, computed tomography (CT), and magnetic resonance imaging (MRI) were recorded preoperatively and at 1, 3, 6, 9, and 12 months of follow-up and every 6 months thereafter. Bone fusion was assessed according to the American Spinal Injury Association (ASIA) grading. Vertebral body loss was measured on pretreatment anteroposterior and lateral radiographs using the method described by Rajasekaran and Shanmugasundaram.13

Drug Susceptibility Testing

Drug susceptibility testing was performed using the proportional method recommended by the World Health Organization, and the concentrations of drugs in media were as follows: isoniazid, 0.2 µg/mL; rifampicin, 40 µg/mL; ethambutol, 2 µg/mL; streptomycin, 4 µg/mL; rifapentine, 40 µg/mL; para-aminosalicylic acid, 1.0 µg/mL; amikacin, 30 µg/mL; capreomycin, 40 µg/mL; kanamycin, 30 µg/mL; levofloxacin, 2 µg/mL; protonamide, 40 µg/mL; dipasic, 0.1 µg/mL. A strain was declared resistant to a drug when the growth rate was greater than 1% compared with the control. Multidrug-resistant TB strains were defined as those resistant to both isoniazid and rifampicin. In addition, isolates resistant to rifampicin and isoniazid, as well as any member of the quinolone family and at least 1 of the remaining second-line anti-TB injectable drugs, were defined as extensively drug resistant.

Results

Demographics

The number of patients receiving treatment for spinal TB per year increased from 15 in 1999 to 106 in 2013 (Figure 1). The total number of patients treated at the authors’ institution for spinal TB during these years was 967. There were 473 women and 494 men with a mean age of 35.86±15.68 years (range, 2-89 years). Patients 21 to 30 years old accounted for 25.75% of the cases of spinal TB; the second-largest group was patients 31 to 40 years old, followed by patients 41 to 50 years old (Table 1). The numbers of male and female patients stratified by age are displayed in Figure 2. Average length of hospital stay is shown in Table 2.
Prevalence of Symptoms and Clinical Manifestations

A total of 120 (12%) patients had comorbidities (Table 1). Back pain was the most common clinical complaint, followed by night sweats and low-grade fever. At physical examination, limitation of motion was found in 733 (97.35%) patients, percussion pain in 723 (74.77%), kyphosis in 386 (39.92%), and a draining skin sinus in 20 (2.07%). A total of 322 (33.3%) of the 967 patients had a neurological deficit (Table 2). At last follow-up, 10 patients had ASIA grade A deficits, 12 had ASIA grade B, 15 had ASIA grade C, and 8 had ASIA grade D. No patient had deteriorated in neurological function.

The most common imaging technique used to evaluate the patients for spinal lesions was MRI (89.58%), followed by CT (32%). Total number of levels involved with spinal TB was 2488; the most commonly involved site was the thoracic spine (1195 [48.03%] thoracic vertebrae), and the least commonly involved site was the sacral spine (105 [4.22%] sacral vertebrae). Mean number of involved vertebrae per patient was 2.57±1.52 (range, 1-13). Approximately 32.68% of patients had 3 or more involved vertebral bodies. There were 33 patients with skip lesions. The most common finding was disk space narrowing. Abscesses were visible by CT and MRI in 617 patients, including paraspinal abscess in 538 and prevertebral abscess in 79. Epidural compression was visible in 322 patients (Table 3). The incidence of spinal TB per spinal level is shown in Figure 3.

Prevalence of Multidrug-Resistant and Extensively Drug-Resistant Tuberculosis

The indications for surgery are detailed in Table 4. Of 740 patients undergoing surgery, 123 were diagnosed based on positive culture, 218 were diagnosed based on histology, 302 were diagnosed via surgery, and 37 were diagnosed based on aspirate or biopsy. Forty-nine patients were found to have strains resistant to at least 1 anti-TB drug. Males (51.0%) outnumbered females (49.0%) with a ratio of 1:1 in this study. Mean patient age at presentation was 34.6 years (range, 2-63 years).
Samples were obtained via open surgery in 40 (81.6%) patients, whereas sputum was used in 9 (18.4%) patients. No patient was found to be HIV positive.

Of the 49 drug-resistant cases, 24 (48.98%) patients had multidrug-resistant strains and 2 (4.1%) had extensively drug-resistant strains. Among the first-line drugs, maximum resistance was found against isoniazid (63.27%), followed by rifampicin (59.18%) and streptomycin (48.98%) (Figure 4). Among the second-line drugs, maximum resistance was found against levofloxacin (32.65%) and rifapentine (30.61%). The least resistance was found against amikacin (2.0%) and kanamycin (4.1%) (Figure 5). Among the non-multidrug-resistant group, maximum resistance was found against isoniazid, streptomycin, and rifapentine.

**Incidence of Complications**

Forty-four patients experienced complications, occurring from 1 week to 6 years postoperatively. Sixteen patients experienced sinus formation at the incision site postoperatively and were treated by incision, drainage, and anti-TB drug treatment. Four patients were found to have a new abscess at the site of a nonoperative spinal segment and were treated by surgery. Of 44 patients who had complications after surgery, 9 were found to be resistant to at least 1 anti-TB drug. All patients recovered after treatment and chemotherapy.

**Discussion**

Tuberculosis is an enormous threat to human health. Sir Percival Pott first described spinal TB in 1782. In the current study, spinal TB affected all age groups, from 2 to 89 years of age. The largest group of patients was 21 to 30 years old. In one study, 55% of patients were older than 70 years, whereas in another, 30.6% of patients were 31 to 40 years old. In addition, more patients older than 30 years were female than male in the current study, which is similar to data reported by the World Health Organization. Thus, young females represented a major percentage of patients in this study. Unlike in the study by Wang et al, most patients in the current study lived in rural areas, being in poverty and neglecting their health.

The most common symptom in the current study was back pain, followed by night sweats and low-grade fever. Unlike in other studies, back pain, weakness, and numbness were major symptoms. In addition, night sweats and low-grade fever were discontinuous but persistent according to the patients’ medical histories. This variation in the duration of symptoms may be due to the insidious clinical course and nonspecific manifestations of spinal TB. In terms of clinical signs, limitation of motion, percussion

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**Table 4**

<table>
<thead>
<tr>
<th>Indication for Surgery</th>
<th>No. (%) of Patients</th>
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<tbody>
<tr>
<td>Compression and/or injury of the spinal cord, cauda, or nerve root</td>
<td>367 (37.95)</td>
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<tr>
<td>Severe spinal kyphosis and progressive spinal kyphosis</td>
<td>318 (32.89)</td>
</tr>
<tr>
<td>Spine instability</td>
<td>357 (36.92)</td>
</tr>
<tr>
<td>Compression of vital organs (eg, trachea)</td>
<td>8 (0.83)</td>
</tr>
</tbody>
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pain, and kyphosis were major presentations. In some studies, 6,11,17,18 22% to 85% of patients had a neurological deficit; in the current study, 33% of patients had a neurological deficit. After anti-TB chemotherapy and surgery, neurological function improved in most patients. All patients with ASIA grade D neurological deficit had recovered at last follow-up. Some studies 4,11,19,20 reported a rate of combined spinal and pulmonary TB from 26% to 32%; in the current study, concomitant TB of the lung was present in 14.37% of patients.

Similar to other studies, 4,11,21 the thoracic and lumbar spines were the spinal segments most commonly affected, accounting for 89% of the involved vertebrae. Unlike in the study by Schlesinger et al, 15 patients in the current study had a more extensive disease state with paraspinal abscess and epidural compression; this difference between studies may be due to the delay in diagnosis. In this population, degenerative joint disease or inflammatory changes were usually considered to be the causes of back pain, and this may have delayed early and accurate diagnosis of spinal TB. 20 Magnetic resonance imaging and CT are still the most useful modalities for detecting spinal lesions, especially MRI, which has good sensitivity and specificity. 22,23 Eighty-nine percent of patients in the current study were diagnosed by MRI. A total of 740 patients received surgical intervention. Most patients were young and recovered well postoperatively. There was no surgical mortality.

According to Tuli, 24 any attempt at surgical excision of the disease prior to the anti-TB era met with serious complications, dissemination of disease, and high mortality (nearly 50%). Anti-TB drugs markedly improved the results of management by surgical intervention. All patients in the current study underwent anti-TB chemotherapy preoperatively. The indications for surgery were compression and/or injury of the spinal cord, cauda, or nerve root; severe spinal kyphosis and progressive spinal kyphosis; spine instability; and compression of vital organs. The optimal timing of surgery was after anti-TB chemotherapy proved to be effective, with an ESR less than 40 mm/h and a CRP value less than 1 mg/L. Anti-TB chemotherapy is necessary for surgical intervention for spinal TB. Anterior, posterior, and combined techniques, as well as osteotomies and vertebral column resection, have been described to correct spinal alignment and restore sagittal balance. 25,26 Nutrition support is important in the course of all treatments because spinal TB is a wasting disease.
Early diagnosis with less invasive modalities, such as CT-guided biopsy, may reduce patient morbidity and improve quality of life. In the current study, 227 patients refused operative treatment due to cost; they hoped to recover with conservative treatment although their physician advised surgery.

CONCLUSION

In spinal TB, back pain is the most common clinical symptom, and the thoracic spine is the vertebral body most often involved. The most commonly used first- and second-line anti-TB drugs are isoniazid and levofloxacin, respectively.

REFERENCES


