A new classification and guide for surgical treatment of spinal tuberculosis

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Abstract So far, there is no widely accepted classification system based on objective findings that can serve as a guide in selecting the treatment method for spinal tuberculosis. This retrospective study evaluates patients with spinal tuberculosis (Pott's disease) treated with different surgical procedures. Our aim was to outline a new classification of spinal tuberculosis. A retrospective review of 76 cases (55 male and 25 female patients) of spinal tuberculosis was conducted. Five of the patients were treated medically, and the others who were treated surgically were classified into three types (I, II and III) according to the new classification system for spinal tuberculosis. All 76 patients were classifiable by this new system. The most common complication observed was local kyphosis (maximum 8 degrees) in type-II patients, but none of the patients needed correction. No neurological deterioration was observed in any of the cases. This new classification system helps in differentiating the various manifestations

of spinal tuberculosis and appears to correlate with the surgical treatment of spinal tuberculosis. We believe that this new classification system can be used as a practical guide in the treatment of Pott's disease.

Résumé Il n'y a pas de système permettant de classer de façon objective les méthodes de traitement de la tuberculose osseuse. Cette étude rétrospective évalue les patients présentant une maladie de Pott, traités avec différentes techniques dans le but avoué de mettre en évidence une nouvelle classification de cette pathologie. Une étude rétrospective de 76 cas (55 hommes et 25 femmes) de tuberculose osseuse a été réalisée. Cinq patients ont été traités médicalement, les autres chirurgicalement en les classant en trois types A, B et C, selon la nouvelle classification. Les 76 patients ont été classés avec ce nouveau système. La complication la plus habituelle observée a été la cyphose locale (max. 8°) dans les types II. Mais il n'a pas été nécessaire chez ces patients de réaliser une correction chirurgicale. Nous n'avons observé aucune détérioration sur le plan neurologique. Cette nouvelle classification permet de différencier les différentes manifestations de la tuberculose osseuse et permet de faire une corrélation avec le traitement chirurgical. Nous espérons qu'elle pourra être utilisée et réaliser ainsi un guide pratique du traitement du mal de Pott.

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Introduction

Spinal tuberculosis is the most common and the most serious form of tuberculosis lesions in the skeleton [5, 29].

If the patients are diagnosed early, they can be treated medically. Although clinical and radiological findings are clear in tuberculosis of the spine, making an early and

definite diagnosis is not yet easy, because disease progression is slow and insidious. Due to this difficulty in the early diagnosis of the disease, several patients have received treatments like non-steroid anti-inflammatory drugs, physical therapy, a corset, etc., prior to correct diagnosis [21, 23, 25].

If there are not any complications and if the lesion is limited to the vertebrae, triple-drug anti-tuberculous chemotherapy can treat tuberculosis [24, 25]. However, with proper indications, surgical procedures are superior in the prevention of neurological deterioration, maintenance of stability, early recovery and early mobilisation [10, 26, 29, 30].

Magnetic resonance imaging (MRI) and computerised tomography (CT) have facilitated the preoperative diagnosis of tuberculosis of the spine, but the histopathological diagnosis is still essential [1, 17]. CT-controlled biopsy and abscess drainage also aid in making the diagnosis [7]. Due to these technical advances, cases with severe deformity and complications (gibbosity, paraplegia) are seen less frequently today [21, 23, 24].

The wide lesions, abscess formations, sinuses, vertebral deformities and neurological deficits due to spinal tuberculosis should be treated surgically. To date, there are several surgical treatment methods in the literature. New surgical techniques for tuberculosis of the spine are still being reported today.

However, which method to use for which case has not yet been determined exactly. There are only two spinal tuberculosis classifications in the literature. One of them is associated with posterior spinal tuberculosis and the other with thoracic spinal tuberculosis [20, 23]. Both have not presented an adequate method for forming a consensus on the management of spinal tuberculosis. Thus far, it is clear that there is a significant lack of an accepted and definitive classification system of spinal tuberculosis. Therefore, we decided to establish a classification system that relies on objective criteria such as abscess formation, presence of neurological deficit, degree of kyphosis, disc degeneration, sagittal index, stability-instability, etc., and that also can serve as a guide for treatment. MRI and CT studies were regarded as essential for the evaluation of patients both in the pre-diagnostic and post-treatment periods.

This classification system has been set up by retrospective analysis of 76 cases that were treated medically and surgically at the Gülhane Military Medical Academy, the Department of Orthopedics and Traumatology.

The purpose of this study is to demonstrate a new classification system as a practical guide in the treatment of spinal tuberculosis.

Materials and methods

Seventy-six spinal tuberculosis cases were treated medically and surgically at the Gülhane Military Medical Academy,

the Department of Orthopedics and Traumatology, between December 1989 and December 2002. The patients were evaluated and followed for at least 2 years (range, 2 to 5 years) in this study. The average age of patients was 28 years (range, 18 to 62), and 21 (27.6%) of the patients were female, while 55 (72.3%) were male. Preoperative neurological examination revealed that 1 (1.31%) case was Frankel A, 8 (10.52%) cases were Frankel C, 30 (39.47%) cases were Frankel D and 37 (48.68%) cases were Frankel E level (Table 1). After routine blood tests and radiological investigations, the patients suspected as potential tuberculosis cases were hospitalised. Their detailed blood tests, specific cultures for abscess and other debridement materials and radiological investigations were evaluated. Conventional radiograph were used to calculate the sagittal index and demonstrate instability. CT and MRI were helpful to understand abscess formations and their effects on peripheral tissues and the spinal cord, disc degenerations and vertebral collapse. All cases were maintained on a triple-drug anti-tuberculosis therapy. The definitive tuberculosis diagnosis was confirmed by histological examination in all patients. Except for five patients who were treated only medically after CT-controlled biopsy, all patients were treated surgically. The same surgical team performed all operations.

Surgical procedures (abscess drainage, anterior strut grafting, anterior instrumentation and posterior instrumentation) changed according to the progression of the disease. If there was no vertebral collapse, then abscesses were only drained. In case of vertebral collapse and kyphosis, surgical meticulous debridement and grafting were done. Instabilities and severe kyphosis (sagittal index ≥ 20 degrees) were reduced by posterior instrumentation and fusion. In cases of instability and severe kyphosis, it is necessary to perform posterior instrumentation and fusion after anterior procedures. Posterior surgery can be done in same session with anterior surgery or 10–15 days after.

Our classification system was based on seven clinical and radiological criteria (abscess formation, disc degeneration, vertebral collapse, kyphosis, sagittal index, instability and neurological problems). It also recommends specific techniques for each type. We have divided tuberculosis of the spine into three types by using as our criteria (Table 2).

Table 1 Preoperative and postoperative neurological status

Grade	Preoperative status of patients (%)	Postoperative status of patients (%)
Frankel A	1 (1.31%)	1 (1.31%)
Frankel B	—	—
Frankel C	8 (10.52%)	1 (1.31%)
Frankel D	30 (39.47%)	23 (30.26%)
Frankel E	37 (48.68%)	51 (67.10%)
Total	76	76

Table 2 GATA* Classification of spinal tuberculosis

TYPE		LESION	TREATMENT		SAMPLE
Type I	A	The lesion located in vertebra, one level disc degeneration, no collapse, no abscess, no neurologic deficits.	Fine needle biopsy and drug therapy
	B	Abscess formation, one or two level disc degeneration, no collapse, no neurologic deficit	Abscess drainage & debridement		
Type II		Vertebral collapse (pathological fracture) Abscess formation Kyphosis (correctable with anterior surgery) Stable deformity, with or without neurological deficit. Sagittal index < 20°	1. Anterior debridement & fusion 2. In existence of neurologic deficit decompression should be added 3. Strut cortical graft is used for fusion
Type III		Severe vertebral collapse Abscess formation, Severe kyphosis Instable deformity, with or without neurological deficit. Sagittal index ≥ 20°	1. Anterior debridement & fusion 2. Decompression 3. Correction of deformity & internal fixation (anterior, posterior or both)

*GATA=Gulhane Askeri Tip Akademisi (Gulhane Military Medical Academy)

GATA Classification for spinal tuberculosis

Type I There is one-level disc degeneration and soft tissue infiltration without abscess, but no collapse and neurological deficit.

- (A) The lesion is limited to the vertebrae (drug treatment is sufficient, but cases need to be controlled periodically).
- (B) There is evident abscess formation not limited to the vertebra, but there is no collapse, instability or neurological deficit (abscess drainage and debridement are sufficient, and drainage can be performed by anterior, posterior or endoscopic methods) (Fig. 1a,b).

Type II There is one- or two-level disc degeneration, evident abscess formation and mild kyphosis correctable with anterior surgery. The sagittal index (SI) is less than 20 degrees. There may be

a neurological deficit due to abscess information. Instability is not seen in these cases. Debridement with an anterior approach and fusion with strut-cortical graft is necessary. If there is a neurological deficit, decompression should be performed. For 2 months, a body cast was used, and after another 2 months, a body corset was applied in the postoperative period (Fig. 2).

Type III There is one- or two-level disc degeneration, abscess formation, instability and deformity that cannot be corrected without instrumentation. The sagittal index is more than 20 degrees. In addition to anterior debridement and fusion, if there is a neurological deficit, decompression must be performed. Deformity needs to be corrected and stabilised by internal fixation. Stabilisation can be performed with either anterolateral or posterior approaches, or both. In

Fig. 1 Type IB lesion **a** AP/lateral X-ray of lumbar spine with *black arrow* (lateral) demonstrating early disk destruction. **b** (left) Coronal MRI T2 with significant bone marrow edema at location of disk destruction (*black arrow*); (right) transaxial CT showing large left paravertebral abscess

these types of cases (except for five of them), we performed anterior debridement and fusion with tri-cortical autogenous graft (iliac crest or rib), posterior decompression, instrumentation and fusion in the same session. In the other five cases (according to the general status of the patient), we did the posterior surgery 1–2 weeks later (Fig. 3). A postoperative body corset was applied for only 2 months.

Results

The GATA classification described above is based on the retrospective analysis of the 76 patients who were treated medically and surgically. Five patients were treated only medically after CT-controlled biopsy. The other 71 cases were treated surgically. Eleven out of 76 cases were type I (14.47%), 48 were type II (63.15%), and 17 were type III (22.36%).

Fig. 2 Type II lesion. **a** Lateral X-ray with bony erosion L2–L3. **b** (top) MRI T1 without enhancement demonstrating mid-lumbar abscess cavity; (bottom) MRI T1 without enhancement demonstrating

mid-lumbar abscess cavity. **c** Lateral X-ray of lumbar spine following strut graft placement. **d** MRI sagittal proton density following strut graft placement. **e** MRI T1 coronal following strut graft placement

Fig. 3 **a** Clinical side view picture demonstrating thoracolumbar junction (TLJ) gibbous deformity. **b** Lat/AP X-ray demonstrating thoracolumbar junction (TLJ) gibbous deformity. **c** MRI T2 sagittal image with gibbous deformity at thoracolumbar junction (TLJ) with

canal compromise. **d, e** Intraoperative AP/Lat X-rays following egg-shell procedure, posterior debridement, posterior instrumentation and fusion. **f** Postoperative clinical side view picture

Disc degenerations

Disc destruction was observed in all patients. A non-specific back pain arises from this degeneration. The pain was localised to the degenerated area. Weight bearing and spinal motion increased the pain. If there was any abscess formation, this pain was diminished by drug therapy.

Abscess and sinuses

A cold abscess was found in 93.4% of the patients. These abscesses were drained surgically. We observed that the size of these abscesses reduced after anti-tuberculosis therapy. If the disease was localised in the thoracolumbar and lumbar region, the observed abscesses were paraspinal and frequently tracked to the psoas muscle. However, if the disease was localised in the thoracic region, epidural abscesses were additionally observed. Sinuses were noted in 62% of the patients. Of these sinuses, 35% were active and characterised by serous or serosanguinous discharge and a circle of pigmentation at the opening point. All sinuses were either curetted or excised, and 65% of them healed with unstable scars.

Vertebral collapse and deformities

Three patients had kyphoscoliosis, and two patients had kyphosis and scoliosis (or kyphoscoliosis). Vertebral body collapse and several degrees of kyphosis were observed in almost all patients of type II and III.

Neurological deficits

Thirty-nine patients (51.3%) had several levels of neurological deficits. In the thoracic region, neurological

problems were more severe than those in the lumbar region. In the lumbar region, neurological symptoms were similar to those seen in nerve root compressions. After surgical treatment, weak motor function and sensorial deficits diminished to 12%. Preoperative Frankel grades were changed in favour of the patients (Table 1). One case with Frankel A level remained at level A (1.31%). While all 7 cases in level C improved to level D, 14 level D cases improved to level E, bringing the total of level D cases to 23 (30.26%) and 51 cases (67.10%) of level E.

Complications

Motor recurrence or severe complications that require treatment were not observed in any of the cases that were followed postoperatively for a minimum period of 2 years.

In one of the type II cases, fistulae were observed in the third month postoperatively. It was healed by increasing the drug treatment period to 3 months. One patient of type 3 had a recurrent abscess and also was re-debrided twice. He eventually healed.

An increase in average of 8 degrees in kyphosis was observed in four patients of type II, but this did not require additional surgical treatment. In these types of cases, the body corset application period was extended to 4 months.

Discussion

Diagnostic delay is a common problem in spinal tuberculosis [21]. It is necessary to obtain a detailed patient history and clinical and radiological investigations to prevent this problem. MRI findings have led us to detect the lesion

localisation, involvement of discs and vertebral bodies, abscess formations and their compressive effects on the spinal cord [1, 17]. Nevertheless, spinal tuberculosis progresses slowly and insidiously, and early diagnosis before abscess formation and disc degeneration is difficult. For this reason, a detailed patient history is very important in these cases. In the early stages, single-level disc degeneration can be detected by MRI. Nevertheless, disc degeneration shows a unique degenerative process, and so the probability of diagnosing the condition as an infection is very low [17]. In either case, painful symptoms of patients can be resolved with medical treatment. If there is a tuberculosis history (in the patient or a family member), night sweats and weight loss focusing on the lesion, detailed MRI investigations are necessary for early diagnosis and medical therapy. CT-controlled biopsy from the destroyed area in the centre of the vertebral body is the gold standard technique for the early histopathological diagnosis of these patients [17].

If there is a cold abscess, antibiotic-analgesic therapy, bed rest or bracing cannot prevent the extensive destruction of vertebral bone and disc material [7, 21, 30]. After cold abscess and two-level disc degeneration, immediate drainage, microbiological and histopathological examination of the abscess along with medical therapy can protect the patient from vertebral collapse and prevent any delay in the diagnosis. The localisation of abscesses is very important. They can be observed in two locations, namely paraspinal and epidural. Epidural abscesses may cause more serious neurological problems because they can compress the cord. We observed that they are more pronounced in the thoracic region than in the lumbar region. Abscess drainage via the psoas muscle diminishes the compressive effects of pathology in the thoracolumbar and lumbar region [20]. Therefore, patients with epidural abscesses have therapeutic priority. Meningitis is another complication, and cervical involvement is another site for the disease in the literature [4, 11, 13, 15]. We did not observe cervical involvement or meningitis.

Nevertheless, many spinal tuberculosis cases are diagnosed after the progressive degenerative processes. These cases can only be treated surgically [2, 3, 28]. There are several surgical techniques: abscess drainage [7, 10], anterior strut grafting [12, 19], anterior instrumentation [8, 27], posterior instrumentation [14, 18], combined anterior and posterior stabilisation [6, 9] and video-assisted minimally invasive thoracoscopic spinal operations [16]. If there is no vertebral collapse, grafting is not necessary. But in the case of vertebral collapse and kyphosis, it is necessary to curette and graft the affected bone. If there is instability and severe kyphosis, (sagittal index $\geq 20^\circ$), instrumentation and fusion should be performed. There are some good results from other studies using anterior instrumentation, but conven-

tionally we performed posterior instrumentation. If bone quality is sufficient and the infection status allows anterior fusion, it can be performed. However, the best surgical method for each particular case has yet to be decided.

A classification system based on objective findings can be a guide in selecting the treatment method for spinal tuberculosis. There has been no widely accepted classification so far. Our aim was to select the best treatment method depending on objective criteria.

Delay in diagnosis and surgery can cause degenerative pathologies, deformities and complete paraplegia, especially in cases with incomplete neurological deficit [5, 21, 29]. These types of patients should be immediately immobilised, admitted to hospital, and early surgical treatment should be performed.

Surgical treatment is by far the superior treatment. In summary, abscess drainage and debridement enhance drug treatment [22]; biopsy specimens can be taken efficiently for histopathological diagnosis [10, 21]; local instability and disc degeneration are treated by fusion, which prevents pain and the development of deformity [3, 10]; decompression is provided in cases with neurological problems [19]; if there is any deformity, it can be corrected [14, 18]; surgical treatment leads to rapid recovery and early mobilisation [5, 21].

The earlier the surgical treatment begins, the faster the healing process. The risk of paraplegia by losing time should be kept in mind. We believe that this new classification can be used as a practical guide in the treatment of spinal tuberculosis.

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