Review article

Update on the surgical management of Pott's disease

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1. Introduction

Tuberculosis of the bones and joints remains rare, accounting for only about 1 to 3% of all cases of tuberculosis [1,2], with similar incidence time trends. The latest report from the World Health Organisation (WHO) on tuberculosis control indicates that tuberculosis cases have started to decline worldwide for the first time [3]. Similarly, the WHO Tuberculosis Surveillance and Monitoring Report issued in 2012 indicates a decrease in the incidence of tuberculosis in recent years [4].

Spinal tuberculosis, as Pott’s disease, accounts for half the cases of osteo-articular tuberculosis [1]. Vertebro-inoculation occurs via the haematogenous route and the process then spreads to the intervertebral disk and, in some cases, to the adjacent vertebra. Para-sagittal abscesses may develop by direct spread from the vertebral lesion. The thoracic spine is predominantly involved [5]. Pain is the most common presenting manifestation. However, the limited symptoms and absence of specific radiological changes early in the course of the infection often result in diagnostic delays. Computed tomography (CT) and magnetic resonance imaging (MRI) are valuable diagnostic tools. Confirmation of the diagnosis is obtained by identification of the tubercle bacillus in respiratory specimens and/or in samples obtained by abscess aspiration or bone biopsy.

The treatment of spinal tuberculosis usually relies on non-surgical means, namely, the administration of four anti-tuberculosis drugs and bracing. Two situations may require surgical treatment: loss of sagittal alignment of the spine due to extensive osteolysis and spread of an abscess into the para-sagittal tissues and spinal canal. In a 1960 report on the surgical treatment of cervical, thoracic, and lumbar spinal tuberculosis in 412 patients, Hodgson et al. [6] described the anterior approach with debridement as of fundamental importance. This principle is still applied to some extent in contemporary surgical strategies. Major advances have been achieved in recent years, however, with the use of open internal fixation combined with anti-tuberculosis drugs, the introduction of percutaneous internal fixation, and the development of interventional radiology techniques.

Here, our objective was to review recent epidemiological data, diagnostic criteria, and medical and surgical treatments for spinal tuberculosis.

2. Epidemiology

The 2011 WHO report indicates a stabilisation in the incidence of newly diagnosed tuberculosis, in contrast to the steady increase noted earlier. In 2010, the incidence of tuberculosis was 8.8 million and the mortality rate 1.4 million. Nevertheless, tuberculosis-related deaths decreased by 40% between 1990 and 2010 [2,7].

Considerable differences exist across geographic regions. In Europe, these differences are ascribable to HIV/AIDS, increasing poverty, inequalities in government funding of tuberculosis control.
efforts, increased tubercle bacillus resistance to anti-tuberculosis drugs, and immigration from endemic areas. Although the incidence of tuberculosis remains low in France, a few geographic regions and populations are at higher risk: tuberculosis is chiefly seen in large cities and the risk is greatest among intravenous substance users, the homeless, and immigrants [8–10].

Tubercle bacillus identification in sputum samples is the screening test currently used in the WHO tuberculosis control programme but detects only individuals with pulmonary tuberculosis. One-third of the world’s population is believed to harbour the tubercle bacillus. When the test is positive, short-term treatment with anti-tuberculosis drugs is given under direct observation by healthcare providers. The effectiveness of this control programme is obviously limited in patients with non-pulmonary tuberculosis. Thus, the first problem raised by spinal tuberculosis is the frequently long time to diagnosis [11,12].

3. Diagnosis

In France, the intradermal tuberculin test is still used to diagnose latent tuberculosis. This test may be positive in individuals having received the Bacillus Calmette-Guérin (BCG) vaccine, who

Fig. 1. Computed tomography, coronal and sagittal views: osteolysis in a 40-year-old patient with T11-T12 spinal tuberculosis.

Fig. 2. Magnetic resonance imaging, T2 STIR sagittal view: abscess lying behind the aorta from T8 to L2 (same patient as in Fig. 1).

Fig. 3. Drainage of the abscess via a video-assisted minimally invasive right anterior approach. Note the osteolysis after debridement (same patient as in Fig. 1).

Fig. 4. Post-operative radiographs showing preservation of sagittal alignment by the T8-L1 posterior fusion (same patient as in Fig. 1).
must therefore be tested using *in vitro* assays that measure the interferon gamma released into venous blood by infected T cells. The French National Authority for Health (HAS) recognizes the role for these *in vitro* assays as an alternative to intradermal tuberculin testing for the diagnosis of extra-pulmonary tuberculosis. In addition, microscopic examination of a variety of specimens (sputum; gastric aspirate, particularly in children; abscess samples, and urine) for presence of the tubercle bacillus can assist in the

![Computed tomography of the neck, coronal and sagittal views: osteolysis and retropharyngeal abscess in a 79-year-old patient with C3-C4 spinal tuberculosis.](image)

**Fig. 5.** Computed tomography of the neck, coronal and sagittal views: osteolysis and retropharyngeal abscess in a 79-year-old patient with C3-C4 spinal tuberculosis.

![Percutaneous drainage of the abscess via a pre-sterno-cleido-mastoid approach (same patient as in Fig. 5).](image)

**Fig. 6.** Percutaneous drainage of the abscess via a pre-sterno-cleido-mastoid approach (same patient as in Fig. 5).

![Post-operative radiographs of the cervical spine showing the fusion achieved via a combined posterior and anterior approach (same patient as in Fig. 5).](image)

**Fig. 7.** Post-operative radiographs of the cervical spine showing the fusion achieved via a combined posterior and anterior approach (same patient as in Fig. 5).

![Computed tomography, sagittal and axial views: osteolysis in a 53-year-old patient with T8-T9 spinal tuberculosis.](image)

**Fig. 8.** Computed tomography, sagittal and axial views: osteolysis in a 53-year-old patient with T8-T9 spinal tuberculosis.
should be subjected to histological examination for an epithelioid and giant-cell granuloma [14–16].

Spinal lesions that suggest tuberculosis are vertebral body osteolysis and kyphosis caused by bone destruction. These lesions can be evaluated on standing lateral radiographs and assessed in detail by CT (Fig. 1). Among currently available techniques, MRI has the best sensitivity and offers acceptable specificity for spinal lesions [17]. T2 STIR images can ensure the early detection of inflammatory oedema. In addition, MRI shows the extent of tuberculous abscesses and visualises spinal cord lesions (Fig. 2), allowing their detection before the onset of clinical manifestations. The diagnosis of tuberculous infection cannot be established based on imaging studies alone. Nevertheless, imaging studies are useful to assess the extent of the lesions, guide the collection of samples for tubercle bacillus identification, and assist in defining the best treatment strategy.

4. Medical treatment

Anti-tuberculosis drug treatment must be monitored closely to prevent the emergence of multi-resistant strains. From 2005 to 2010, Europe was among the regions with the lowest treatment success rates, i.e., 69% among new patients and 48% among previously treated patients [18]. The recommended treatment starts with four drugs given for 2 months: isoniazid, 5–15 mg/kg; rifampicin, 10–20 mg/kg; ethambutol, 15–25 mg/kg; and pyrazinamide, 30–40 mg/kg. Isoniazid and rifampicin are then given for the next 4 months. Fluoroquinolones are alternative first-line drugs. The latest recommendations indicate that spinal tuberculosis should be treated in the same way as pulmonary tuberculosis (with a longer treatment duration of 1 year in children according to 2010 WHO guidelines). However, when the clinical, laboratory,
and imaging study findings suggest persistent inflammation, most physicians prefer longer treatment duration of 9 months [16,19,20].

5. Surgical treatment

In 1960, at a time when the surgical treatment of spinal tuberculosis was still controversial, Hodgson et al. [6] described the routine use of debridement via the anterior approach, with a 93% fusion rate. In 1961, the French Society for Orthopaedic Surgery and Traumatology (SOFCOT) emphasised the predominant role for medical treatment while acknowledging the existence of two strategies, namely, routine local surgery and medical treatment alone with four anti-tuberculosis drugs and a brace [21,22]. However, published studies indicate widespread use of combined medical and surgical treatment: thus, in a review of case-series published between 1980 and 2011, surgery was performed in 75% of patients [5].

At present, the need for surgery is recognised [23–25] in patients with evidence of spinal cord or nerve root compression, extensive abscess formation, spinal instability due to osteolysis with kyphosis, and failure of medical treatment. In patients without evidence of neurological compromise, the treatment consists in anti-tuberculosis drugs and bracing, provided the sagittal alignment of the spine is preserved [26]. Imaging studies must be obtained at regular intervals throughout the treatment to look for worsening of the kyphosis. If vertebral body osteolysis results in anterior column collapse, the need for instrumental correction and fusion should be discussed. The rate of neurological complications is estimated at 10 to 40% [27]. Emergency surgical decompression is indicated only in patients with evidence of spinal cord compression and usually involves laminectomy followed by internal fixation and posterior fusion at the thoraco-lumbar spine or by corporectomy at the cervical spine.

In patients with extensive abscess formation but no neurological deficit, the anterior approach remains the reference standard [28–31]. This approach allows direct debridement of the pre-vertebral and intra-spinal focus of infection (Fig. 3). Pharmacokinetic studies have established that surgery improves the effectiveness of anti-tuberculosis drugs when debridement is optimal [32,33]. In addition, same-stage anterior grafting plays a key role in filling the lytic defect and strengthening the anterior column [34,35]. At the thoraco-lumbar spine, posterior fixation must be performed also to correct the kyphosis and ensure long-term stability of the spine in the sagittal plane (Fig. 4). Garg et al. [36] and Kumar et al. [37] advocated using the posterior approach alone to perform spinal canal decompression and abscess drainage during the same stage as internal fixation and fusion. Zhang et al. [38] described a similar technique involving the addition of a bony graft implanted into the anterior lytic defect via the posterior approach in order to stabilise the entire spinal segment, thereby preventing loss of correction with kyphosis. At the cervical spine, abscess drainage, corporectomy, and internal fixation are usually performed via the anterior approach alone. Additional posterior stabilisation is required only in patients with extensive bone destruction (Figs. 5–7). In sum, the surgical management of
typical spinal tuberculosis rests on two principles: debridement with spinal cord decompression and stabilisation of the spine. These principles are also followed in some developing countries, where surgical treatment can prevent the long-term development of severe kyphosis [39].

An alternative that may deserve consideration in some cases is percutaneous needle aspiration of the caseous necrosis to ensure decompression [40]. This procedure may be of value in patients with severe osteolysis responsible for spinal instability, a situation that requires posterior fixation as the first surgical step (Fig. 8). Spinal canal decompression by laminectomy must be performed with the patient in the prone position, which can increase the tension on the spinal cord. Furthermore, the introduction of Kerisson forcespans into the tight space of the canal increases the risk of spinal cord compression (Fig. 9). Aspiration of the caseous necrosis under CT guidance decreases the size of the collection and obviates the need for laminectomy (Fig. 10). In addition, posterior spinal stabilisation can be achieved with less risk of propagation of the infection along the internal fixation material (Fig. 11). A second stage of video-assisted surgery via a minimally invasive anterior approach is then performed to ensure debridement and bony grafting (Fig. 12). Finally, Wimmer described a percutaneous fixation technique [41] that might constitute a less invasive alternative. This technique may deserve evaluation in high-risk patients with spinal tuberculosis (Figs. 13–15).

6. Conclusion

Spinal tuberculosis (Pott’s disease) predominantly affects the thoracic spine and is often diagnosed late. Worldwide surveillance data published since 2011 point to stabilisation of the incidence of active tuberculosis. The treatment relies chiefly on anti-tuberculosis drugs with the same regimens as for pulmonary tuberculosis, although a treatment-duration of 9 months is often used in everyday practice. In the absence of a neurological emergency, surgery is indicated to prevent secondary spinal cord compression in patients with extensive abscess formation and/or sagittal spinal collapse. Both the anterior and the posterior approaches can be used. For thoraco-lumbar lesions, we usually start with the posterior approach to stabilise the spine. Decompression by percutaneous aspiration of the caseous necrosis decreases the risk of intra-operative neurological complications in high-risk patients. A minimally invasive anterior approach is then used to perform optimal debridement and to implant a bony graft designed to achieve long-term stability of the spine. At the cervical level, debridement and spinal stabilisation are performed via the anterior approach alone. Additional posterior fusion is required only in patients with marked osteolysis responsible for severe instability.

Declaration of interest

The authors declare that they have no conflicts of interest concerning this article.

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