

# Perioperative concerns in Pott's spine: A review

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## Abstract

Pott's disease is the most common granulomatous spine infection caused by tubercle bacilli and is a common site of osseous tuberculosis, accounting for 50–60% of cases. The delay in establishing diagnosis and management results in complications such as spinal cord compression and spinal deformity. The aim of this narrative review is to discuss the perioperative concerns in patients for spine surgery. The literature source for this review was obtained via PubMed, Medline, Google Scholar, Cochrane database of systematic reviews, and textbooks until December 2019. On the literature search, we could not retrieve any review article specifically discussing the perioperative concerns of spinal tuberculosis. Therefore, the aim of the present narrative review is to discuss the perioperative concerns of patients for spine surgery along with the specific concerns related to spinal tuberculosis.

**Keywords:** Anesthesia, perioperative concerns, spinal tuberculosis

Pott's disease is tuberculosis of the spinal column and is named after Percival Pott (1714–1788), a surgeon in London. Out of all extrapulmonary tuberculosis, only 10% of patients have a bone or joint involvement and out of this 50% develop spinal tuberculosis (TB) making it the most common site of skeletal involvement.<sup>[1]</sup> Neurological deficit develops in 10–50% cases.<sup>[2]</sup> Very often anesthesiologists are involved in the perioperative management of patients with spinal TB scheduled for spine or non-spine surgery, thus, mandating their awareness on this. This narrative review will discuss the perioperative concerns in patients undergoing surgery for Pott's spine.

## Methodology

An extensive literature search was carried out through Medline, PubMed, EMBASE, and Google Scholar using the keywords “tuberculosis, spinal/surgery,” “anaesthesia,” “intraoperative monitoring,” “autonomic dysfunction,” “pain management,” and “postoperative complications” from 1990

till December 2019. On PubMed search using the keyword “tuberculosis, spinal surgery” and “anaesthesia,” we could retrieve only 41 results and on further scrutiny, only 12 were found to be relevant. The search was limited to the English language and the reference lists of retrieved articles were examined to identify further articles. We could not retrieve any narrative or systematic review on perioperative anesthetic concerns in spine surgery for spinal TB.

## Diagnostic Investigations

Blood investigations used to diagnose TB include complete blood count, erythrocyte sedimentation rate (ESR), enzyme-linked immunosorbent assay (ELISA), and polymerase chain reaction (PCR). ESR has a sensitivity of 60–90% and is used to monitor therapeutic response. PCR with a sensitivity of 75% and specificity of 97% is useful in the paucibacillary state. Skin tests like Mantoux test with 40–55% sensitivity and 75% specificity is of no diagnostic value in endemic areas due to false-positive results in Bacillus Calmette–Guérin-vaccinated individuals.<sup>[1]</sup>

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Radiological tests are useful in diagnosing TB spine. MRI is the modality of choice as it helps in differentiating Pott's disease from malignancy or intraspinal tuberculoma. In recent years, Diffuse-weighted MRI and apparent diffusion coefficient values in combination with MRI have been used.<sup>[3,4]</sup>

Newer modalities such as BACTEC radiometric assay and GeneXpert *Mycobacterium tuberculosis* have a specificity of 98–100%, the latter having the advantage of rapid result and ability to detect rifampicin resistance. WHO in March 2017 recommended its use in patients with associated HIV and smear-negative TB.<sup>[5]</sup>

## Management

The goal of management of spinal TB is to eradicate the infection, prevent or treat neurological deficits, and to correct or halt the progress of spinal deformity.<sup>[6]</sup>

In advanced stages with deteriorating neurologic functions, the medical treatment, that is, directly observed treatment short-course (DOTS) antitubercular treatment (ATT) in conjunction with radical surgery is required.<sup>[7,8]</sup> Indications for surgical management are lack of response to chemotherapy, recurrence, worsening neurological deficit even after chemotherapy, severe weakness at presentation, spine instability, incapacitating pain, and severe deformities.<sup>[9]</sup>

Various surgical procedures performed are decompression, drainage of cold abscess in the cervical or psoas region, debridement and fusion with or without instrumentation which can be achieved by spinal reconstruction or fusion procedures (e.g., plate and screws), laminectomy (for posterior spinal disease or in paraplegia due to extradural granuloma/tuberculoma), microdiscectomy or costotransversectomy. Recently, minimally invasive video-assisted thoracoscopic surgery (VATS) has been used for debridement but its role in severe neurological deficits is questionable.<sup>[10-12]</sup>

Various approaches available for the aforementioned procedures include anterior approach, transoral or trans-hyoid approach, posterior approach, extrapleural anterolateral approach, or combined procedures. Pott's spine mainly involves the anterior column, thereby, the anterior approach allows adequate exposure, debridement, and easy reconstruction, especially when posterior structures are intact.<sup>[13]</sup> The cervical spine is best approached by an anterior approach in the supine position. The transoral and transthyrohyoid approach are employed for lesions in atlantoaxial regions.<sup>[14,15]</sup> The posterior approach is most commonly used due to familiarity and faster recovery but requires a prone position. The combined anterior and posterior approach is reserved only for severe destructive lesions and unstable pathologies.<sup>[16-18]</sup>

## Preoperative Investigations

In addition to the routine preoperative investigations, liver function tests are required to rule out drug-induced hepatitis.<sup>[19,20]</sup> Sputum culture and chest X-ray posteroanterior are done if pulmonary TB is suspected. The role of coagulation profile to assess the baseline coagulation status in spinal TB before surgery stands controversial<sup>[21,22]</sup>; however, it is indicated in patients with suspected liver dysfunction, surgery associated with major fluid shifts, or blood loss requiring massive transfusion. The extent of kyphoscoliotic deformity leading to cardiopulmonary compromise can be evaluated by measuring Cobb's angle in plain X-ray spine,  $>40^\circ$  requiring surgical correction<sup>[23]</sup> Further tests such as echocardiography, dobutamine stress echo, pulmonary function tests, and arterial blood gas analysis are indicated in patients with limited cardiopulmonary reserve or requiring thoracotomy or one-lung ventilation (OLV).<sup>[24]</sup>

## Anesthetic considerations

### Preoperative concerns

1. Patients presenting for surgery for Pott's spine may frequently have pulmonary TB. In patients with active pulmonary TB, elective surgery should be delayed until the patient is no longer infectious. The quantitative bacteriologic studies indicated that the concentration of viable *M. tuberculosis* decreased by more than 90% (10-fold) during the first 2 days of treatment with isoniazid, and by more than 99% (100-fold) by days 14–21 with rifampicin and pyrazinamide.<sup>[25]</sup> The American Society of Anesthesiologists (ASA) recommends delaying elective surgery until at least 2–3 weeks after starting ATT, or clinical improvement or three negative sputum smears on different days.<sup>[26]</sup>
2. Pott's spine with kyphoscoliosis may be associated with restrictive pulmonary pathology.<sup>[27]</sup> The decrease in chest wall compliance increases the work of breathing. Impairment in lung functions is more in severe spinal deformities (Cobb's angle  $>70^\circ$ ), proximally located curvature, and older patients.<sup>[23,28]</sup> Chest infection, if present, must be treated before surgery
3. The type and approach of surgery have a significant influence on the development of postoperative pulmonary complications with a lower incidence with a posterior approach than anterior or combined approaches.<sup>[29]</sup>
4. Complete preoperative neurological assessment should be documented to rule out any deterioration following maneuvers such as tracheal intubation and patient positioning. Also, the level of the lesion and the time elapsed since the injury determines the cardiovascular and respiratory derangements perioperatively, especially in patients with spinal shock where autonomic dysreflexia may follow.<sup>[24]</sup>

5. Airway management for surgery involving the cervical spine may pose difficulties due to the need for spinal immobilization and the risk of aspiration. Thus, routine use of aspiration prophylaxis and preparation for difficult airway management is advocated
6. Severe scoliosis (Cobb's angle  $>100^\circ$ ) may also be associated with cardiac dysfunction due to distortion of the mediastinum, and cor pulmonale secondary to chronic hypoxemia and pulmonary hypertension<sup>[23]</sup>
7. Patients undergoing spine surgery are at increased risk of venous thromboembolism (VTE) as a result of prolonged surgery, prone position, and an extended period of postoperative recumbency.<sup>[30,31]</sup> Pharmacological deep venous thrombosis (DVT) prophylaxis must be considered in such cases. The role of non-pharmacological DVT prophylaxis is contentious and must be used only as an adjunct<sup>[32]</sup>
8. These patients are often on ATT and a wide spectrum of antibiotics. ATT has effects on various organs like liver (rifampicin), nervous system (isoniazid and streptomycin), hematology (thrombocytopenia), and kidney (ethambutol). Both ATT and antibiotics should be continued until the day of surgery. The effects of ATT on various anesthetic agents are shown in Table 1.<sup>[20]</sup> ATT-induced hepatitis is a serious complication warranting interruption in ATT till hepatitis subsides, thus, elective surgery is avoided
9. These patients are also frequently on nonsteroidal anti-inflammatory drugs (NSAIDs) which in addition to gastrointestinal side effects also cause reversible inhibition of platelet function, resulting in significantly increased blood loss. Therefore, NSAIDs should be discontinued before surgery depending upon their elimination half-lives, for example, diclofenac and ibuprofen should be stopped 1 day and piroxicam 11 days prior to surgery.<sup>[33]</sup>

## Intraoperative Concerns

### Autonomic dysfunction

Autonomic dysfunction has been reported in patients with spine TB and can lead to clinical symptoms, like postural hypotension, syncope, cardiorespiratory arrest during

invasive procedures. A preliminary study by Raimondi *et al.* suggested the presence of altered autonomic cardiovascular autoregulation, that is, reduced baroreceptor reflex action in non-hypoxic TB patients.<sup>[34]</sup> Similarly, Chilkoti *et al.* and Tyagi *et al.* reported autonomic dysfunction and adrenal insufficiency in patients with spine TB undergoing thoracic spine surgery.<sup>[35,36]</sup> The latter reported the increased incidence of hypotension and a substantial decrease in systolic blood pressure and diastolic blood pressure without compensatory tachycardia following induction and positioning suggesting autonomic dysfunction in patients undergoing surgery for TB spine. Therefore, it is warranted to evaluate the autonomic nervous system in the preoperative period and also consider the stress dose of corticosteroids in case of perioperative hemodynamic perturbations not responding to fluid management.<sup>[34,35]</sup>

### Management of blood loss

Tubercular spine surgery may be associated with significant blood loss. Preoperative anemia should be corrected. Intraoperatively, proper positioning, antifibrinolytics such as tranexamic acid (TXA) and aminocaproic acid are used to decrease blood loss. In addition, fibrinogen concentrates, thromboelastometry, acute normovolemic hemodilution, controlled hypotension, and temperature regulation are some of the techniques used to decrease blood loss and the need for transfusions.<sup>[37]</sup> Controlled hypotension using the combinations of sevoflurane or isoflurane and opiates, or alpha and beta-blockers and sodium nitroprusside has been widely used.<sup>[38]</sup> Dexmedetomidine is an effective and safer agent in achieving controlled hypotension in adults undergoing posterior fixation spine surgery when compared to nitroglycerin.<sup>[39,40]</sup> Magnesium and remifentanyl have also been found to have similar efficacy with minimal adverse effects.<sup>[41]</sup> Similarly, esmolol<sup>[42]</sup> and milrinone<sup>[43]</sup> have also been found to be effective.

Hemostatic agents like recombinant factor VII, desmopressin, aprotinin, TXA, and epsilon aminocaproic acid (EACA) have been used for the reduction of blood loss and transfusion requirement in spine surgery.<sup>[44,45]</sup> Out of these, TXA appeared to be more beneficial than other antifibrinolytic

**Table 1: Effects of antituberculosis treatment on various anesthetic agents (20)**

Drug	Effect of tuberculosis treatment	Recommendation
Induction agents	Unchanged	Risk of awareness with total intravenous anesthesia
Inhalational agents	Risk of halothane hepatitis	Newer agents are preferable
Local anesthetic agents	Unchanged	General anesthesia and systemic opioids should be avoided
Neuromuscular blockers	Increased metabolism of, for example, rocuronium/vecuronium	Neuromuscular monitoring and titrate the dose
Opiates	Increased metabolism, often more frequent dosing	Titrate the dose (Regional technique and patient-controlled analgesia is recommended)

agents in reducing surgical blood loss without increasing the incidence of thromboembolism.<sup>[45]</sup>

Postoperatively, fibrin sealants, shed blood salvage, erythropoietin, or intravenous iron can be used in the management of blood loss, especially when the patient refuses blood products.<sup>[37]</sup> Blood conservation strategies in spinal surgery is a multidisciplinary approach. Cost-effectiveness and the benefits of long-term patient outcomes are the subjects of current and future research.<sup>[46]</sup>

### Positioning

Patient positioning is determined by the surgical approach selected. The anterolateral approach requires lateral position whereas the posterior approach to the thoracic spine requires prone, knee-chest, or knee-elbow position. Problems with prone or knee-chest position include ocular injuries, peripheral nerve injury (e.g., brachial plexus, ulnar nerve, peroneal nerve), abdominal and limb compartment syndrome, pressure sores, accidental extubation or disconnection, hemodynamic instability, shoulder dislocation, thrombosis, and stroke.<sup>[46,47]</sup> Therefore, precautions like protection of pressure points, neutral head and neck positioning, proper eye padding, freely hanging abdomen, and adequate cardiorespiratory monitoring are mandatory before the start of surgery. A systematic review observed the relationship between increased operation time and position-related complications and concluded that complications in prone position increased when mean operative time exceeded 120 min. However, no relationship was observed for other surgical positions.<sup>[46]</sup>

### One Lung Ventilation (OLV) for anterior approaches

In patients undergoing TB spine surgery, gas exchange may be compromised due to deformity-induced restrictive lung disease or/and preexisting pulmonary TB. The use of OLV would further worsen the preexisting pulmonary dysfunction if present.<sup>[48]</sup> Therefore, patients with previous lung disease should be carefully evaluated and the need for postoperative ventilation should be assessed before surgery.<sup>[49]</sup>

### Intraoperative monitoring

For uncomplicated spine surgeries, standard ASA recommended minimal mandatory monitoring is sufficient. An arterial and central venous pressure (CVP) catheter is recommended if controlled hypotension or combined anterior and posterior approach is planned. However, it should be kept in mind that CVP values may be misleadingly high in prone position due to increased intrathoracic pressure.<sup>[50]</sup> Respiratory monitoring should include peak airway pressure monitoring, especially during prone positioning and OLV.<sup>[51]</sup>

### Monitoring for spinal cord integrity

Injury to the spinal cord is the most feared complication associated with spinal procedures. The Stagnaro wake-up test has been considered the gold standard and is performed after instrumentation, decompression, and correction of the deformity have been completed.<sup>[52,53]</sup> However, it is performed intermittently, may be difficult in uncooperative patients and may cause dislodgment of instruments, displacement of intravenous lines and monitors, accidental extubation, air embolism, and intraoperative recall.<sup>[54]</sup> Literature is replete with studies comparing the efficacy of various short-acting intravenous and inhalational agents such as remifentanyl, fentanyl, propofol, dexmedetomidine, sevoflurane, desflurane, etc., for performing the wake-up test.<sup>[55-57]</sup> Total intravenous anesthesia (propofol and remifentanyl) along with bispectral index monitoring for anesthetic depth has been found to allow rapid wake up for performing the test.<sup>[58]</sup>

Intraoperative neurologic monitoring (IONM), Somatosensory evoked potentials (SSEPs), and motor-evoked potentials (MEPs) allow for the continuous assessment of spinal cord function. The clinical usefulness of SSEP lies in its ability to demonstrate the functional integrity of neural pathways in an anesthetized patient.<sup>[52]</sup> Motor-evoked potentials are the electrical activity in peripheral nerves and muscles after cortical or spinal stimulation and provide a useful measure of the functional integrity of motor pathways. However, these cannot be monitored continuously, and are difficult to interpret in patients with underlying motor disorders and are also sensitive to anesthetic agents, that is, inhalational agents and neuromuscular blockers.<sup>[52]</sup> Controlled neuromuscular blockade permits recording of compound muscle action potentials while eliminating patient motor activity that could interfere with surgery.<sup>[59]</sup> The role of IONM in spine surgery has recently been questioned and no substantial decrease in the rate of the neurologic deficit has been observed. Further randomized studies are required to clarify the indications of IONM in spine surgery.<sup>[60]</sup>

### Concerns in patients with active TB

Patients with spine TB may also have concomitant active pulmonary TB warranting specific considerations. Elective cases should be taken up as the last case of the day followed by fumigation to allow the decontamination of theater. The patient and the OT staff should preferably wear either a well-fitting surgical mask or an N95□ mask to avoid droplet infection. The contamination of the anesthesia machine can be prevented by the use of a circuit high-efficiency particulate air (HEPA) filter. Most postanesthesia care units do not have isolation area, therefore, immediate postoperative care should be maintained in operation theater.<sup>[20]</sup>

## Postoperative Concerns

Postoperative visual loss (POVL) is a rare event seen in only 0.01% of spinal deformity patients, encountered following prone positions.<sup>[61]</sup> The most common cause of POVL is an ischemic optic neuropathy (ION), accounting for 89% of the cases.<sup>[62]</sup> Various risk factors responsible for POVL are obesity, male sex, use of Wilson frame, longer anesthetic duration, and greater blood loss. Also, decreased administration of colloid as a non-blood replacement during spinal surgery has been observed to be independently associated with ION.<sup>[63]</sup> Recently, the ASA task force-practice advisory for POVL strongly recommends identifying patients with preoperative anemia, vascular risk factors (e.g., hypertension, diabetes, peripheral vascular disease, coronary artery disease, previous stroke, carotid artery stenosis), obesity, and tobacco use, by proper history taking and examination, to decrease the risk of POVL.<sup>[64]</sup> It also discusses and recommends risk factor modification for POVL by intraoperative blood pressure management, management of blood loss and administration of fluids, use of vasopressors, patient and head positioning, and staging of surgical procedures.<sup>[64]</sup>

### Postoperative elective ventilation

The decision for postoperative elective artificial ventilation must be evaluated before the surgery completion. Various risk factors include the presence of preexisting comorbidities such as neuromuscular disorder, severe restrictive pulmonary dysfunction, morbid obesity, prolonged procedure, surgical incision involving the thoracic cavity, and blood loss greater than 30 mL/kg.<sup>[24]</sup>

### Postoperative pain management

Postoperative pain management constitutes an important aspect as it helps in early ambulation, rehabilitation, and avoiding postoperative pulmonary complications. Multimodal analgesia<sup>[65]</sup> has gained precedence to improve pain control by reducing opioid consumption and related adverse effects by encouraging the use of various non-opioid analgesics like NSAIDs,<sup>[65-68]</sup> neuromodulatory agents like gabapentin and pregabalin,<sup>[69]</sup> dexamethasone,<sup>[70]</sup> magnesium, ketamine, dexmedetomidine,<sup>[71]</sup> local anesthetics,<sup>[65]</sup> etc.; intrathecal or epidural injections (via single-shot injection, continuous infusion, patient-controlled analgesia).<sup>[72]</sup>

Recently, local wound infiltration has evolved as a postoperative pain management modality in tubercular spine patients due to difficulty in regional anesthesia techniques as a result of distorted spinal anatomy and the presence of infection. The efficacy of wound infiltration with ropivacaine, adrenaline, and dexmedetomidine was evaluated in spine surgery for Pott's spine patients and was observed to provide better postoperative

analgesia with lower postoperative morphine requirement.<sup>[73]</sup> The intercostal or intrapleural block is recommended for postoperative pain relief in spine surgeries involving the anterior approach.<sup>[74]</sup>

### Postoperative complications

Problems specific to surgery for spine TB include wound infection, discitis, postoperative osteomyelitis and spinal epidural abscess. Spinal epidural abscess (SEA) is a clinically important entity and seen in 1.2 per 10,000 patients.<sup>[75]</sup> Various predisposing factors for SEA include diabetes mellitus, spinal trauma or surgery, chronic renal failure, carcinoma, alcoholism, etc. The classical triad of presentation is intense localized back pain, progressive neurologic deficit, and fever.<sup>[76]</sup> It is a neurological emergency, early diagnosis (by CT myelography and MRI) and immediate surgical spinal cord decompression should be performed.<sup>[24]</sup>

## Conclusion

The goal of treatment in spinal TB is to eradicate the disease and prevent or treat the spine deformity and/or neurologic deficits. In addition to the standard perioperative concerns for spine surgery, in Pott's spine, we must consider concomitant active pulmonary TB, general state of the patient's health (nutrition and anemia, the impact of the TB on organ function), potential drug interactions of ATT with anesthetic agents, underlying autonomic dysfunction, concerns with the use of OLV for thoracoscopic spine surgery and the risk of nosocomial infection transmission to the operation theater staff and the other patients.

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### Conflicts of interest

There are no conflicts of interest.

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