

Neurosurgical Approaches to Spinal Infections



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KEYWORDS

• Spine • Infection • Surgery • Postoperative infection • Instability • Decompression • Deformity

KEY POINTS

- Spinal infections may be life threatening.
- Surgery is indicated in inadequate biopsies, conservative treatment failure, neurologic deterioration, spinal instability and deformity.
- In abrupt neurologic deterioration, emergency surgery must be performed.
- Choice of the operative procedure depends on the causative agent, site of the lesion, neurologic status, and bone destruction.

INTRODUCTION

Spinal infections are rare pathologies that compromise 2% to 4% of all bone infections.^{1,2} These infections often jeopardize both the integrity of the spinal column and its neural contents, creating a consumptive process that may be life threatening. Therefore, in recent years more attention has been paid to spinal infections with the availability of increased diagnostic accuracy. Yet, even with improved diagnostic tools and procedures, delays in diagnosis remains an important issue.³ Spinal infections can be categorized according to the different entities, such as contagious agent, anatomic localization, and onset of disease. There is usually also a predisposing factor that compromises the immune system and affects the spread as well as the severity of disease. Postoperative spinal infections are an important topic. Management of spinal infections requires a

multidisciplinary approach involving spinal surgeons, infectious disease specialists, radiologists, rehabilitation personnel, psychologists, and social services. We emphasize neurosurgical approaches to spinal infections, focusing on anatomic location and causative agent.

NORMAL ANATOMY

Spinal infections are located mainly in the epidural space, body of the vertebra, intervertebral disc, perivertebral area, and intradural space. Infection may be localized in one of these compartments. Erosion of vertebral endplates causes deformation of the cortical lining and spreads to disc space (spondylodiscitis), subligamentous paravertebral space (paravertebral and psoas abscesses), and/or epidural-intradural space (epidural abscesses, intradural abscesses, and meningitis), consecutively.

The authors certify that there is no conflict of interest with any financial organization regarding the material discussed in the article.

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Neuroimag Clin N Am 25 (2015) 295–308

<http://dx.doi.org/10.1016/j.nic.2015.01.008>

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PATHOLOGY

The spine is known to be susceptible to infections with the incidence varies between 1:100,000 and 1:250,000 in developed countries. According to the literature, mortality rate ranges between 2% and 17%.^{4,5} There is a superiority in males and age distribution has 2 peaks: under age 20 and between age 50 and 70.^{4,6}

The major causative agents of spine infections are bacteria, which cause pyogenic infections; tuberculosis (TB) or fungi, which are responsible for granulomatous infections; and parasites, which are the least common etiology. Among them, the majority are bacterial pyogenic infections owing to *Staphylococcus aureus*.⁷ Of note, in one-third of all cases of spinal infections, the infectious agent could not be identified.⁸

Pathogen spread occurs via 3 routes: hematogenous, direct external inoculation (iatrogenic), and spread from contiguous tissues. Risk factors for spinal infections include previous spine surgery, distant infectious foci, diabetes mellitus, malnutrition, advanced age, intravenous drug abuse, human immunodeficiency virus infection, a history of malignancy, prolonged use of steroids, rheumatologic disease, liver cirrhosis, renal failure, and septicemia.⁵ Among these, previous spine surgery is most common (30%), without regard to the operative technique.⁹

MANAGEMENT

Management can vary according to the type of the causative agent, localization of the disease, neurologic condition, general status of the patient, and stability as well as alignment of the spinal column. The most frequently affected spinal segments are lumbar (58%), thoracic (30%), and cervical (11%).¹⁰ Clinical signs and symptoms caused by spinal infections often are subtle and insidious;

therefore, clinical suspicion in patients with nonmechanical pain is important in making a proper diagnosis in early stage of the disease.

Diagnostic studies must be targeted toward anatomic segments of the disease, anatomic localization of the infection, neurologic status of the patient, clinical onset of the disease, the structure of the spine, and the causative agent (**Table 1**). In many cases, the causative agent is inferred; therefore, the empirical treatment is given. After or even all diagnostic tools are used, biopsy is recommended for the analysis of the organisms.

BIOPSY

Closed (Percutaneous) Biopsy

The rate of definite diagnosis is 68% to 86%.^{11–13} Percutaneous CT-guided needle biopsy is found to be safe and its accuracy has been reported up to 70%.¹⁴ Recently, endoscopic biopsy is used in cases of spondylodiscitis, because it also allows discectomy and drainage, and its performance for bacterial recovery is better than CT-guided spinal biopsy.^{15,16} The paramedian Kambin triangle for sampling of the intervertebral disc is the primary approach. The Kambin's triangle is defined as a right triangle over the dorsolateral disc. The hypotenuse is the exiting nerve root, the base (width) is the superior border of the caudal vertebra and the height is the dura/traversing nerve root.^{17,18} The transpedicular approach is another route that is defined for the percutaneous biopsies.^{19,20}

Open Biopsy

Patients who have already received antibiotic therapy can have false-negative biopsy results. If the first biopsy is negative, a second biopsy should be done after an antibiotic-free duration of time. If the second biopsy is also negative, then open surgical biopsy should be considered. Overall,

Table 1
Diagnosis scheme for surgical planning

Anatomic Segments	Anatomic Localization	Neurologic Status	Clinical Onset	Structure of Spine	Causative Agent
Cervical (upper)	Vertebral body	Intact	Acute	Alignment (No/Ne/K)	Pyogenic
Cervical (subaxial)	Intervertebral disc	Neurologic deficit	Subacute	Stability (S or Uns)	Fungal
Thoracic	VB + ID		Chronic	Destruction	Parasitic
Lumbar	Epidural				Others
Sacral	Subdural				
Multisegmental	Intamedullary				
	Paravertebral				

Abbreviations: ID, intervertebral disc; Uns, unstable; K, kyphotic; Ne, neutral; No, normal; S, stable; VB, vertebral body.

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