



Review Article

Spinal infections in children: A review

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ABSTRACT

Spinal infections are uncommon but significant causes of morbidity and hospitalization in the paediatric population. These infections encompass a broad range of conditions, from discitis to osteomyelitis and spinal epidural and intramedullary abscesses. Paediatric spinal infections can be caused by a range of bacterial, viral, fungal and parasitic agents. Ultrastructural differences of the vertebrae and associated structures result in distinct mechanisms of pathogenesis of spinal infections in children compared to adults. The non-specific nature of symptoms produced by them can cause considerable diagnostic delays. Magnetic Resonance (MR) imaging can facilitate early identification of the disease, and distinguish it from other spinal pathologies. The association of antimicrobial resistant bacterial strains from some of the cases appears worrisome; as is the increasing incidence of *Kingella kingae* infections causing spinal infections. Rest and immobilization are the general treatment, and prompt initiation of antimicrobial therapy is warranted to ensure optimal clinical outcome. Most patients generally have a good prognosis; however, early identification and prompt initiation of antimicrobial therapy is essential to achieve the best therapeutic response.

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1. Introduction

Spinal infections include infections primarily affecting (a) the spinal cord, (b) the nerve roots and meninges, or (c) the vertebrae, intervertebral discs, and epidural space.¹ They are broadly classified as pyogenic or non-pyogenic, with the former category including vertebral osteomyelitis and discitis, while parasitic, fungal, and tuberculous infections constitute the latter category.^{2,3} These infections are rare but significant causes of morbidity and hospitalization in the pediatric population. Though accurate statistics are unavailable from most parts of the world, data from the developed countries reveal an incidence of 0.3 per 100,000 cases among individuals aged less than 20 years^{4,5} (Table 1).^{6–10} Spinal infections can contribute to prolonged hospitalization, unnecessary diagnostic tests and antibiotic use, lost school days, caregiver absenteeism at work, and considerable healthcare expenditure. Corresponding with the increase in general population, the number of individuals with immune compromising conditions, intravenous drug use, and spinal instrumentation, the incidence of these infections is likely to increase in future. These

infections deserve special clinical attention as they exhibit distinct pathogenic mechanisms, exhibit non-specific symptoms and can be potentially devastating.

In most children, the average age at diagnosis of spinal infections is between 2 and 7 years.¹¹ However, neonates can be affected as well (Table 2).^{11–16}

A number of risk factors exist for the acquisition of these infections, and are summarized in Table 3.^{9,10,13,17–22,26}

1.1. Infections of the spinal cord

Spinal infections may be caused by a number of bacterial, viral, fungal, and parasitic agents (Table 4). Intramedullary spinal cord abscesses due to bacterial pathogens are rare in children, though some reviews reported that 20–50% of all cases occurred in children.¹ The reported risk factors include congenital heart disease, immune disorders, long-term use of vascular access devices, spinal cord tumors, and dermal sinuses. Abscesses within and outside the spinal cord may result from dermal sinuses.^{10,24–26} The patients generally have an antecedent history of infection elsewhere, and the spinal lesions may develop from hematologic or lymphatic spread. The condition initially presents as myelitis, and can progress to abscess formation if left untreated.¹

Viral infections often disrupt protective mucosal barriers, promoting the entry and spread of oropharyngeal flora leading

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Table 1
Incidence of spinal infections in children.

Type of infection and age	Incidence	References
All spinal infections, across all ages	2.4 per 100,000 cases per year	4,5
All spinal infections in persons aged ≤20 years	0.3 per 100,000 cases per year	
Spinal epidural abscesses, across all ages	0.2–2.0 per 10,000 hospital admissions per year	6–8
Spinal epidural abscesses	0.6 per 10,000 hospital admissions per year	9
Intramedullary spinal cord abscesses	Extremely rare	10

Table 2
Age distribution of spinal infections in children.

Type of infection	Observation with respect to age	References
All spinal infections	Mean age at diagnosis: 2–7 years	11
Osteomyelitis	Rare in children aged ≤3 years	12
Discitis	Rare in children aged ≥8 years	12
Spinal epidural abscesses	Mostly in children aged 7.6–8 years	13,14
	Occasionally in neonates	15
Spinal subdural abscesses	Mostly in infants and toddlers	16
Intramedullary spinal cord abscesses	Mean age at diagnosis: 36 months (range, 18 days to 17 years)	10

Table 3
Risk factors associated with spinal infections in children.

Type of infection	Risk factor	References
All infections	Hematologic seeding from infectious focus in skin, genitourinary tract, gastrointestinal tract, oral cavity, respiratory tract	2
Spinal epidural abscesses	Underlying disease (in 1/3rd of children)	13
	Immunocompromised states (sickle cell anemia, polymyositis, leukemia)	9,17
	Tuberculosis	18
	Vertebral osteomyelitis	19
	Trauma and hematoma (in 17–24% of cases)	20,21
Spinal subdural abscesses	Midline congenital dermal sinuses and hematogenous spread of infection	22
Intramedullary spinal cord abscesses	Dermal sinus tracts (53% of cases)	26
	Hematogenous spread of infection from foci in vulva, urinary tract, lungs, middle ear, endocardium, kidney and sagittal sinus	10,26
	Intramedullary spinal cord tumors, trauma, bacterial meningitis	10,25,26

to respiratory infections. The ensuing bacteremia may seed the organisms within the joint space, bones or intervertebral discs, creating foci of suppurative infection.²⁷ Reports have suggested that varicella infection may increase the risk for spinal epidural abscesses due to secondary bacterial.^{28–30}

Infection with poliovirus, herpes virus, and cytomegalovirus (especially in patients with HIV) can also result in myelitis. With interruption of wild poliovirus circulation from many parts of the world, myelitis associated with it has decreased in the recent years. However, an earlier study reported an increase in herpes zoster myelitis.³¹

Fungal pathogens including *Candida* and *Aspergillus* can also cause spinal infections in children.¹

Table 4
Common pathogens associated with spinal infections in children.

Category	Name of the pathogen
Bacterial	<i>Staphylococcus aureus</i> (including Methicillin Resistant <i>Staphylococcus aureus</i> , MRSA) Group B streptococci <i>Escherichia coli</i> <i>Listeria</i> spp. <i>Haemophilus influenzae</i> <i>Neisseria meningitidis</i> <i>Pneumococcus</i> <i>Neisseria meningitidis</i> <i>Brucella</i> spp. <i>Kingella kingae</i>
Viral	<i>Herpes viruses</i> <i>Polio viruses</i> <i>Cytomegalovirus</i>
Fungal	<i>Aspergillus</i> spp. <i>Candida</i> spp.
Parasitic	<i>Taenia solium</i> <i>Schistosoma</i>

Among parasitic agents, *Schistosoma* sp. is frequently reported in children.¹ Rarely, cysticercosis can also be a cause of spinal masses in children, especially in endemic areas.³² It can manifest in extraspinal (vertebral) or intraspinal (epidural, subdural, arachnoid or intramedullary) forms.

About 44% of children with intramedullary spinal cord abscesses may be afebrile, and localizing neurologic signs may be absent. The major symptoms include weakness, numbness, paralysis, paresthesias, and incontinence of bowel/bladder.²³

1.2. Infections of the nerve roots and meninges

Bacterial meningitis is the commonest spinal infection in children, and the infectious process might involve the dura, leptomeninges, and CSF. Spinal invasion mostly follows hematologic seeding, traumatic inoculation, local extension from sinusitis, mastoiditis, otitis, brain abscesses, etc., and may subsequently spread along the peripheral nervous system. Group B streptococcal infections account for about 50% cases in infants in neonates, followed by *Escherichia coli* and *Listeria*. About 40–60% of cases in younger infants are caused by *Haemophilus influenzae*, followed by *Neisseria meningitidis* and *Pneumococcus*. The predominant isolates from older children and adults include *Pneumococcus*, *N. meningitidis*, and *Staphylococcus aureus*.¹

1.3. Infections of the vertebrae, discs, and epidural space

Childhood spondylodiscitis may encompass a spectrum of spinal infections ranging from discitis to vertebral osteomyelitis, with associated soft tissue abscesses.¹² A recent study reported 12 cases of spondylodiscitis among 540 pediatric patients presenting with back pain.³³ The condition may involve any location within the spine, but commonly occurs in the lumbar region in children less than 3 years of age.³⁴

1.3.1. Vertebral osteomyelitis

Vertebral osteomyelitis is uncommon in children, and accounts for only 1–2% of all cases. The mean age at presentation is usually over 7 years. Most infections typically involve the lumbar or thoracic regions. The pathogen most frequently associated with vertebral osteomyelitis in children is *S. aureus*.²³

1.3.2. Bacterial discitis

Discitis is most common between children aged 1–5 years. Studies indicate that spinal infections in children begin in the

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