Spinal infections: diagnosis, clinical assessment and treatment

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Abstract

Spinal infection is a collection of a diverse group of pathologies. Untreated the consequences are generally severe. In spondylodiscitis early diagnosis can be challenging because of the initially non-specific symptoms. Once a diagnosis has been made clinicians must chose the correct antibiotics and ensure their administration for a sufficient length of time. Late pain and disability in adults is a common and disappointing outcome though children generally do much better. Infection is a common complication of spinal surgery, often presenting late. Modifiable risk factors should be addressed preoperatively and instrumentation and bone graft should be used only when necessary. In deformity surgery an attempt should be made to retain the instrumentation in those cases which present within 2 years of index procedure. Tuberculosis (TB) is endemic in the developing world and becoming increasingly common in the Western countries. Treatment is aimed at eliminating the disease, preventing deformity and avoiding neurological compromise all of which will be aided by an early diagnosis. The surgical management of late presenting TB can challenge even the most experienced surgeons. In spinal infections identification of the organism is vitally important. Prolonged antibiotic courses should be given and surgery should be utilised judiciously to improve outcomes.

Keywords clinical presentation; imaging; spinal infection; tests; treatment

Spondylodiscitis/vertebral osteomyelitis

Introduction

Traditionally spondylodiscitis in children has been thought to be different from that seen in adults. Modern imaging techniques have shown that this is not the case. In fact, it is impossible to differentiate paediatric and adult spondylodiscitis on MRI alone. The picture seen is one of concurrent vertebral osteomyelitis and associated discitis. Despite the similar pathogenesis there is a different clinical picture seen between the groups. In part this is thought to be due to the superior immunocompetence of children and in part due to the causative process. Children are principally affected by transient bacteraemia from cuts and low-grade infections while adults suffer from prolonged bacteraemia associated with ill-health, acquired immunocompromise and advanced age. Spondylodiscitis in children can be difficult to diagnose because of non-specific symptoms and a difficulty in younger children communicating their symptoms. Treatment in children is usually successful with antibiotics alone largely avoiding surgery and prolonged immobilization. The picture in adults is different with a higher rate of residual disability and mortality especially in the elderly and diabetics.

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Pathophysiology

Spondylodiscitis in children is rare and its incidence unknown. It has been estimated to represent approximately 3% of all community acquired osteo-articular infections treated in hospital.[1] It occurs most commonly in children between 2 and 8 years old and whilst it can occur throughout the spine it has a predilection for the lumbar and lumbosacral spine with 75% of all cases occurring here.[2] Children under 5 years have a particular propensity to spondylodiscitis affecting the lumbar and lumbosacral region.[3,4] The incidence of vertebral osteomyelitis/discitis in adults is around 2.2/100 000.[5,6] It represents about 3–5% of all adult osteomyelitis and is more common in men than women.

Pathogens can infect the spine from three sources: haematogenous, direct inoculation, and contiguous spread. Direct inoculation is unusual in children in whom direct manipulation of the disc is rare. In adults postoperative infection is a major cause of morbidity. The rate of infection in discectomy alone is around 1%.[7] The inclusion of instrumentation or bone graft for fusion procedures increases the risk of infection greatly. Whilst it is rare to encounter contiguous spread in children it may be caused by an adjacent infective focus such as a retropharyngeal abscess.[8] Haematogenous spread is the commonest source of infection with transient bacteraemia occurring in children because of small cuts, abrasions and low-grade upper respiratory infections. In contrast, infections in adults often relate to a more sustained bacteraemia caused by long-term infections and immunocompromise due to prolonged ill-health and advanced age.[9]

Staphylococcus aureus is the commonest organism isolated in both adults and children with spondylodiscitis.[10] *Streptococcus* species are also often implicated in children. In adults Gram-negative bacteria (*Escherichia coli*, *Pseudomonas* and *Proteus* species) from the genitourinary system are responsible in about 23% of cases. Whilst these common organisms will make up the majority of cases, care has to be taken to consider the modern microbial landscape. Antibiotic sensitivity has to be considered as do atypical infections in patients with long-standing health problems. *Salmonella* is associated with sickle-cell disease and children with severe disabilities are prone to Gram-negative infections from urinary track sepsis such as *E. coli* or *Pseudomonas.* Consideration must also be given to granulomatous infections including *Mycobacterium tuberculosis* and *Brucella* spp. in patients with a history of exposure to known carriers or established immunocompromise.

Clinical presentation

Paediatric: the diagnosis of spondylodiscitis in children can be challenging with a prolonged duration of symptoms progressing

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subtly over many weeks. Children of different ages present with a diverse picture and the clinician can be challenged by limits in their ability to communicate. Symptoms are variable and often non-specific and children are not usually systemically unwell. Temperatures above 38°C are uncommon. Abdominal pain, low fever, difficulty walking, anorexia, loss of desire to play and irritability can be seen. There can be loss of lumbar lordosis because of muscle spasm and pain is often worse at night. Loss of 'spinal rhythm' can be seen in the ambulant child who bends down stiffly to pick up a dropped toy or coin and holding the hip in extension can provoke discomfort.[11] In cervical infections, neck stiffness or dysphagia may be seen.[8]

Children under 3 years are unable to effectively articulate their symptoms and can present with dysfunction of the lower extremities or failure to walk in 63% of cases.[10,12] Back pain (27% of patients) and true neurological disturbance (9% of patients) is uncommon in this age group.[12] The progression to non-ambulance can be rapid and is frightening for parents and front-line medical staff leading to an early, inaccurate, diagnosis of paralysis. It is important to properly examine the child and attempt to elicit active movements with the child sitting or lying as well as perform and document an accurate neurological examination.

In children between 3 and 8 years the predominant complaint is abdominal pain which is particularly common with low thoracic lesions. MRI examination often shows psoas inflammation partially explaining this phenomenon. Hip extension in these patients is very likely to cause discomfort. A high index of suspicion alongside a complete physical examination looking for tenderness in the spine and loss of spinal movements is required to prevent these children undergoing investigation for abdominal or genito-urinary pathology prior to spondylodiscitis being considered.

Teenagers tend to localize their symptoms to their back especially in the case of lumbar or lumbosacral spondylodiscitis. In adolescent patients the symptoms can mimic a disc prolapse with discomfort radiating into the legs in a non-dermatomal pattern and pain exacerbated by straight-leg raising. Prior to spinal MRI, assessment of inflammatory markers can allow differentiation between the two conditions.

Adult: clinical presentation in adults can be initially vague with non-specific symptoms. The presentation can be acute, sub-acute or chronic depending on the pathological organism. Overwhelming sepsis is uncommon however may occur, especially with *S. aureus* infection which is associated with higher mortality rates.[13] The availability or MRI has decreased the time from onset of symptoms to diagnosis; however, at least half of cases take more than a month for the diagnosis to be made. Pain is the commonest presenting symptom in adults. Acute infection tends to present with more severe pain, muscle spasm and severe limitation in spinal movements. Fever is present in only 52% of patients. Hamstring tightness is common, causing limitation in straight leg raise, and psoas irritation may cause hip flexion. The development of an epidural abscess can cause neurological symptoms ranging from isolated root irritation to spastic paralysis depending on the levels involved.

Investigations

Laboratory tests: the erythrocyte sedimentation rate (ESR) is commonly elevated (40–85 mm/hour [reference range: 0–20 mm/hour]) in the presence of spondylodiscitis (Figures 1 and 2). ESR rises slowly during the days following the onset of infection reaching a peak around day 7. In contrast the C-reactive protein (CRP) rises more rapidly and reaches clinically significant levels in 24–48 hours. The white cell count is often normal and is only elevated in approximately 35% of patients and even then only rarely exceeds 12,000 cell/mm^3 limiting its use as a diagnostic tool.[8,14] CRP can also be used successfully to monitor response to antibiotics with reduction and then normalization allowing effective decisions to be made regarding treatment. Blood cultures should be taken in all patients suspected of having spondylodiscitis, where possible prior to administration of antibiotics. The diagnostic yield is approximately 50% but this is reduced to 15% when antibiotics have been given. Diagnostic accuracy is also improved if samples are taken while the patient is pyrexial.

In children, the majority of spondylodiscitis is caused by staphylococcal and streptococcal organisms so treatment can be commenced without positive blood cultures. The exception to this is when atypical infections are suspected, for example in areas with high levels of drug resistance or in children with long-term ill health. Under these circumstances negative blood cultures may require additional action. Antibiotics should be suspended for 72 hours and further blood cultures taken during pyrexia. CT-guided or open biopsies may be required and have a diagnostic yield of 80% and 93% respectively but carry the risk of additional morbidity.[8,15,16]

In adults, Gram-positive organisms (especially *S. aureus*) remain most common accounting for approximately 67% of infections. However, the microbial landscape is more varied than in children and the high prevalence of Gram-negative organisms from the genitourinary system makes a positive microbiological diagnosis of greater importance. Blood cultures must be taken before starting antibiotics and when possible should coincide with a spike in temperature. If the clinical situation allows a biopsy should be considered. It is rare for these patients to be so unwell that a short delay to allow biopsy cannot be tolerated. Needle biopsy under radiological guidance has a good diagnostic yield in 68–86% of patients prior to initiation of antibiotics. If antibiotics have been started then the diagnostic accuracy of biopsy is significantly reduced. Should blood cultures and biopsy be negative then we would recommend starting empirical antibiotics and observing clinical response. Should there be a failure to improve symptoms then an open trans-pedicular biopsy can be performed after a 72-hour window in antibiotic therapy.

Imaging: X-rays have low specificity and sensitivity for spondylodiscitis. In the late phase narrowing (but not usually obliteration) of the disc space is seen (Figure 1). Full spine radiographs at this time are useful to assess the development of structural deformities.

Bone scintigraphy with technetium-99 pyrophosphate is sensitive but not specific for spondylodiscitis and becomes positive within a few days after onset of infection.[17] It is recommended when an osteo-articular infection is suspected but the clinical signs do not allow anatomical localization. It is also useful when MRI is not readily available but is limited by low specificity and poor spatial resolution. These limitations can be addressed by single photon emission computed tomography (SPECT) but results in significant radiation exposure to the patient. SPECT is a valid alternative in those patients in whom MRI is contra-

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