Pyogenic Spondylitis: Clinical Features, Diagnosis and Treatment

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Summary: Although pyogenic spondylitis is an infrequent infection, its incidence is increasing because of the growing number of elderly people and immunocompromised patients. Diagnosis is often difficult and appropriate imaging, blood cultures and/or biopsy are essential in making an early diagnosis. Most of the cases can be treated non-operatively. Surgical treatment is indicated in patients with spinal cord or cauda equine compression with progressive neurological deficits and/or patients who have failed conservative treatment. Early and accurate diagnosis of pyogenic spondylitis is important for timely and effective management, in order to reduce the occurrence of spinal deformity and dysfunction.

Key words pyogenic spondylitis, spondylodiscitis, discitis, vertebral osteomyelitis, spinal osteomyelitis

INTRODUCTION

Pyogenic spondylitis continues to represent a worldwide problem. It is an uncommon but severe and potentially life-threatening condition. Diagnosis is often difficult, as no specific signs or symptoms are present. It encompasses a broad range of clinical entities, including pyogenic spondylodiscitis, discitis, vertebral osteomyelitis and spinal osteomyelitis. In this article, we will discuss clinical features, diagnosis and treatment of pyogenic spondylitis.

EPIDEMIOLOGY

Pyogenic spondylitis is relatively rare with an incidence between 0.4-2.0 cases per 100,000 each year, and there is evidence suggesting that the incidence is increasing due to the improved life expectancy of patients with chronic debilitating diseases [1,2]. Predisposing factors include diabetes mellitus, long-term steroid therapy, malignancy, liver cirrhosis, chronic renal failure, malnutrition, substance abuse, human immunodeficiency virus (HIV) infection, and septicemia. It is primarily an adult disease affecting predominantly people in their fifth decade of life and the age-adjusted incidence increases with every decade thereafter. Males are more susceptible than females at a ratio of 1.5-3:1 [3]. The most common site is the lumbar spine, followed by the thoracic, cervical and sacral region. The anterior part of the vertebral body is classically involved in pyogenic spondylitis. Involvement of the posterior element is relatively uncommon.

PATHOPHYSIOLOGY

Pyogenic spondylitis commonly arises from a haematogenous spread of bacteria. The arterial route of spread is more common than the venous route. In the lumbar spine, the Batson’s paravertebral venous plexus may act as a potential route of infection. The same segmental artery supplies the lower portion of an upper vertebra and the upper position of the adjacent

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patients. In approximately one-third of cases the infection especially in immunocompromised species. Organisms of low virulence may also cause, Pseudomonas species and Proteus Escherichia coli. Frequently isolated gram-negative organisms are Escherichia coli, Pseudomonas species and Proteus species. Organisms of low virulence may also cause these infections especially in immunocompromised patients. In approximately one-third of cases the infective organisms cannot be identified [7,8].

CLINICAL CHARACTERISTICS

The diagnosis of pyogenic spondylitis must be considered in combination with blood and tissue cultures and histopathological findings. The onset of pyogenic spondylitis was classified into 3 types [9-11]: acute (severe symptoms including high fever, violent pains and malaise), subacute (moderate symptoms with fever, moderately intense pain and slight malaise) and insidious types (mild symptoms; subfebrile body temperature and local pains which do not disturb the general condition). In contradistinction to the slowly developing insidious symptoms of compression due to tuberculosis, pyogenic infection usually strikes with dramatic suddenness. Local pain, fever, limitation of motion and localized tenderness near the affected area are the most common symptoms in pyogenic spondylitis. Other symptoms include nausea, vomiting, anorexia, weight loss, lethargy and confusion. Less commonly, neurological complication can also be caused by direct neural infiltration and ischemic damage to the spinal cord. Suspected diagnosis of pyogenic spondylitis is based on clinical symptoms, although, in some cases (the insidious type of onset), there may be few symptoms. Diagnosis is often delayed for such patients because the time of onset is not clear.

The differential diagnosis for patients presenting with local pain includes tuberculous spondylitis, degenerative or metastatic spinal disease, disc herniation, vertebral compression fracture and inflammatory spondyloarthropathies such as ankylosing spondylitis or reactive arthritis.

LABORATORY TESTS

Erythrocyte sedimentation rate (ESR) is a sensitive laboratory indicator of pyogenic spondylitis. Elevation in ESR correlates with the presence of inflammatory response but it is not specific for infection. Although the ESR provides useful information regarding response to treatment, it normalizes slowly even after successful treatment.

C-reactive protein (CRP) is an acute phase protein synthesized by hepatocytes. CRP increases rapidly after the onset of a bacterial infection. It is elevated in most patients, and is more specific than ESR. CRP normalizes after appropriate treatment more quickly than the ESR.

In contrast, the white blood cell (WBC) count may be elevated or within the normal range in patients. It is not particularly useful in making a diagnosis, but should be part of an infection/fever workup as it may provide some general guidance concerning a response to treatment [12].

Given the variability in the sources of infection, blood cultures, urinalysis and urine for culture should be obtained in patients suspected of having a pyogenic spondylitis. Blood cultures are positive in around half the patients. A chest radiograph and sputum culture should be obtained to look for subclinical respiratory infection.

IMAGING STUDIES

Plain radiographs should be taken for all patients suspected of having pyogenic spondylitis (Fig.1). Changes in pyogenic spondylitis are not apparent on plain radiographs until 2-8 weeks after the initial symptoms [7,13]. The abnormalities are disc space narrowing, blurring of the endplates and loss of height of the affected vertebral bodies. After eight to 12 weeks, obvious destruction of bones can be observed. Soft tissue extension is suggested by an abnormal psoas shadow, widening of the mediastinum, or enlargement of the retropharyngeal space, though it is less common than in tuberculosis infections. Griffiths et al [14] classified the bone destruction stage radiographically as early stage (narrowing of the disc space), destructive stage (bone destruction, collapse of softened vertebra and bone proliferation) and osteosclerotic stage (new bone formation and osteosclerotic changes).

Magnetic resonance imaging (MRI) is the most sensitive tool for imaging of pyogenic spondylitis. It is particularly useful in the early stage when other imag-
for increased water content within the infected tissue (Fig.2). The pattern on contrast-enhanced MRI is important in the diagnosis and treatment of pyogenic spondylitis (Fig.3). When pus collections have formed, they are often a hypointense signal in a T1-weighted image and hyperintense signal in a T2-weighted image. The contrast-enhanced T1 weighted image will show a mass lesion with peripheral enhancement. Diffuse enhancement throughout the mass lesion is more consistent with granulation tissue.

On MRI images (T2-weighted and contrast-enhanced T1-weighted images), intraspinal sepsis and the general pathological process of the pyogenic lesion in the vertebrae were classified into five categories with special emphasis on the enhancement pattern of the suspected septic lesion [15]: stage I, bruise and localized radiolucency in the endplate of the vertebra; stage II, vertebral edema and/or suspected fluid collection within the vertebral corpus (inhomogenously increased signal intensity on the MRI with disc space narrowing) in one or two vertebral levels, with poor demarcation of the lesion; stage III, irregularly increased signal intensity area on the MRI, with confinement of the lesion within the posterior longitudinal ligament (subligamentous); stage IV, evident fluid collection in the disc in association with extensive endplate destruction and diffusely extended high-signal lesions in the vertebral corpus, together with transligamentously extended epidural mass lesions at multiple levels.

**Fig. 1.** Plain radiograph findings of pyogenic spondylitis due to Streptococcus pneumoniae in 59-year-old man. Anteroposterior (A) and lateral (B) radiographs show loss of disc space and endplate destruction at L3-4 (arrow).

**Fig. 2.** Magnetic resonance imaging (MRI) findings of Staphylococcus aureus pyogenic spondylitis in 77-year-old man. (A) T1 weighted sagittal image demonstrates hypointense signal in L2-3 vertebral bodies and the disc space (arrow). (B) T2 weighted sagittal image shows hyperintense signal in L2-3 disc space (arrow) with epidural mass (*). (C) The short T1 inversion recovery (STIR) sagittal image shows hyperintense signal in L2-3 vertebral bodies and disc space (arrow) with epidural mass (*).
levels; and stage V, obvious disappearance of the disc, vertebral collapse with inhomogenously increased signal intensity within the vertebral collapse, epidural fluid collections of mass lesions, and abnormally increased signal intensity in the vertebrae, including spinous process and paravertebral ligaments as well as muscles. Stage I-III abscesses are confined (contained) lesions while stage IV and V lesions, with circular or “ring-like” enhancement in the periphery of the abscess are unconfined (uncontained) lesions.

Computed tomography (CT) yields positive findings in the early stages and demonstrates hypodensity

Fig. 3. Magnetic resonance imaging (MRI) findings of pyogenic spondylitis in 59-year-old man (same case as Figure 1). The contrast-enhanced T1 weighted sagittal image (A) shows the enhancement of L3-4 epidural abscess (arrow). Coronal (B) and axial (C) contrast-enhanced T1 weighted images show peripheral enhancement of paravertebral abscess (*).

Fig. 4. Computed tomography (CT) findings of pyogenic spondylitis in 77-year-old man (same case as Figure 2). Sagittal reformat CT image (A) and axial image (B) show a destructive change at L2-3 (arrow).
and flattening of the involved disc, erosion of the vertebral body and endplate, soft tissue swelling and obliteration of fat planes around the vertebral bodies (Fig 4).

Radionuclide studies, such as Gallium-67 citrate and technetium-99 m scans, are more sensitive than plain radiographs in detecting the early stage [1]. Fluorodeoxyglucose (FDG)- positron emission tomography (PET) has also been shown as a useful adjunct to imaging for the diagnosis of pyogenic spondylitis [16].

CONSERVATIVE TREATMENTS

Conservative treatment with immobilization and systemic administration of antibiotics is the first choice of treatment for pyogenic spondylitis. In the early stage of infection, bed rest should be continued until the acute pain improves. However, attention should be paid to the possible occurrence of complications caused by bed rest, such as pneumonia, dementia, decubitus, ulceration, deep vein thrombosis and pulmonary embolism, especially in elderly patients. The patients may then be allowed to get up wearing an appropriate cast or brace to minimize spinal movements. This should be worn for 3 or 4 months depending on the amount of bone destruction or deformity. External immobilization helps to stabilize the spine, decrease pain and prevent deformity and neurological deterioration [17].

Antibiotic therapy should not be started until appropriate cultures have been performed unless the patient is septic or critically ill. Blood culture should be performed frequently and such cultures are useful in identifying organisms. Biopsy is indicated mainly in patients with negative blood culture. Biopsy specimens should be sent for Gram staining, histopathology, aerobic, anaerobic, tuberculous and fungal culture. If the organism remains undetermined then empirical antibiotics comprising first generation cephalosporin or penicillin are usually used to cover the common infective organisms, namely, staphylococcus and streptococcus. The choice of antibiotic is adjusted according to the subsequent bacterial culture results. Consultation with microbiologists is important to optimize antibiotic coverage and to identify possible sources of bacteraemia. Inappropriate antibiotic use can result in prolonged hospital stays and increased costs, and it can also have adverse consequences on the patient’s prognosis. The optimal duration of antibiotic therapy is not well defined, with several studies recommending six to eight weeks of intravenous therapy and others recommending only four weeks. Antibiotic therapy for less than four weeks may result in an unacceptably high recurrence rate [18]. We usually treat with intravenous antibiotics until the CRP is normal which takes about two to four weeks, then change to oral antibiotics for a total of three months.

Hyperbaric oxygen therapy (HBO) may be beneficial in patients with pyogenic spondylitis [19]. HBO raises the absolute oxygen tension at the infection site, which improves neutrophilic oxidative activity and promotes wound healing and neovascularization. This therapy is now recommended as a primary and/or adjunctive treatment for a wide range of clinical disorders.

Half to three-quarters of all patients respond positively to conservative treatment, and spontaneous interbody fusion occurs at 6 to 24 months after the onset of symptoms. However, 10-20% of patients require surgical treatment [20].

SURGICAL TREATMENTS

Surgical treatment may be indicated for the following reasons: resolution of significant spinal cord or radicular compression; prevention or correction of biomechanical instability and deformity; management of severe persistent pain; or drainage of abscesses. There is a broad range of options for the surgical treatment of pyogenic spondylitis, which include anterior or posterior approach with or without instrumentation. Traditionally, the operative treatment for pyogenic spondylitis is anterior decompression and debridement, followed by an anterior fusion without instrumentation. A disadvantage of this treatment is increased morbidity caused by extensive exposure during open surgery, because the patients are often in poor nutritional and/or poor general condition.

Good outcomes were previously reported for percutaneous suction aspiration and drainage (PSAD) under local anesthesia in the treatment of pyogenic spondylitis resistant to conservative treatment. In 1998, Nagata et al recommended this technique for patients with early-stage pyogenic spondylitis [21]. The indications for use of this technique to manage pyogenic spondylitis are as follows; the patient’s condition has not improved with antibiotics and immobilization for at least 1 month, there is only a single affected intervertebral disc, the involved vertebrae are located in the lower thoracic or lumbar spine, there is no major neurologic deficit, and radiographs show no remarkable bone destruction and no severe deformity in the region of the affected vertebral body. Furthermore,
this technique is indicated in a patient in whom radiographs show remarkable destructive change in the affected vertebrae and anterior surgery is not feasible under general anesthesia because of the patient’s poor general condition. In 2010, Ando et al. reported that PSAD is minimally invasive and enables pathogen identification, histopathological diagnosis and even simultaneous treatment. This treatment also provides a medico-economic advantage by shortening treatment periods and eliminating open surgery [22]. Matsubara et al. reported that PSAD should be strongly considered for patients with paralysis due to an epidural abscess who cannot undergo general anesthesia due to poor general condition [23].

Recent advances in minimally invasive surgery (MIS) techniques, such as percutaneous pedicle screw (PPS) fixation, offer an alternative method of surgical treatment for pyogenic spondylitis [24]. Although the use of instrumentation in the setting of pyogenic spondylitis has been controversial, the benefits of MIS compared with conventional open surgery include decreased muscular trauma, less blood loss and shorter operative time.

OUTCOME

The overall attributable mortality varies across reports but probably stands between 2 and 11% [25]. Recurrence usually occurs within 6 months, rarely up to 1 year after completion of antibiotic therapy. Relapse has been noted in 1-22% of patients treated for pyogenic spondylitis during the antibiotic era [20]. Neurological deficits occur in 25% of patients, with less than 10% having a permanent deficit [1]. Around one-third of survivors suffer residual disability.

The early and correct diagnosis of pyogenic spondylitis is important for timely and effective management to reduce the occurrence of spinal deformity and dysfunction. Delay in diagnosis or management is detrimental to the outcome.

CONFLICT OF INTEREST: The authors declare that they have no conflict of interest.

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