Spinal Infections; Modern Literature Review

Hasan Emre AYDIN¹, Zuhtu OZBEK², Emre OZKARA², Ali ARSLANTAS²

¹Department of Neurosurgery, Eskisehir Yunus Emre State Hospital, Eskisehir, Turkey
²Department of Neurosurgery, Osmangazi University, Medical Faculty, Eskisehir, Turkey

INTRODUCTION

The aim of our study is to summarize the clinical features, diagnosis, treatment and management of spinal infections. Spinal infections can be primary, or secondary after spine surgery. Primary spinal infections generally arrive from the genitourinary system, respiratory tract or cutaneous infections. Secondary spinal infections may occur during lumbar puncture, spinal anesthesia, disography, chemonucleolysis, invasive treatment of low back pain by local anesthesia, or after spinal surgery (4). The haematogeneous spread of microorganisms into the bone marrow of the vertebral bodies is the most common source of infection in adults (41).

Spinal infections can be classified in different ways. According to anatomic localization; infections of the spine can affect the vertebral bodies, the intervertebral disc, the spinal canal and the surrounding tissue. If the vertebral bodies are affected, it is defined as osteomyelitis. If the intervertebral disc is affected, it is defined as discitis. Epidural abscess occurs in the spinal canal and paraspinal abscess occurs in the surrounding tissue. Discitis or osteomyelitis can be seen alone but often affect the epidural and paraspinal region and create a complex disease known as spondylitis (35).

Causative microorganisms for spinal infection can be classified as either pyogenic or non-pyogenic (granulomatosis). Granulomatous infections are classified as tuberculosis, brucellosis, typhoid, paratyphoid and salmonella infections (9). Pyogenic osteomyelitis is seen in 60% of all cases. Osteomyelitis can spread by the hematogenous route and result in severe neurological deficits. Tuberculosis osteomyelitis develops with mycobacteria resistant to medical treatment and causes serious problems. Brucella is

ABSTRACT

Spinal infections can be primary, or secondary after spine surgery and it can be thought of as a spectrum of disease comprising spondylitis, discitis, spondylodiscitis, epidural infections, meningitis, polyradiculopathy and myelitis.

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 the correct diagnosis in the early stage of disease. Neurologic deficits occur when the spinal cord becomes compressed, edematous, or ischemic due to compression by infection.

Diagnosis of spondylodiscitis relies on various factors like neurological symptoms, radiological studies, serological tests and identification of the microorganism. Technological advances in diagnosis, medical therapy and surgery have resulted in excellent outcomes and have greatly reduced the morbidity and mortality rates associated with spinal infections. Surgical drainage with sustained intravenous antibiotic treatment remains the cornerstone of therapy. Nonoperative management may be considered in selected cases.

The aim of this study was to detail general diagnostic and management principles for this disease. Medical records were reviewed and we define the incidence and clinical features of spinal infections under the current diagnostic and therapeutic guidelines.

KEY WORDS: Brucellosis, hydatid cyst, spinal infections, spinal tuberculosis, spondylitis
Although patients with spinal tuberculosis have nonspecific symptoms that can cause a delay in the diagnosis, the early diagnosis of spinal TB has become easier with advanced imaging techniques in radiology such as magnetic resonance imaging (MRI) (Figure 1). Computed tomography (CT) shows only bone, but MRI evaluates the involvement of the ligaments and the surrounding tissue (2,17,27).

The lesion in spinal TB usually affects more than one vertebrae and the lesions can cause a progressive bone destruction leading to vertebral collapse and kyphosis. We can generally diagnose this bone destruction with X-ray graphs (Figure 2). The collapse results in neurological deficits because of the spinal cord compression (27).

It is difficult to differentiate spinal TB from fungal osteomyelitis and metastatic spinal tumors (27). A positive skin test and biochemical parameters such as elevated erythrocyte sedimentation rate may be useful in the diagnosis of spinal TB (18,27). These laboratory studies are important to monitor the effect of medical treatment and

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**SPONDYLITIS**

**A. Pyogenic Spondylitis.**

Pyogenic spondylitis can be the result of infections with bacteria or non-specific agents. The average age of the patients varies between 50-60 years. Males are up to three times more often affected than females (10). The most infectious agent in pyogenic spondylitis is Staphylococcus aureus. It affects more than 50% of the cases (41). The source of the spondylitis can be the genitourinary tract, and pulmonary or skin infections. The main predisposing conditions are diabetes, immunosuppression, advanced age and the drug dependency. Routine laboratory studies that include erythrocyte sedimentation rate, white blood cell count, C-reactive protein (CRP) and acute phase proteins are not specific but these tests are helpful in the diagnosis (32). Treatment of pyogenic spondylitis patients with intravenous antibiotics such as cephalosporin and vancomycin against the most common bacteria is recommended (13).

**B. Non-pyogenic (Granulomatous) Spondylitis**

**Tuberculosis Spondylitis (Pott’s Disease)**

The first case of spinal tuberculosis (TB) was described in 1779 by Percival Pott. Tuberculosis spondylitis frequently spreads via the haematogeneous route. The average age of the patients varies between 40-50 years (33).

Spinal TB is the most frequent extrapulmonary location of mycobacterial infection. The lower thoracic and lumbar region seems to be the most common site of spinal column involvement in spinal TB but the cervical spine is affected on rare occasions (29,38).
to detect secondary infection (40). Growing mycobacteria in cultures takes time and the gold standard in diagnosis is biopsy (27).

There are various classification systems for the diagnosis or treatment of spinal TB. Such classification systems only provide a practical classification. The main limitation of these classification systems are the insufficient focus on posterior lesions (31).

The treatment of spinal TB is another part of the discussion. Antituberculosis drugs play a large role in the recovery and response of patients with spinal TB (18,27). The combination of rifampicin, isoniazid, ethambutol, and pyrazinamide for two months followed by the combination of rifampicin and isoniazid for 10-13 months is the most frequent protocol for the medical treatment of spinal TB (13,18). The important point in the treatment of spinal TB is neurological deficits. Medical therapy is the effective treatment in patients with or without neurological deficits but usually laminectomy is recommended for patients with neurological deficits. Especially in the thoracic region, the anterior approach is the best technique for debridement of the lesions. The aim of the therapy is to decompress the spinal cord by removing the affected disc and infected bone and stabilize the spine. On the other hand, there have been no prior reports on the role of radical surgery based on the severity of spinal TB (11,13,20,27).

**Spinal Brucellosis**

Brucellosis is a zoonosis and may affect many organ systems (1,30). It is a systemic infection, caused by facultative bacteria of the species Brucella (12,30). Brucellae are small, gram-negative coccobacilli that can be transmitted to humans from infected animals (21). The genus was named in 1887 when David Bruce first isolated these bacteria from soldiers with Malta fever. Six species of the genus have been isolated and are named B. abortus, B. suis, B. canis, and B. melitensis (32). The most common agent is Brucella melitensis (35). Spine infiltration is the most common localized form of brucellosis (1). The incidence of the disease varies according to the region of the study. The frequency is 8-53% in current series (1,25). The type of skeletal involvement depends on the patient’s age (30). Spinal brucellosis usually affects elderly patients, especially those over 50 years of age (32,39).

In general, the endemic areas are the Mediterranean, the Balkans, the Middle East, Central Asia, and Central and South America (1,9,30,41). Brucellosis is a major health problem in these countries owing to consumption of unpasteurised milk or milk products (25,39).

Brucellosis can present with various neurological findings through involvement of a variety of organs and tissues (25). Patient symptoms and radiology are non-specific in the early period of the disease, delaying the diagnosis. The disease has 3 forms: acute, subacute and chronic. Fever is the dominant symptom in the early period but paraparesis is the dominant symptom in the late period (1,30).

Spinal brucellosis can affect the vertebral column, intervertebral disc and paraspinal tissue. Despite all the potential regions of the spinal canal that can be affected, the most commonly involved sites are the L4-L5 and L5-S1 junctions (1).

The diagnosis can be confirmed by serological tests and radiological imaging. The vacuum phenomenon is the characteristic sign (air between the disc space and superior articular process) on spinal CT (24). The characteristic radiographic finding of brucellosis is local erosion of the superior or inferior vertebral body angle (Pons sign) (Figure 3) (1). Perfusion CT and especially MRI are the most useful methods for the diagnosis and differentiation from other spinal pathologies (Figure 4) (1,39). Bone destruction is less severe than in Pott’s disease (30).
Histopathological findings are also not specific. The granuloma consists of epithelioid cells, giant cells, and lymphocytes and may contain confluent areas of fibrinoid necrosis and phagocytes. The granuloma is surrounded by a chronic inflammatory reaction composed of lymphocytes, plasmocytes, and leukocytes (30). The definitive diagnosis of brucellosis is made by isolation of the bacteria on culture (32).

The aim of treatment is control the illness effectively and prevent complications or relapse (30). The current medical treatment for spinal brucellosis is the combination of tetracycline for 6 weeks with an aminoglycoside as suggested by the World Health Organization (1,12,25). Diagnostic or curative surgery can be performed as a last option in spinal brucellosis management. When spinal instability, cord compression, radiculopathy, cauda equina syndrome, or severe weakness of the muscles due to extradural inflammatory mass or progressive collapse are present, surgical intervention should be performed (1). The relapse rate after therapy has varied between 4% and 55% in different studies of brucellar spondylitis (25).

**Fungal Spondylodiscitis**

A fungal etiology of spondylodiscitis is seen in less than 5% of the cases. Fungal spondylodiscitis results in a granulomatous response and can be caused by candida, blastomycosis, crypticocciosis and actinomycosis (7,14,22). Spinal infections due to Candida species have increased significantly in recent years, depending primarily on the patients’ immune status (19,41). Fungal spondylodiscitis usually occurs in the immunodeficient population (41). The causative microorganisms are Candida species such as C. albicans, C. dubliniensis, C. lusitane, C. parapsilosis (7,19,22). Candida spondylodiscitis may occur by implantation of an infected region or by the haematogeneous route (41). Fungal spondylodiscitis can occur in the lumbar spine but the involvement of cervical spine is even less common (8,28).

The diagnosis of Candida spondylodiscitis requires a multidisciplinary team as the neurological symptoms are nonspecific and usually arise late in the course of the disease (41). Important clues for diagnosis are the risk factors that include a history of central venous catheter, immunesuppression, parenteral nutrition, hemodialysis, surgery, massive burns, neutropenia, diabetes or prolonged use of antibiotics (19). Neurological deficits can occur in 20% of patients with Candida spondylodiscitis (26). In
contrast to pyogenic spondylodiscitis, fever and malaise are quite rare in fungal spondylodiscitis. Low back pain is the most common symptom (19).

The treatment of the fungal spondylodiscitis is not clear and the organism is variably sensitive to antifungal drugs. Amphotericin B has been considered as the first choice drug for the medical therapy (26). However, fluconazole can be used due to its favourable side-effect profile as amphotericin is nephrotoxic (34). Antifungal treatment is usually continued until resolution of clinical symptoms and normalization of the serum inflammation markers. Surgery is necessary for some cases that show progressive neurological impairment, spinal instability and persistent infection despite antifungal treatment (19).

**Parasitic Spondylodiscitis**

Hydatid cyst is the most common parasitic disease in the spinal cord. Parasitic infections such as toxoplasmosis, schistosomiasis, cysticercosis and toxocariasis can also affect the spinal canal. The toxoplasmosis frequency has increased parallel to the AIDS frequency in the last decade in endemic regions (35).

Spinal hydatid cyst was first described by Churrier in 1807 and is a rare parasitic infectious disease. Spinal cysts are rarely found in children and are most commonly seen between ages of 30 and 50 years. Primary spinal extradural hydatid cysts constitute less than 1% of all hydatid cyst cases (15,23). Since neurological findings are similar to the more frequently encountered lumbar disc herniations, the diagnosis is commonly established after radiological imaging or during surgery. It is seen endemically all around the world and especially in countries involved in livestock breeding such as the Mediterranean countries of Spain, Greece and Turkey, and also in Syria, New Zealand, Australia, Uruguay, Argentina and Russia, (5,23). Turkey is an endemic region for hydatid cysts, and the incidence has been reported as 1 per 2000 cases (23).

Spinal hydatid cysts are classified in five groups as intra-medullary, intradural extramedullary, extradural intraspinal, vertebral and paravertebral cysts (5). Involvement was not limited only to the vertebra but spread to the extradural intraspinal and paravertebral area in the present case, making it impossible to classify it under a single group. Thus, it was not possible for us to separate the spinal involvement of hydatid cysts with definite criteria.

Radiology and serological tests are necessary for the diagnosis. MR imaging is the gold standard for radiological diagnosis (Figure 5). Fine-needle aspiration biopsy may be used (6). A definite diagnosis is established with serological tests and histopathology in the late period as well as with non-specific tests such as erythrocyte sedimentation rate, blood count for eosinophilia, and CRP (Figure 6).

Albendazole is used for 28 days for medical treatment. Albendazole is known to have a higher bioavailability than mebendazole and to be more effective against helminths (3). Preoperative use of albendazole has been found to decrease intra-cystic pressure, to facilitate the surgery and to decrease recurrent lesion development (6). Surgery is the primary method in treatment but is difficult and controversial. It is necessary to prevent anaphylaxis and recurrent infections by maintaining cyst integrity and discharging the cyst content without contaminating the patient and to clean the surgical site with appropriate solutions (Figure 7). The surgical site should be decompressed and cleaned with solutions and surgical stabilization performed if necessary (16).

**Future Questions and Conclusion**

The advance of radiological and immunochemical
procedures could improve early diagnosis of discitis. Despite these diagnostic procedures, biopsy and cultures are necessary to confirm the diagnosis. In addition to the diagnosis, recent clinical studies discuss subjects such as the best treatment; antibiotic therapy or surgery for the patient group with neurological deficits, the optimal time for drug therapy or surgery, and which one is the best approach for surgery. The diagnosis and the treatment of spinal infections need multidisciplinary management. The best way to prevent spinal infections is improvement of health care and life conditions of population.

REFERENCES


Figure 6: Germinative membrane with adjacent bone structure. Female vesicles including protothecoses in the cyst wall (H&E,X200).

Figure 7: White cystic structures that were removed by preserving their integrity by a transpedicular approach to the L4 vertebral corpus are seen at the surgical site.