Management of Patients with Spondylodiscitis: An Overview

Sufwan Elbasher Alsadiq Algrmi[1],Mahmoud Mustafa Mohamed Taha [2],Ibrahim Metwaly Abdel Fattah[3],and Essam Mohamed Elsayed Youssef [4]

[1]M.B; B.CH.Zawia University -Libya.

[2]Professor of Neurosurgery,Faculty of MedicineZagazigUniversity.

[3]Lecturer of Neurosurgery,Faculty of Medicine Zagazig University.

[4]Lecturer of Neurosurgery, Faculty of Medicine Zagazig University.

Correspondingauthor:Sufwan Elbasher Alsadiq Algrmi

Email:aljermi86@gmail.com

Abstract

Background:Spinal infections can be described etiologically as pyogenic, granulomatous (tuberculous, brucellar, fungal) and parasitic spondylodiscitis, a term encompassing vertebral osteomyelitis, spondylitis and discitis, which are considered different manifestations of the same pathological process; epidural abscess, which can be primary or secondary to spondylodiscitis and facet joint arthropathy.When infection affects the intervertebral disc, the term to describe this condition is usually spondylodiscitis. If invades the endplates or the vertebral body, the infection is more correctly designated for vertebral osteomyelitis or spondylitis. However, at the time of diagnosis in many cases, the infection has already compromised these two structures; therefore, both terms are frequently used.Conservative treatment is the standard of care for patients with spondylodiscitis, using multidisciplinary approaches involving microbiologists, infectious disease consultants, anaesthetists, intensivists and geriatricians, with public health physicians for contact tracing. The morbidity and mortality of patients with spondylodiscitis treated conservatively has fallen from 56% to 25% over the last 15 years.However, careful selection of patients who need surgical treatment is necessary. Surgical treatment is absolutely indicated in patients with spinal cord or cauda equina compression with progressive neurological deficits. Relative surgical indications include spinal instability due to extensive bone destruction, significant deformity or conservative treatment failure

Keywords:Spondylodiscitis,Intervertebral Disc

Spondylodiscitis:

Spondylodiscitis is the main manifestation of hematogenous osteomyelitis in patients aged over 50 years and represents 3–5% of all cases of osteomyelitis **(1).**

Estimates of its incidence in developed countries range from 4 to 24 per million per year **(6).**

A number of studies report a bimodal age distribution with peaks at age less than 20 years and in the group aged 50–70 years, though all ages can be affected. Vertebral osteomyelitis has a male preponderance, with a male to female ratio of 1.5–2:1 **(3)**.

The incidence of vertebral infections has been rising through the combined effect of an increase in the susceptible population and improved ascertainment, due to better diagnosis **(4)**

Other studies attribute the increase of spondylodiscitis cases to the infection after spinal surgery**,** diabetes mellitus, long term steroid use, chronic renal or liver diseases, immunosuppressed patients and ageing population **(5).**

Pathogenesis of pyogenic spondylodiscitis:

Pathogens can infect the spine via three routes: by hematogenous spread, by direct external inoculation, or by spread from contiguous tissues. The hematogenous arterial route is predominant, allowing seeding of infection from distant sites on to the vertebral column. An understanding of the vascular supply of the spine and its development with age is important in distinguishing the two main patterns of disease encountered in adults and children **(6).**

In children, intraosseous arteries display extensive anastomoses and vascular channels penetrate the disc. Therefore, a septic embolus is unlikely to produce a substantial osseous infarct and the infection is often limited to the disc. By contrast, in adults the disc is avascular and the intraosseous anastomoses involute by the third decade of life, effectively creating end arteries, meaning that a septic embolus results in a large infarct **(5).**

The subsequent spread of infection to the neighbouring disc and vertebra creates the characteristic lesion of spondylodiscitis. Extensive infarction leads to wedging, cavitation and compression fractures with resulting spinal instability, deformity and risk of cord compression uncontrolled infection can breach the bone and track into surrounding soft tissues, causing paravertebral abscesses, and spread posteriorly into the spinal canal, forming an epidural abscess with further risk of paraplegia,subdural abscess and meningitis **(7).**

Pyogenic osteomyelitis of the posterior elements of the vertebrae (pedicles, transverse processes, laminae andposterior spinous processes) is very rarely encountered in haematogenous infections due to their relatively poor blood supply compared with the vertebral body **(7).** Posterior involvement is more common with tuberculous and fungal spondylitis (**8**).

Haematogenous pyogenic spondylodiscitis affects preferentially the lumbar spine, followed by the thoracic and cervical spine in decreasing frequency (58%, 30%, 11% respectively)**,** possibly reflecting the relative proportions of blood flow. Cervical lesions are commoner in intravenous drug users **(24).** Multifocal involvement occurs in 4% of cases **(9).**

Tuberculous lesions more commonly affect the thoracic spine in most series and are more likely to involve more than two (sometimes non-contiguous) vertebrae compared with pyogenic cases **(10).**

Direct inoculation is most commonly iatrogenic following spinal surgery, lumbar puncture or epidural procedures and accounts for up to (25% to 30%) of case insome spondylodiscitis studies **(11).**

In vertebral infections, the posterior parts of the vertebrae are usually affected. Infection of implanted prosthetic material is an important predisposing factor following surgery **(12).**

Rarely, spondylodiscitis may follow stab or gunshot wounds to the spine. Contiguous spread is rare. It can occur from any adjacent infective focus, commonly from aortic graft infections, a ruptured esophagus or a retropharyngeal abscess **(10).**

Postoperative and iatrogenic spondylodiscitis:

The incidence of postoperative discitis after routine lumbar discectomy has been reported between (0.7% and 2.8%) of operative cases **(5).** When one adds a fusion to the procedure, the incidence rates rise from (0.9% to 6%). Spinal instrumentation adds further complicating factors, and infection rates average 7% with a range of (1.3 to 12%). Another study revealed the incidence of infection to be 2.7% **(13).** Clearly, aseptic technique and appropriate antibiotic prophylaxis have dramatically reduced infection rates in the perioperative period **(14).**

Infection may also occur after lumbar puncture, myelogram, cervical laminectomy, lumbar sympathectomy and other procedures. Several factors supposed to increase the rate of infection following spinal surgeries, including increased age, poorly controlled diabetes mellitus, chronic malnutrition, steroid therapy, previously radiated area, preexisting neoplasm, prolonged preoperative hospitalization, suboptimal sterile techniques, prolonged procedures, and increased operating room traffic **(15).**

When compared to spontaneous spondylodiscitis, patients with postoperative spondylodiscitis were found to be younger, with less frequent underlying diseases and a more prolonged interval between onset of symptoms and diagnosis **(16).**

The most common presentation of postoperative infection is an initial relief of symptoms with surgery followed by a return of back pain (2 to 6) weeks later, exacerbated by virtually any motion of the spine, and sometimes radiating to the hip, leg, scrotum, groin, abdomen, or perineum. The cases are rarely acute and seldom present with a septic picture. Constitutional symptoms may include occasional fever, increased sweating, and chills. Almost all patients with postoperative discitis reported in the literature had paravertebral muscle spasm and limited range of motion of the spine. Point tenderness is present in 33% of the cases. The surgical site usually appears benign only (10% to 12%) of patients had signs of superficial wound infection and (0%to 8%) had expressible pus (**17**).

There is often lack of leukocytosis but the ESR is usually elevated. However, an elevated ESR can frequently be seen because of the underlying disease, but the trend of changes on serial ESR testing can be very helpful (**5**).

The bone scan will often show increased uptake in the operative site due to the normal healing process. A galliumscan is likely to be of greater assistance and can be more indicative of the extent of infection. Plain radiographs are initially normal, and later (average 3 months) reveal decreased disc space height and blurring of the affected endplates. MRI imaging remains the test of choice and the findings are identical to those seen in spontaneous pyogenic spondylodiscitis **(18).** S. epidermidis is the most common pathogen in postoperative spodylodiscitis followed by S. aureus, Gram negative organisms, including E. coli, Pseudomonas aeruginosa can also be incriminated **(19).**

It is advocated that any suspected post-surgical infection be subjected to CT guided needle aspirate and culture. If pathogenic infection is proven or strongly suspected minimum of 6 weeks of culture specific intravenous antibiotics (or until ESR decreases significantly). Pending the identification of the organism, one should start with an anti-staphylococcal antibiotic (e.g. vancomycin with or without rifampin) and a broad spectrum anti gram negative antibiotic, and then modify the regimen based on the sensitivity results **(19).**

Surgery should be reserved for cases of sepsis, epidural abscess formation, and progressive neurological deficits. The surgical approach depends mainly on the extent of the problem. Patients discovered early in the course may be treated by re-exploration posteriorly. In more extensive cases or chronic cases, an anterior approach is recommended **(20).**

Diagnosis:

Diagnosis is based on clinical, laboratory and radiological features. It is often delayed or missed due to the rarity of the disease, the insidious onset of symptoms and the high frequency of low back pain in the general population **(21).**

A- Clinical features:

The symptoms of spondylodiscitis are non-specific. Back or neck pain is very common, but up to 15% of patients may be pain free **(22).** The onset is usually insidious and (red flag) features include constant pain that becomes worse at night. Radicular pain radiating to the chest or abdomen is not uncommon and may lead to misdiagnosis or even unnecessary surgery **(5).**

Fever is less commonly experienced and occurs in only about half of patients. Neurological deficits, including leg weakness, paralysis, sensory deficit, radiculopathy and sphincter loss, are present in a third of cases **(11).** These are more likely to be associated with epidural abscess, delayed diagnosis, and cervical lesions **(23).** Risk factors for paralysis also include diabetes mellitus, advanced age and steroid use **(24).**

Spinal deformities, predominantly kyphosis is commoner in tuberculous spondylodiscitis **(25).** Untreated chronic infections can progress to sinus formation. Cervical spondylodiscitis may manifest with dysphagia or torticollis **(26).** Spinal tenderness is the commonest sign detected on examination, reported in (78% to 97%) of cases, often associated with restricted range of movement and paravertebral muscle spasm (**27).**

A fluctuant mass may be present rarely and sciatic pain can often be elicited. In children, symptoms of spondylodiscitis are non-specific and include irritability, limping, refusal to crawl, sit or walk, hip pain or even abdominal pain. Incontinence may be a presenting feature **(5).**

Fever is less common in young children with discitis compared with older children with vertebral osteomyelitis. Loss of lumbar lordosis and lower back movement is the commonest sign on examination **(28).** Compared with adults, children are less likely to have comorbidities and neurological deficits are uncommon **(29).**

B- Laboratory features:

1- Haematological and biochemical markers:

Erythrocyte sedimentation rate (ESR) is a sensitive marker for infection but lacks specificity. In most reports, it is elevated in over 90% of cases; with mean values ranging from 43 mm/h to 87 mm/h. ESR is used in predicting response after 1 month of conservative treatment. It was found that a fall in ESR to below 25%of the presenting value was a good prognostic marker unchanged or rising ESR was more difficult to interpret and suggesting evaluating this marker in conjunction with other parameters **(30).**

C-reactive protein (CRP) is similarly raised in the large majority of cases with spondylodiscitis **(30).** In a study of 29 successfully treated patients, CRP had returned to normal in all survivors at 3 months follow-up **(31).** Some authors suggest that CRP is the preferred marker for monitoring response to treatment **(32).**

The leucocyte count is the least useful amongst the inflammatory markers; it is high in only a third to half of affected patients **(33).** Immunocompromised patients and those aged over 60 years were more likely to have a normal white cell count. However, age did not appear to affect leucocyte count **(34).** Some authors have noted an increase in neutrophil count in pyogenic when compared with tubercular or brucellar spondylitis **(35).**

Approximately 70% of patients with spondylodiscitis may be anemic (microcytic hypochromic anemia) as noted in some studies **(36)** also patients with sickle cell anemia have more liability to spondylodiscitis **(37).** About half have a raised alkaline phosphatase serum value **(38).**

2- Microbiological investigations:

The value of obtaining a microbiological diagnosis can not be over emphasized. The wide range of potential pathogens and the rise in antimicrobial resistance, both in hospital and the community, argues for the determination of the causative agent. Empirical broad spectrum antibiotic therapy is linked to increased rates of complications such as Clostridium difficile associated diarrhea and higher healthcare costs and should be reserved for patients presenting with severe sepsis once blood cultures have been taken **(39).**

Blood cultures:

Blood culture is a simple and cost-effective method for identifying bacterial agent of spondylodiscitis, as the infection is mostly monomicrobial and often has a hematogenous source. The yield from blood cultures varies between (40% and 60%) in clinically defined cases of pyogenic spondylodiscitis **(40).**

The yield is lower in postoperative infections, where biopsy may be needed to confirm the diagnosis, and higher with more virulent organism's and in the presence of pyrexia. Discordant results between blood cultures and biopsy have been reported in one study, including polymicrobial results being missed by blood cultures **(41).** In the presence of multiple positive blood cultures with Gram positive organisms, concurrent infective endocarditis should be excluded **(42).**

Biopsy and culture:

The frequency of performing biopsies (either open or percutaneous) varied among spondylodiscitis studies, ranging from (19 to 100%) and was often reserved for patients with negative blood cultures. Biopsy cultures from these cases were positive in (43% to 78%) of cases **(43).** In one study, where all 101 patients underwent biopsy, the yield was 75% **(44).**

The value of a percutaneous biopsy as a safe and minimally invasive intervention is well established **(45).** Some experts recommend a second percutaneous biopsy if the first one is negative **(46).**

Friedman et al. (10) who reported positive initial percutaneous biopsy cultures for 50% of 24 patients with spontaneous spondylodiscitis, a frequency that improved to79% on repeat biopsy. Other investigators would consider a negative percutaneous biopsy result as an indication for surgical biopsy, especially if the clinical progress is unsatisfactory **(47).**

Culture positivity is higher with surgical sampling, even when minimally invasive techniques are used**.** The diagnostic yield can be further improved by submitting more than one specimen for culture **(48).**

French guidelines recommend sending six biopsy samples**.** Biopsy yield is reduced by prior antibiotic usealthough as many as 39% of biopsy cultures in suspected cases of spondylodiscitis with no prior antibiotic exposure may be negative **(49).**

The role of biopsy in children with spondylodiscitis is debated. Some investigators used it for the majority of their patients**,** whilst others reserved it for cases that had not responded to empirical therapy or where mycobacterial or fungal agents were suspected **(50).**

Biopsy material should undergo aerobic, anaerobic, fungal and mycobacterial cultures. Inoculation into enrichment broth should be considered for fastidious organisms Biopsy of other sites such as bone marrow may behelpful in brucellosis **(51).**

Radiology:

✓Plain radiography:

It is frequently employed as a screening test and may reveal early changes such as subchondral radiolucency, loss of definition of the endplate and loss of disc height. Later changes include destruction of the opposite endplate, loss of vertebral height and para-vertebral soft tissue mass. However, changes tend to appear (2 to 8) weeks after onset of symptoms and false positive results can occur due to degenerative change (**2**).

Figure (1): Lateral radiograph of the thoracolumbar spine of a 70-years old patient with pyogenic spondylodiscitis that originated from an infected pacemaker shows partial collapse of the T11 and T12 vertebral bodies and T11 to T12 disc degeneration **(43).**

✓Computed tomography (CT):

Is the best modality at delineating bony abnormalities, including early endplate destruction (before they become visible on X ray), later sequestra or involucra formation, or pathological calcification suggestive of TB **(52).**

It is inferior to MRI in imaging neural tissue and abscesses. Disc changes appear as hypodense areas. CT is currently mostly used for the radiological guidance of spinal biopsy **(53).**

✓Magnetic Resonance Imaging (MRI):

MRI is considered the modality of choice for the radiological diagnosis of spondylodiscitis **(54).**

It has a reported sensitivity of 96%, specificity of 93% and accuracy of 94%. Its advantage over other modalities lies with its superior ability to provide anatomical information, particularly relating to the epidural space and spinal cord. The characteristic changes consist of decreased signal intensity from disc and adjacent vertebral bodies on T1-weighted images, increased signal intensity on T2-weighted images (due to oedema) and loss of endplate definition on T1 weighting **(55)**.

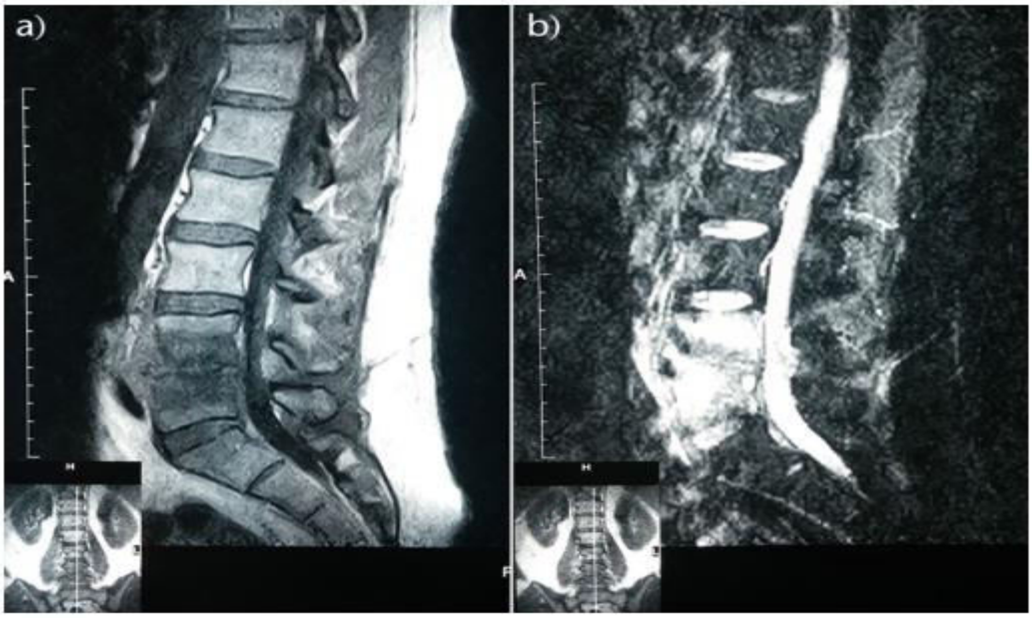

Figure (2): Sagittal (a) T1-weighted and (b) T2-weighted MRI of the lumbar spine of a 45-year-old patient with spontaneous pyogenic spondylodiscitis showing reduction of the L4 to L5vertebral disc height and erosion of the adjacent vertebral end-plates **(42).**

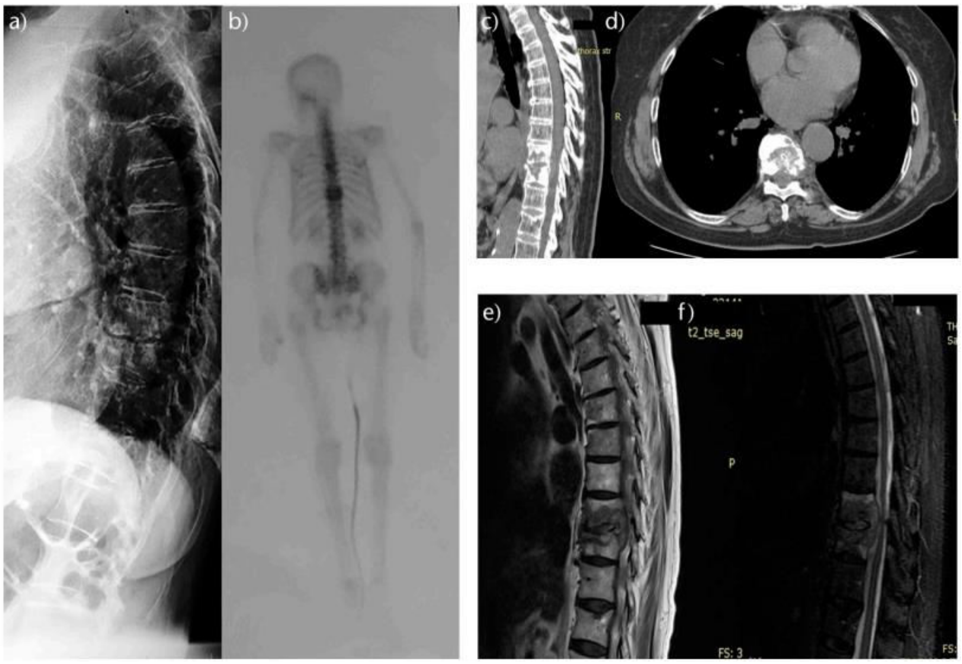

Figure (3): (a) Lateral radiograph of the thoracic spine, (b) 99mTc-MDP bone scan, (c) sagittal and (d) axial CT, and sagittal (e) T1-weightedand (f) T2-weighted MRI of the spine of an 83-year-old woman with tuberculosis spondylodiscitis showing increased radionuclideuptake and destruction of the T9 to T10 vertebrae (**32**).

✓**Gadolinium enhancement:** of discs, vertebrae and surrounding soft tissues improves the accuracy of MRI,particularly in early infections when other changes maybe subtle, and also helps to differentiate infective lesions from degenerative changes (Modic type 1 abnormalities)or neoplasms **(56).**

In pyogenic spondylodiscitis, emerging evidence suggests that some MRI changes commonly persist or evenworsen during treatment despite clinical improvement and may result in unnecessary surgery. Reliable markers of resolution of infection, such as bony restoration and complete loss of gadolinium enhancement, appear very late in the healing process **(57)**.

Re-imaging in the critical period of (4 to 8) weeks of treatment showed increased loss of disc height, and often persistent or worsening vertebral body and disc enhancement. MRI signs that often-showed improvement include the presence of epidural enhancement, epidural abscess or spinal canal encroachment, but none was associated with the patients' clinical status **(57).**

✓**Technetium-99m–methylene diphosphonate bone scinti-graphy**: has a reported sensitivity of 90%, but a poorer specificity of 78%, degenerative changes resulting in false positive results **(58).**

✓**Gallium-67 scintigraphy:** is a valuable adjunct to bone scan, and when combined they have a sensitivity of 90%, a specificity of 100% and accuracy of 94% **(59).** The use of Indium-111-leucocyte **scan** is not recommended due to poor sensitivity, spondylodiscitis lesions often displaying non-specific photopenic regions **(60).**

Fluorine-18 fluorodeoxy glucose positron emission tomography (FDG-PET): is another promising method, reported to have higher sensitivity, specificity and accuracy in spinal infections **(58).** Results are comparable with MRI in patients with high and medium grade spinal infections, whereas it seems to be superior in detecting low grade infections **(61).** However, this method is not widely available and evidence regarding its usefulness and cost effectiveness is still limited **(62).**

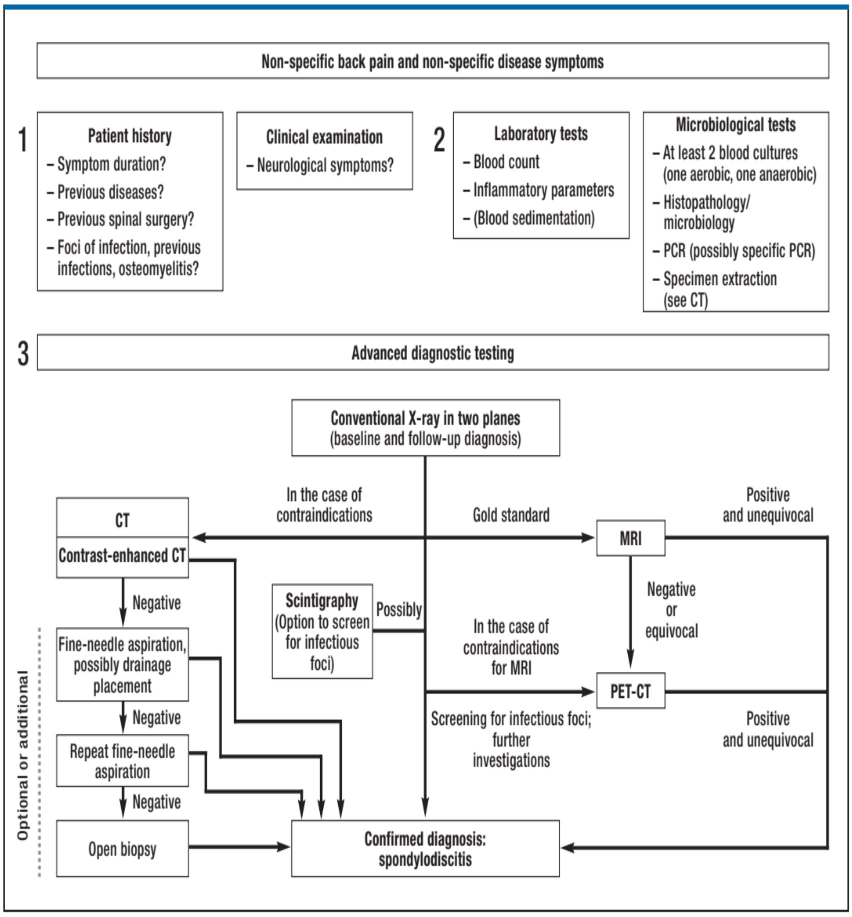

Figure (4): Three-step diagnostic algorithm to detect spondylodiscitis**.** PCR, polymerase chain reaction; PET, positron emission tomography **(48)**.

ConflictofInterest: Noconflictofinterest.

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