



Original Article

Surgical management of spontaneous thoracic and lumbar spondylodiscitis by fixation and debridement

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ABSTRACT

Background: Spondylodiscitis could be considered one of the most disturbing challenges that face neurosurgeons due to variety of management strategies. The lumbar region was highly affected then dorsal region with higher percentage for lesion in L4/5 (25%) followed by T11/12 and L5/S1 (15%). In our study, we discuss the efficacy of debridement and fixation in cases of spontaneous thoracic and lumbar spondylodiscitis.

Methods: This retrospective study included 40 patients with spontaneous thoracic or lumbar spondylodiscitis indicated for surgical intervention in the period from March 2019 to February 2021. All patients were subjected to thorough history taking, neurological examination, and investigations. The patients were operated on through posterior approach by debridement and posterior transpedicular screws fixation and fusion.

Results: Clinical assessment early postoperative revealed 75% of cases showed full motor power and 20% showed improvement in motor power, for sensory assessment, 85% showed improvement, the mean visual analog scale (VAS) score was of 3.65 ± 0.87 . After 3 months postoperatively, 95% of cases were full motor power with sensory and autonomic (sphincteric) improvement. The mean VAS score was 2.5 ± 0.68 . After 6 months postoperative, the clinical assessment revealed that 95% of cases were full motor power with sensory manifestation improvement, and 95% of them were continent. The mean VAS score was 1 ± 0.85 . Culture results showed that 65% of samples were negative culture, 15% had methicillin-resistant *Staphylococcus aureus*, and 10% had *Escherichia coli* with a single case of *Pseudomonas* and another one of fungal (*Candida albicans*). Postoperative 90% of cases showed improvement in erythrocyte sedimentation rate results and 95% of cases showed improvement in C-reactive protein results.

Conclusion: Management of spontaneous thoracic and lumbar spondylodiscitis by surgical debridement and posterolateral open transpedicular fixation seems to be effective and safe method despite the presence of infection. We found that the clinical condition of our patients showed significant improvement with this addressed approach.

Keywords: Debridement, Fixation, Lumbar, Spondylodiscitis, Spontaneous, Thoracic

INTRODUCTION

Spinal infections encompass several entities that have characteristic presentations and clinical courses. These are often pyogenic but can also be granulomatous or parasitic and include spondylodiscitis, septic discitis, vertebral osteomyelitis, and epidural abscess.^[3] Recent publications suggest that 95% of pyogenic spinal infections involve the vertebral body, with only 5% involving the posterior elements of the spine.^[17,21] Spinal tuberculosis is the most serious

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form of musculoskeletal tuberculosis and comprises up to 50% of all affected patients. The incidence of neurologic involvement represents 10–47% of those with spinal tuberculosis.^[1,9] Hematogenous pyogenic spondylodiscitis affects preferentially the lumbar spine, followed by the thoracic spine, the cervical spine, and, very rarely, a multifocal infection.^[10] Diagnosis could be difficult and 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.^[20] Despite improved recognition of the disease, management strategies vary widely across centers. The standard treatment for pyogenic osteomyelitis/discitis is a course of intravenous antibiotics followed by a lengthy course of oral antibiotics along with external spinal immobilization.^[14,18] However, in the presence of progressive neurologic deficit, spinal instability, or kyphotic deformity or in the absence of response to medical therapy, surgical debridement is recommended.^[19,34] The primary aim of surgical techniques is debridement with biopsy for culture and histopathology, but since, in most cases, after decompression, drainage, and a sequestrectomy, the spine is unstable, a mechanical stabilization is needed at the same session or in a secondary operation.^[10]

Debridement without fusion is advocated by some surgeons, however, large multilevel laminectomies without instrumentation may result in severe instability and provoke neurological deficit.^[24,31] Application of instrumentation in the presence of spinal infection is controversial.^[6,9] The traditional management of bony infections in general includes intravenous antibiotics, drainage or debridement of all pus, and possibly removal or avoidance of hardware, to avoid bacterial colonization.^[40] However, several studies in literature reported patients with spinal infections who were treated by spinal stabilization while in the acute stage and had good outcomes.^[16,22,36] The main criticism for the placement of metallic implants is the possibility of bacterial colonization and the formation of a biofilm which blocks the penetration of antimicrobials.^[11,23] However, titanium alloy is less susceptible for this problem than stainless steel.^[4,11,39]

The aim of our study is to evaluate the impact of debridement and fixation on clinical and radiological outcomes in patients of spontaneous spondylodiscitis.

MATERIALS AND METHODS

This retrospective study included 40 patients with spontaneous thoracic or lumbar spondylodiscitis indicated for surgical intervention in the period from March 2019 to February 2021. Age ranged between 15 and 75 years old and all patients with spontaneous spondylodiscitis in thoracic or lumbar regions. All patients were subjected to thorough history taking, neurological examination, and investigations.

Investigations included laboratory in the form of full routine laboratories with special concern to erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP). Furthermore, radiological (plain X-rays and magnetic resonance imaging [MRI]) of affected spine region was performed to assess the neural elements with good visualization of neural canal components, intervertebral discs, and computed tomography (CT) of pathological spine was done. It provides accurate details of bony anatomy, diameter of bony canal and allows measurement of the length of the screws. It is useful for the assessment of deformities and loss in vertebral height. The patients were operated on through posterior approach by debridement and posterior transpedicular screws fixation (long segment if affected level was at thoracolumbar junction while short segment if other single level lumbar or thoracic affection) and posterolateral fusion. Postoperative antibiotics for 28 days, analgesics, and neurotropic drugs were routinely used for all patients. The patients were followed up at inpatient and outpatient basis. Early follow-up (1st month postoperative) included postoperative back pain visual analog scale (VAS score), neurological status, radiological evaluation of placement of the fixation system, and alignment of the vertebral column.

Later follow-up (at 3 and 6 months) was divided into functional outcome which is improvement in back pain, laboratory and microbiological outcome with improving ESR&CRP laboratories, postoperative culture of the specimen, radiological outcome such as confirmation of incidence of fusion (after 6 months) and postoperative complications in the form of persistent infection, wound infection or implant failure, or pseudoarthrosis should be documented.

Statistical analysis

Data were collected, coded, and entered into Microsoft access. Data analysis was performed using Statistical Package for the Social Sciences-Version 20. The mean and standard deviation of assessed variable were presented. Categorical variables were expressed as numbers and percentages. Qualitative data were tested for normality using one-sample Kolmogorov–Smirnov test. Mann–Whitney U-test was used to compare two independent groups and Chi-square test was used to compare more than 2 groups. $P \leq 0.05$ was considered the cutoff point for statistical significance.

RESULTS

The mean age was 49.8 ± 12.5 years old ranged between 15 and 75 years old, as regard sex distribution, 70% were male, and 30% were female. As regard comorbidities, higher percentage was for diabetes mellitus (15%) and drug addiction (15%), other comorbidities included post-COVID, renal, hepatic, and prostatic cancer versus 35%

were free [Table 1]. Those comorbidities made most patients immunocompromised. Different levels of lesion determined by MRI with higher percentage for L4/5 (25%) followed by T11/12 and L5/S1 (15%) [Table 2]. As regard preoperative clinical assessment, 75% of cases had Grade 5 motor power, and 45% had radiculopathy in sensory assessment, with 15% were incontinent with mean VAS score was 7.3 ± 1.3 [Table 3].

All cases had elevated ESR preoperative with 95% had positive CRP. Early postoperative 75% of cases were full

motor power and 20% showed improvement in motor power, for sensory assessment, 85% showed improvement, with 85% were continent in autonomic (sphincteric) assessment and 10% showed improvement after operation.

The mean VAS score was of 3.65 ± 0.87 . After 3 months postoperative, the clinical assessment showed that 95% of cases were full motor power, for sensory assessment, 95% showed improvement, with 95% were continent in autonomic assessment. The mean VAS score was 2.5 ± 0.68 . Culture results 65% of samples showed negative culture, 15% had methicillin-resistant *Staphylococcus aureus* (MRSA), and 10% had *Escherichia coli* results [Table 4].

Six months postoperative, the clinical assessment showed that 95% of cases were full motor power, for sensory assessment, 95% showed improvement, with 95% were continent. The mean VAS score was 1 ± 0.85 . After operation, 90% of cases showed improvement in ESR and 95% showed improvement in CRP. In our study, there was a statistical significance difference in motor power, sensory, and autonomic assessment in addition to VAS score between early postoperative and after 3 months follow-up with $P < 0.05$, which indicated proper improvement after 3 months. On the other hand, there was no statistical significance difference with $P > 0.05$

Table 1: Description of demographic characters and personal history.

Variables	Number (n=20)	
Age (years)		
Mean±standard deviation	49.8±12.5	
Range	26–79	
Sex		
Female	12	30%
Male	28	70%
Age groups (years)		
20–30	4	10%
31–40	6	15%
41–50	10	25%
51–60	16	40%
61–70	2	5%
71–80	2	5%
Medical history		
Free	14	35%
HTN	6	15%
Drug addiction	6	15%
DM	6	15%
Renal	2	5%
Prostatic	2	5%
HCV	2	5%
HBV	2	5%
Post-COVID-19	2	5%

HTN: Hypertension, DM: Diabetes mellitus, HCV: Hepatitis C virus, HBV: Hepatitis B virus, COVID: Coronavirus disease

Table 2: Frequency of different MRI findings.

MRI	Number (n=40)	%
T 3/4	2	5
T 5/6	2	5
T 6/7	2	5
T 6/7 and T 8/9	2	5
T 9/10	4	10
T 11/12	6	15
L 2/3	2	5
L 3/4	2	5
L 4/5	10	25
L 4/5 and L 5/S1	2	5
L 5/S1	6	15

T: Thoracic, L: Lumbar

Table 3: Frequency of different preoperative clinical.

Preoperative examination	Number (n=40)	%
Motor power assessment		
Grade 0	2	5
Grade 3	2	5
Grade 4	6	15
Grade 5	30	75
Sensory assessment		
Normal	2	5
Radiculopathy	18	45
Hypoesthesia	4	10
Claudication	14	35
Loss of sensation	2	5
Autonomic assessment		
Continent	34	85
Incontinent	6	15
Visual analog scale score		
Median/IQR	7.5/2	
Mean±standard deviation	7.3±1.3	

Table 4: Frequency of different culture findings.

Culture findings	Number (n=20)	%
Negative	26	65
Methicillin-resistant <i>Staphylococcus aureus</i>	6	15
<i>Escherichia coli</i>	4	10
<i>Pseudomonas</i>	2	5
<i>Candida albicans</i>	2	5

between clinical assessment after 3 and 6 months follow-up [Table 5]. Furthermore, there was a statistical significance difference in ESR and CRP level between preoperative and postoperative laboratory assessment follow-up with $P < 0.05$, which indicated proper improvement after operation in laboratory assessment. There was a statistical significance difference in lesion fusion level between 3 and 6 months postoperative follow-up with $P < 0.05$, which indicated proper improvement after operation in fusion level. About 65% of cases showed no complications but 20% had wound infection which was managed by repeated dressings with povidone-iodine, local and systemic antibiotics and 10% had delay in fusion. Only one case showed partial pulled out screws in the upper two fixed vertebrae but the patients were not agonized and refused undergoing further intervention for revision of those pulled out screws.

DISCUSSION

Spondylodiscitis is the most frequent among spinal infections. Titanium is the implant material of choice because it is very difficult for bacterial biofilm compared to other materials.^[7,26,28] This study included 40 patients with spontaneous thoracic or lumbar spondylodiscitis indicated for surgical intervention. In our study, the mean age of study group was 49.8 ± 12.5 and 40% were between 51 and 60 years old with 70% of males, and 30% of females. While in Waheed *et al.*, they treated 44 consecutive patients with a median age of 41.3 years (range 13–65 years), and there was a slight male predominance (59.1%).^[38] While Giordan *et al.*, the median age was 67 (range: 16–89) years, with a significant proportion of patients older than 60 years (71%).

Patients who underwent surgical treatment were significantly younger (mean age at presentation: 52.7 years) than patients who were medically treated (mean age at presentation: 64.8 years). The male: female ratio was 2.06:1.^[12] Giordan *et al.* reported that among conservatively treated patients, 35% had Type II diabetes mellitus, 27% had hypertension or chronic obstructive pulmonary disease, 18.1% were obese, 3% were substance abusers, 5.2% were immunosuppressed, and 8.8% had no other medically relevant comorbidities. Only two patients had a negative past medical history, and one patient was a drug abuser with an associated chronic HIV infection.^[12] In our study, as regard comorbidities, higher percentage was for diabetes mellitus (15%), hypertension (15%), and drug addiction (15%) then post-COVID-19, renal, hepatic (B or C virus), or prostatic cancer, each was 5% versus 35% of patients were free.

Mohamed *et al.* mentioned that low back pain was present in 22 cases (88%), 16 cases (64%) had lower limb pain (sciatic and claudication pain), and 12 cases (48%) had weakness.^[25] Moreover, in Kamal *et al.*, all patients in their study (39 patients) had presented with back pain in addition, a total of 21 patients (21/39, 53.8%) had various degrees of neurological impairment on presentation.^[19] In Waheed *et al.*, all the patients presented with local pain in the spine, which was more pronounced over the affected level, 34.1% of the patients had a neurological deficit.^[38] In our study, all cases complained of lower back pain, but 90% had lower limbs pain, and 20% had lower limb heaviness. The lumbar region was highly affected in our series, then thoracic region with higher percentage for lesion in L4/5 (25%) followed by T11/12 and L5/S1 (15%). Waheed *et al.* mentioned

Table 5: Comparison of clinical examination follow-up.

Variables	Early post		3 m post		6 m post		P-value
	No.	%	No.	%	No.	%	
Motor power assessment							
Not improved	2	5	2	5	2	5	0.002 ^a
Improved	8	20	0	0	0	0	0.99 ^b
FMP	30	75	38	95	38	95	
Sensory assessment							
Not improved	2	5	2	5	2	5	0.02 ^a
No sensory affection	4	10	0	0	0	0	0.99 ^b
Improved	34	85	38	95	38	95	
Autonomic assessment							
Continent	34	85	38	95	38	95	0.02 ^a
Incontinent	2	5	2	5	2	5	0.99 ^b
Improved	4	10	0	0	0	0	
Vas score							
Median/IQR		3.5/1		2.5/1		1/2	0.009 ^a
Mean±standard deviation		3.65±0.87		2.5±0.68		1±0.85	0.01 ^b

^aStatistical significance difference between early postoperative and 3 months follow-up. ^bStatistical significance difference between 3 months and 6 months follow-up. FMP: Full motor power

that the most common affected region was the lumbar region (26 patients out of 44 patients) and Kamal *et al.* mentioned that thoracic involvement was 16/39 patients, 41%, thoracolumbar junction was 6/39 patients, 15.4%, and lumbar and lumbosacral were 15/39 patients, 38.6%.^[19,38] Our series revealed that all cases had elevated ESR preoperative with 95% had positive CRP. In Sudprasert *et al.* case series, all cases showed elevated ESR and positive CRP.^[33] William *et al.* showed that high ESR and CRP values with the mean ESR at the 1st hour were 160 mms/h and CRP was 188 mg/L.^[15] Furthermore, Waheed *et al.* noted that the ESR and CRP were elevated in all the patients.^[38] Treatment of spine infection remains a challenge for spine surgeons, with the most effective method still being a matter of debate. Most surgeons agree that in early stages of infection, antibiotic treatment should be pursued; under certain circumstances, however, surgery is recommended. In a case series of 90 patients, Tsai *et al.* noted that early surgery with antibiotics treatment had better clinical outcomes than antibiotics treatment alone in patients with pyogenic spondylodiscitis, patients treated with early surgery, and antibiotics were hospitalized for fewer days and required less antibiotics than those treated with antibiotics alone, also having better functional outcomes.^[35] In our series, we did surgical debridement and spinal stabilization by posterolateral approach with transpedicular fixation in the same session for all included patients (40 patients) and in a series of 16 cases. Ozalay *et al.* also described the management of thoracic or lumbar spondylodiscitis with anterior debridement and reconstruction (tricortical graft or titanium mesh cage), combined with single-stage posterior instrumentation and grafting.^[27] Zhang *et al.* also described a single-stage surgical management even for multilevel spondylitis of the upper thoracic region.^[41] Si *et al.* observed the clinical outcome of anterior versus posterior instrumentation in the treatment of pyogenic vertebral osteomyelitis of the lumbar spine and found no significant difference in fusion time.^[32] Choi *et al.* did percutaneous endoscopic debridement and drainage with four different approach methods for the treatment of spinal infection and his results showed good clinical outcome.^[5,8] Blondel *et al.* also did minimally invasive osteosynthesis in septic conditions to lessen the hazards of disease spread and to shorten the surgery time in a multi comorbidities patients.^[2] Turel *et al.* mentioned the role of minimally invasive spine surgery in the management of pyogenic spinal discitis and all his patients had excellent recovery.^[25] In our surgical strategy, we debrided the infected tissue as we can to help in eradication of infection, good neural tissue decompression, decreasing the recurrence, and obtaining proper fusion, in contrary, Mohamed *et al.* did posterior fixation without debridement for vertebral body osteomyelitis and discitis only neurodecompression and as mentioned 14 patients were treated with posterior-only decompression

and long-segment rigid fixation, without formal debridement of the infected area and reported that this strategy resulted in resolution of spinal infection in all cases and in significant neurological recovery in almost all cases. Blondel *et al.*, 10 patients were included in this study and treated with a two-step procedure: posterior percutaneous osteosynthesis completed by complementary intervertebral grafting through an anterior access. On the other bank, Noh *et al.* donated a comparison between decompression alone versus fusion for pyogenic spondylodiscitis and found that the decompression only group experienced a shorter duration of treatment with antibiotics and normalization of ESR and CRP levels after the operation and a shorter hospitalization period.^[13] In another comparison was done in asset of 104 patients, Pourtaheri *et al.* compared the outcomes of instrumented versus noninstrumented (decompression) surgical treatment of vertebral osteomyelitis. They carried out instrumented (57 patients) and noninstrumented (47 patients) surgery then reported that they had similar clinical outcome and clearance of infection, however, the patients with instrumentation had more severe clinical condition and longer hospital stay.^[29]

In our series, we performed surgical removal of the infected tissue and we did not use any surgical site local antibiotics. While Fleege *et al.* recommended surgical removal of the infection by extensive debridement with stabilization and filling the defect with a high local dose of antibiotic and a mixture of cancellous bone and antibiotic-loaded hydroxyapatite and calcium sulfate.^[10] Furthermore, Ramey *et al.* mentioned that insertion of an antibiotic-impregnated polymethylmethacrylate strut graft is a novel technique that should be considered to provide strong anterior column support while directly delivering antibiotics to the infection bed.^[30] Some agreed with us about improvement after debridement and instrumentation regardless the performed approach as Ozlay *et al.* Fourteen out of 16 patients (87.5%) were completely relieved of pain and fully active, the other two patients obtained a good result. All seven patients who had a neurological deficit improved. Furthermore, in Zhang *et al.* study, 19 patients with preoperative neurologic deficit restored motor power after surgery by 1.3 grades according to Frankel.^[41] Griffith-Jones *et al.* reported that all patients (10 patients) significantly improved in VAS scores after surgery.^[15] While Tsai *et al.* described a greater improvement in VAS score in decompression alone group than fusion group.^[37] In our study, culture results 65% of samples showed negative culture despite multiple cultures which were referred to prior broad-spectrum antibiotics that were given before surgery in most cases, 15% had MRSA, and 10% had *E. coli* results. There were no cases of Pott's disease in our surgical cases but in the same period of our study, 32 patients were managed conservatively with broad-spectrum antibiotics ± bracing as their symptoms were not severe and there were no epidural compression and minimal destructive nature.

Eight conservatively managed spondylodiscitis cases were associated with a history of proven pulmonary tuberculosis. Choi *et al.* and Mohamed *et al.* revealed that the most common accused bacteria were *S. aureus*, while Waheed *et al.*, *Mycobacterium tuberculosis* was the most frequent organism isolated (15 patients), followed by pyogenic infection (six patients with brucellosis, three with *S. aureus*, and three with streptococcal infection). However, they failed to obtain microbiological confirmation in 17 cases (38.6%) despite performing multiple cultures. Postoperative 90% of our cases showed improvement in ESR levels and 95% showed improvement in CRP results. Furthermore, Noha *et al.*, Kamal *et al.*, Fleege *et al.*, and Tsai *et al.* showed the same finding. Our study agreed with Ozlay *et al.*, Blondel *et al.*, and Zhang *et al.* who documented that bony union was obtained in all cases in a variable period ranged from 6 months to 2 years. Si *et al.* found good fusion in both study groups and radiological results showed no significant difference in fusion time between them.^[32] While Gautam *et al.* found that 13 patients had definitive fusion and 2 patients had probable fusion.^[40]

In our study, there were 65% of cases showed no complications but 20% had wound infection (eight cases) managed by repeated dressing with the targeted or empirical antibiotic as reported in the antibiogram and the eight cases showed improvement in the wound condition without need for another return to operative theater for re-debridement or implants removal, 10% had delay in fusion with a single case of implant pull out before full fusion. Mohamed *et al.* recorded single case of fixation looseness and another one for early superficial wound infection.^[25] In Kamal *et al.*, the wound healing problems occurred in one patient who originally underwent only drainage and debridement of infected/necrotic tissue without instrumentation.^[19] Faraj and Webb reported three patients developed deep wound infection, which responded to repeated debridement and they carried out all procedure redo for one patient with implant failure.^[9]

CONCLUSION

In our study, we managed patients of spontaneous thoracic and lumbar spondylodiscitis by surgical debridement with instrumentation through posterolateral open transpedicular fixation; it seems to be effective and safe. We found that the clinical condition of our patients showed significant improvement with this addressed approach and it also allows effective and rapid cure of inflammation, earlier ambulation, and significantly shorter duration of antibiotic usage.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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