

Outcome Following Surgical Treatment of Pyogenic Spondylodiscitis

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Background: Pyogenic spondylodiscitis (PS) is a rare and life-threatening condition. Traditional treatment is surgical debridement followed by antibiotic therapy.

Objective: To investigate risk factors, bacteriological features, treatment methods and clinical, laboratory, and radiological findings and surgical outcomes in patients with PS.

Material and Method: Twenty-one patients who underwent treatment for PS at Siriraj Hospital during the January 2012 to October 2015 study period were included. All patients received surgical debridement followed by antibiotic therapy.

Results: Five patients had complete cord PS. Infection was found in the following spinal regions: cervical (12), thoracic (2), lumbar (4), and multiple regions (3). The most common presenting symptom was spinal pain. All patients had elevated ESR and CRP. The most common isolated bacterium was *Staphylococcus* spp. Clinical improvement after surgical debridement was observed in all patients, except in two who died because of other complications.

Conclusion: There should be a high index of clinical suspicion for PS in patients who have increased inflammatory markers in the blood and local tenderness or pain in the spinal region. In cases with severe neurological deficit, surgical debridement followed by antibiotic therapy is the most effective treatment.

Keywords: Pyogenic spondylodiscitis, Surgical debridement, Antibiotic therapy

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Infection of the intervertebral disc and adjacent vertebrae is variably referred to pyogenic spondylodiscitis (PS), disc space infection, and vertebral osteomyelitis. They can present with or without associated epidural or paravertebral abscesses. PS is an infection that involves one or more of the extradural components of the spine. Complications of PS include epidural, paravertebral, and psoas abscess formation⁽¹⁾. Incidence has been reported to be from 0.2 to 2 cases per 100,000 per annum and there is evidence suggesting that the incidence is rising, possibly due to improved life expectancy in patients with chronic debilitating diseases⁽²⁻⁴⁾. Diagnosis is based on clinical, laboratory, and radiographic features. Diagnosis is often delayed or missed due to rarity of the disease, insidious onset of symptoms, and high frequency of spinal pain in the general population⁽⁵⁾.

Owing to a high risk of major morbidity and mortality, early diagnosis followed by effective antibiotic therapy and surgical decompression with debridement are required⁽⁶⁾. The aim of this study was to investigate risk factors, bacteriological features, treatment methods, clinical, laboratory, and radiological findings as well as surgical outcomes in patients with PS.

Material and Method

This study was conducted at the Division of Neurosurgery, Department of Surgery, Faculty of Medicine Siriraj Hospital in patients who underwent treatment for PS during the January 2012 to October 2015 study period. Patient medical records, radiographic imaging, bacteriologic results, antimicrobial and surgical therapies were retrospectively reviewed. Diagnosis of PS was defined by clinical findings, blood count, C-reactive protein (CRP), erythrocyte sedimentation rate (ESR), culture, histopathology, and radiological methods, including magnetic resonance imaging (MRI) and computed tomography (CT).

Diagnosis of PS was established when all of the following criteria were met: 1) clinical symptoms of

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spinal pain with characteristic inflammatory features (unrelieved by rest) or fever (temperature of 38°C), as well as neurological deficit on physical examination; 2) imaging findings compatible with vertebral osteomyelitis⁽⁷⁾ and 3) microbiological evidences, such as isolation of microorganism from open bone biopsy specimens, cultured blood, and/or specimens obtained from another adjacent infectious foci. Adjacent infectious foci included epidural abscesses or masses and abscesses in the paravertebral, psoas, or iliopsoas muscles.

The following data were collected and analyzed: age; sex; duration of symptoms before surgical treatment; patient-related risk factors or chronic underlying diseases (e.g. diabetes mellitus, previous bacteremia or focal infections, intravenous drug use, and immunodeficiency); clinical features; hematologic and biochemical features (i.e. blood count, erythrocyte sedimentation rate (ESR), and C-reactive protein (CRP) value); radiologic features (MRI and/or CT); microbiological features and treatment records.

Therapeutic failure was defined as worsened symptoms after one month of specific treatment. Functional status of patients was stratified by level of functional restriction in mobility using Nurick Functional Scale⁽⁸⁾ and American Spinal Cord Injury Association (ASIA) Impairment Scale. Outcome was defined as poor if the patient had therapeutic failure.

Data were analyzed using SPSS Statistics Data Editor Version 22 (SPSS, Inc., Chicago, IL, USA). Mann-Whitney U test or Student's t-test was used to compare means. Fisher's exact test or Pearson's Chi-square test and Wilcoxon signed-rank test were used to compare proportions. Differences were considered statistically significant at a *p*-value of <0.05.

Results

Based on an established diagnosis of PS, 21 patients were hospitalized at the Division of Neurosurgery. Patient demographic and clinical data are shown in Table 1. There were 13 men and 8 women, with an age range of 24 to 85 years (mean 61.9). Of 21

Table 1. Demographic and clinical data

Patient No.	Age	Sex	Underlying disease	Smoking	Alcohol drinking	Time to diagnosis (days)	Predisposing factor
1	64	F	HT	-	-	30	-
2	57	M	DM, HT, CA nasopharynx	+	+	30	UTI
3	40	M	DM, HT	+	+	4	-
4	55	F	-	-	-	60	-
5	59	M	CA nasophaynx	+	+	90	-
6	63	F	DM, HT, cirrhosis	-	-	21	Paraspinal abscess
7	69	M	DM, HT, DLP, gout	-	-	240	UTI
8	73	M	-	-	-	14	-
9	76	M	-	-	-	14	Sepsis
10	77	F	HT	-	-	90	-
11	40	M	DM, cirrhosis	-	+	14	-
12	53	M	-	-	-	14	-
13	47	M	-	-	-	14	-
14	24	M	-	-	-	60	-
15	69	F	DM, HT, CRF	-	-	14	Sepsis
16	49	M	Old CVA	-	-	60	-
17	73	F	HT	-	-	45	-
18	74	M	HT	-	-	14	UTI
19	75	F	HT	-	-	30	-
20	78	M	DM, HT	-	-	10	-
21	85	F	HT, DLP	-	-	14	UTI

+ = present; - = absent; CA = cancer; CRF = chronic renal failure; CVA = cerebral vascular accident; DLP = dyslipidemia; DM = diabetes mellitus; F = female; HT = hypertension; M = male; UTI = urinary tract infection

patients, 7 (33%) had diabetes mellitus, 11 (52%) had hypertension, 2 (9.5%) had dyslipidemia, 2 (9.5%) had cirrhosis, 1 (4.8%) had nasopharyngeal cancer, and 1 (4.8%) had chronic renal failure. Six (28.6%) patients had no comorbidity. Seven (37.3%) patients presented with the primary source of infection of their PS, the most common being urinary tract infection (UTI) (4 patients; 19%) and sepsis from combined MSSA and *Streptococcus* spp. (2 patients; 9.5%) (Table 1).

Among the primary symptoms observed in our patients, episodes of pain was the most frequently encountered symptom in 18 (85.7%) patients, followed by fever in 10 (47.6%) patients. Duration from the onset of the disease to first examination ranged from 4 days to 8 months. Twenty patients (95.2%) had myelopathy and motor weakness. Only one patient (patient 14) had no identifiable clinical myelopathy. All of 21 patients in our study were assessed using ASIA Impairment Scale and Nurick classification (Table 2).

Laboratory investigations revealed elevated CRP (>5mg/L) in 15 (71.4%) patients, elevated ESR (>15 mm/h) in 16 (76.2%) patients, and leukocytosis (leukocyte count >10.5x100/L) in 11 (52.4%) patients. Blood and tissue cultures were performed in all cases. Six (28.6%) patients had a positive blood culture result and tissue sample cultures were positive in 15 (71.4%) patients. Five different microorganisms were isolated from 15 (71.4%) patients. The most frequent etiologic agent was *Staphylococcus* species (53.3%) and 5 (55.5%) of 8 patients with *Staphylococcus* species had methicillin-sensitive *Staphylococcus aureus* (MSSA). Four (26.6%) patients had *Streptococcus* species, 1 patient had *Pseudomonas* species, and 2 patients were

infected by *Escherichia coli* (*E. coli*). All cases of gram negative infection were associated with UTI. Laboratory findings are shown in Table 3.

There was no significant difference in leukocyte counts relative to presence or absence of positive blood culture ($p = 0.63$) or abscess and/or epidural mass ($p = 0.47$) (Tables 4). At the diagnosis, elevated ESR (>15 mm/h) was found in 100% of the 16 patients who were evaluated, and 15 of 16 (95.2%) patients had elevated CRP level (>5 mg/L). Patients with improved Nurick classification or ASIA Impairment Scale had significantly decreased ESR level after surgical decompression ($p < 0.05$). All patients in this study had significantly decreased CRP after surgical decompression ($p < 0.05$).

Of 21 patients in our study, 11 had cervical lesions, 2 had thoracic lesions, 4 had lumbar lesions, and 3 had lesions in more than one spinal region. For associated findings, 14 patients had epidural abscess, 6 had epidural and paraspinal abscesses, and 1 had burst fracture. All of 21 patients were initially treated by surgical decompression and debridement under general anesthesia. The most frequent indications were drainage of abscess, relief of spinal cord compression, and spinal stabilization. In 3 (patient No. 4, 10, 19), percutaneous drainage of paraspinal abscess was performed during the intervention.

Sixteen of 21 patients received spinal instrumentation, with 2 of them (patient No. 7 and 16) requiring surgical revision. Antibiotic therapy according to the results of microbiological culture was given as an initial treatment after surgical decompression in all cases. All patients received a

Table 2. Preoperative clinical findings in patients with PS

Clinical finding	No. of cases (%)
Neck pain	13 (61.9)
Back pain	8 (38.1)
Fever	10 (47.6)
Tenderness	13 (61.9)
Limited ROM	17 (81)
Radiculopathy	0 (0)
Myelopathy	20 (95.2)
Weakness	20 (95.2)
Bowel-bladder involvement	13 (61.9)
ASIA impairment scale	A: 5 (23.8); B: 4 (19); C: 9 (42.9); D: 2 (9.5); E: 1 (4.8)
Nurick classification	0: 1 (4.8); 2: 4 (14.3); 3: 1 (4.8); 4: 6 (28.6); 5: 10 (47.6)

ROM = range of motion

Table 3. Laboratory findings in patients with PS

Patient No.	Leukocytosis (>10,500)	ESR (mm/hr)	CRP (mg/dl)	Hemoculture	Tissue culture
1	-	-	-	-	Strep spp.
2	+	98	76	-	Pseudomonas spp.
3	+	58	9	-	-
4	+	110	406	-	MSSA
5	-	-	-	-	-
6	-	92	71	Staph spp.	MSSA
7	+	-	-	-	E. coli
8	-	-	-	-	MSSA
9	-	94	17	Strep spp.	Strep spp.
10	-	86	148	Bacillus spp.	Staph spp.
11	+	87	74	MSSA	MSSA
12	+	86	129	-	-
13	+	46	241	-	Strep spp.
14	-	-	-	-	-
15	+	117	137	MSSA	MSSA
16	-	94	57	-	Staph spp.
17	-	103	104	-	Strep spp.
18	+	53	17	Staph spp.	E. coli
19	-	86	148	-	Staph spp.
20	+	105	132	-	-
21	+	53	3	-	-

+ = present; - = absent; CRP = C-reactive protein; ESR = erythrocyte sedimentation rate; *E. coli* = *Escherichia coli*; MSSA = methicillin-sensitive *Staphylococcus aureus*; Staph spp. = Staphylococcus species; Strep spp. = Streptococcus species

Table 4. Correlation between leukocytosis and hemoculture, and epidural abscess

Laboratory	Number of patients		p-value
	Absence of leukocytosis	Presence of leukocytosis	
Hemoculture			
Negative	7	8	0.63
Positive	3	3	
Epidural abscess			
Absent	1	0	0.47
Present	9	11	

$p < 0.05$ indicates statistical significance

minimum of 2 weeks of intravenous antibiotics (Table 5).

Follow-up was completed in all patients, except in 2 patients who died (one from cardiovascular event and the other from upper airway obstruction). After treatment, patient outcome was evaluated by Nurick Functional Scale or ASIA Impairment Scale. Of 21 patients included in this study, 8 (38.1%)

recovered, 6 (28.6%) had therapeutic failure, 7 (33.3%) had persistent symptoms, and 8 (38.1%) had improved symptoms at one month after surgical treatment.

Discussion

PS is an uncommon disease. The annual incidence of this disorder ranges from 0.2 to 2.0 cases per 100,000 people. Although rare, PS is the main

Table 5. Level of spinal involvement and treatment data

Patient no.	Location	Operative treatment	Antibiotic therapy
1	C	C3-4 ACCF with drainage	Ceftriaxone
2	C	C3-6 ACCF with occiput to T1 posterior fixation	Tazocin
3	C	C6-7 ACCF	Cefazolin
4	T	T7-10 laminectomy and T8-9 corpectomy with posterior fixation with PCD	Cefazolin
5	C	C6 ACCF	Ceftazidime + vancomycin
6	C	C3-4 ACCF	Cloxacillin
7	C	Transoral odontoidectomy with C2-4 laminectomy and occiput to C5 posterior fixation	Cloxacillin
8	C	C3-5 ACCF with C2-6 posterior fixation	Cefotaxime
9	C	C3-7 ACDF with C4 corpectomy	Ceftriaxone
10	M	C5 ACCF and T6-7, T9-12, L2-5 laminectomy with PCD	Ceftriaxone
11	L	L2, L5 laminectomy with debridement	Ceftazidime
12	T	T7-9 laminectomy with C5-6 ACCF	Levofloxacin
13	C	C3, 5, 7 laminectomy	Ceftriaxone
14	L	L4-5 laminectomy	Cefazolin
15	M	C7, T3, T8-9 laminectomy	Cefazolin
16	L	L4-5 corpectomy with posterior fixation	Fosfomycin
17	L	L2-3 laminectomy	Cefazolin
18	C	C3-4 ACCF with C5-6 ACDF	Ceftriaxone
19	M	C2-5 ACCF T6-7, 9-12, L2-5 laminectomy with PCD	Levofloxacin
20	C	C3-4 ACCF	Cefazolin
21	C	C4-5 ACCF	Meropenem

ACCF = anterior cervical corpectomy and fusion; ACDF = anterior cervical discectomy and fusion; C = cervical; L = lumbar; M = multiple; PCD = percutaneous drainage; T = thoracic

Table 6. ASIA Impairment Scale before and after operative treatment

		Postoperative ASIA Impairment Scale					Total
		A	B	C	D	E	
Preoperative ASIA Impairment Scale	A	3	2	0	0	0	5
	B	0	0	3	1	0	4
	C	0	0	7	0	2	9
	D	0	0	0	1	1	2
	E	0	0	0	0	1	1
Total	3	2	10	2	4	21	

manifestation of hematogenous osteomyelitis in patients aged over 50 years^(8,9). In our series, 76% of patients were older than 50 years (mean age 62), and 37.5% of patients older than 50 years had a hematogenous source.

In most patients with PS, disease is associated with other existing conditions (e.g., diabetes mellitus, chronic renal failure, cancer, and cirrhosis) or conditions that suppress the immune system (e.g., alcoholism,

intravenous drug abuse, and trauma). Diabetes mellitus is the most common related condition, being found in 33.3% of cases⁽¹⁰⁾. Only 28.6% of patients have no predisposing factor. Consistent with these previously reported findings, we had 7 patients (33.3%) with diabetes mellitus, 1 with chronic renal failure, and 2 with cirrhosis. The symptoms of spondylodiscitis are non-specific. Back and/or neck pain is very common, but up to 19% of patients may be pain-free. Fever is

less commonly presented, occurring in only about half of patients^(11,12).

In a study by Safak et al, back pain was the most common symptom, being reported in 90.7% of patients⁽¹³⁾. In the same study, fever was present in 28.9% of patients, and a varying degree of neurological deficits (weakness or mild dysesthesia) were observed in 12.1% of patients. In our study, back pain, neck pain, fever, and neurologic abnormalities were found in 8 (38.1%), 13 (61.9%), 10 (47.6%), and 20 (95.2%) patients, respectively (Table 2). Patients with no reported neck pain had significantly better outcome than patients that reported neck pain ($p = 0.046$).

PS develops in all regions of the spine, but the lumbar disc spaces are most frequently involved⁽¹⁴⁾. Previous study found the cervical area affected in 22% of patients, thoracic area in 23%, and lumbosacral area in 55%⁽¹⁵⁾. In our study, 4 (19%) patients had PS in the lumbar region, 2 (9.5%) in the thoracic region, and 12 (57.1%) in the cervical region of the spine. Epidural abscess was found in 25% of cases⁽¹⁶⁾. In this review, 20 (95%) patients had epidural abscess.

Elevated ESR and CRP are seen in over 90% of patients^(1,17,18). ESR is a sensitivity marker for infection, but it lacks specificity. All of the patients for whom ESR was measured in our study had elevated ESR. For CRP, 95.2% of the patients who were evaluated had increased CRP level. Decrease in postoperative ESR was significantly associated with clinical improvement ($p = 0.048$). A statistically significant difference was observed between pre-operative and postoperative CRP levels ($p = 0.041$).

Concerning the treatment strategy for spondylodiscitis, there is no clear consensus^(19,20). Antibiotic therapy without surgery was shown to be the best treatment for spondylodiscitis⁽²¹⁾. Surgery is reserved for decompression of neural structures, especially in cases with associated spinal epidural abscess or neural compression by reactive granulation tissue. Although an emergency operation is necessary when symptoms are progressing rapidly, it is important to evaluate the nature of the infection (pyogenic or tuberculosis) as accurately as possible^(20,22). In our study and in all of patients, operative treatment was performed to eradicate the infection, obtain tissue culture, restore and preserve the structure and function of the spine, and alleviate pain^(5,13).

A detailed review of surgical management was undertaken in this study. Surgery can improve clinical outcome. All complete cord patients had improvement after surgical decompression. For incomplete cord

patients, 10 (62.5%) of 16 patients were improved, but overall improvement was not significant ($p = 0.262$). After surgery, better ASIA Impairment Scale was observed in 9 patients and persistent ASIA Impairment Scale in 12 patients (Table 6).

Debridement with instrumentation was performed in 16 cases in this study due to instability caused by disc and bone destruction and erosion. Instrumentation after debridement has gained wide acceptance in the setting of concomitant infection. Retrospective study revealed greater improvement in patients with posterior instrumentation than in those without instrumentation^(23,24). In this study, patients who underwent instrument implantation had two times better improvement than patients who did not; however, there was no statistical significance ($p = 0.262$).

The overall attributable mortality varies across reports, but likely stands somewhere between 2 and 11%^(18,25). Up to 16% of patients experience recurrence of infection, particularly those who are immunosuppressed^(25,26).

In all cases of this series, antibiotic therapy based on laboratory confirmation of causative pathogens was given and improvement was observed. Our 2 patients who did not survive died as a result of other severe systemic illnesses in one and upper airway obstruction in one.

Limitations of this study included small sample size and lack of a non-operative or conservative treatment group for comparison.

Conclusion

There should be a high index of clinical suspicion for PS in patients who present with increased inflammatory markers in the blood and local tenderness or pain in the spinal region. In cases with severe neurological deficit, surgical debridement followed by antibiotic therapy is the most effective treatment.

What is already known from this topic?

PS can be diagnosed by clinical manifestation, blood examination, inflammatory markers and radiographic images. The appropriate treatment of PS includes surgical intervention with antibiotic therapy.

What this study adds?

Surgical debridement and decompression with or without spinal instrumentation is mandatory treatment for PS. Operation can improve neurological outcome, even in cases with complete neurological

deficits.

Potential conflicts of interest

None.

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ผลการผ่าตัดรักษาการติดเชื้อของกระดูกสันหลังและหมอนรองกระดูกสันหลัง

ชุมพล คัคณานต์, หล้าชัย พลวิจิตร

ภูมิหลัง: การติดเชื้อของกระดูกสันหลังและหมอนรองกระดูกสันหลังเป็นโรคที่พบได้ไม่บ่อยและวินิจฉัยได้ยาก การรักษาโดยทั่วไป ได้แก่ การผ่าตัดตามด้วยการให้ยาปฏิชีวนะ

วัตถุประสงค์: เพื่อค้นหาปัจจัยเสี่ยงที่ทำให้เกิดโรค ชนิดของเชื้อก่อโรค อาการและอาการแสดง ผลการตรวจทางห้องปฏิบัติการ ภาพวินิจฉัยทางรังสีวิทยา และผลการผ่าตัดรักษาในผู้ป่วยโรคนี้

วัสดุและวิธีการ: คณะผู้พันธ์ได้ทำการสืบค้นจากเวชระเบียนเพื่อค้นหาผู้ป่วยในช่วงระหว่างเดือนมกราคม พ.ศ. 2555 ถึงเดือนตุลาคม พ.ศ. 2558 ที่โรงพยาบาลศิริราช พบผู้ป่วยที่ได้รับการวินิจฉัยว่ามีโรคติดเชื้อของกระดูกสันหลังและหมอนรองกระดูกสันหลังจำนวน 21 ราย ผู้ป่วยทุกรายได้รับการรักษาโดยการผ่าตัดและให้ยาปฏิชีวนะ

ผลการศึกษา: ผู้ป่วยจำนวนทั้งสิ้น 21 ราย ผู้ชาย 13 ราย ผู้หญิง 8 ราย อายุระหว่าง 24 ถึง 85 ปี (เฉลี่ย 61.9 ปี) ผู้ป่วย 5 ราย มีอาการอัมพาตของขาทั้งสองข้างตั้งแต่แรก อาการแสดงที่พบบ่อยคืออาการปวดกระดูกสันหลังและอาการแขนขาอ่อนแรง ระดับของกระดูกสันหลังที่เป็นโรค ได้แก่ กระดูกสันหลังส่วนคอ 12 ราย กระดูกสันหลังส่วนอก 2 ราย กระดูกสันหลังส่วนเอว 4 รายและกระดูกสันหลังหลายส่วน 3 ราย ผู้ป่วยทุกรายมีการเพิ่มขึ้นของระดับ ESR และ CRP ผลการเพาะเชื้อที่ได้จากการผ่าตัดสามารถพบเชื้อก่อโรคได้สูงถึงร้อยละ 71 เชื้อก่อโรคที่พบบ่อยที่สุดคือ *Staphylococcus spp.* ผู้ป่วยทุกรายมีอาการดีขึ้นหลังการรักษา ยกเว้นผู้ป่วย 2 รายที่เสียชีวิตจากโรคแทรกซ้อนอื่น

สรุป: ควรคิดถึงโรคนี้เสมอในผู้ป่วยที่มีอาการปวดที่บริเวณกระดูกสันหลังร่วมกับการเพิ่มขึ้นของ ESR และ CRP และในผู้ป่วยที่มีอาการแขนขาอ่อนแรง การรักษาด้วยการผ่าตัดตามด้วยการให้ยาปฏิชีวนะเป็นการรักษาที่ได้ผลดีที่สุด
