

The Safety and Decision Making of Instrumented Surgery in Infectious Spondylitis

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Objective: Infectious spondylitis is mostly managed by appropriate antibiotic treatment options, and some patients may require surgical interventions. However, surgical interventions that use spinal instrumentation to correct the mechanical instability may be associated with the risk of an increase in the recurrence rate. In this study, we investigated whether spinal instrumentation effects on recurrence of infectious spondylitis.

Methods: The study was conducted as a retrospective study by dividing the subjects into the noninstrumentation surgery and instrumentation surgery groups among a total of 95 patients who had received surgical interventions in infectious spondylitis from 2009 to 2014. The study investigated patient variables such as underlying illness, presumed source of infection, clinical data, laboratory and radiological data, and ultimate outcome, and compared them between the 2 groups.

Results: In the 95 patients, instrumentation was not used in 21 patients but it was used in 74 patients. When the disease involved ≥ 3 vertebral bodies, lumbosacral level and epidural part, noninstrumentation surgery was mainly conducted, but when the disease involved the thoracic level and psoas muscle part, instrumentation surgery was mainly conducted. However, there were no differences between the 2 groups in terms of the recurrence rate and the incidence of primary failure.

Conclusion: The use of instrumentation in treating infectious spondylitis was determined by the level of involvement and part of the infection, but the use of instrumentation did not cause any increases in the recurrence rate and the incidence of primary failure.

Key Words: Infectious spondylitis · Instrumented surgery · Recurrence rate · Primary failure

INTRODUCTION

Antibiotics, bed rest, and general supportive care are the main treatment options in infectious spondylitis³. The indications for surgical treatment include failure of medical management with progressive sepsis, persistent local abscess, progressive neurologic loss, and progressive deformity⁴. Ideally, before surgical stabilization is attempted, the infectivity of local infection should be controlled through antibiotic therapy.

Surgical debridement with spinal instrumentation relieves pain, improves sagittal balance and recovery of neurological function, and result in early ambulation⁵. Nevertheless, use of instrumentation to treat infectious spondylitis can increase the recurrence rate as the bacteria remain adhered to the foreign

material. Therefore, some authors emphasize implementation of instrumentation surgery after performing antibiotic therapy for 6–8 weeks in patients with infectious spondylitis^{7,9,13}.

Therefore, we compared and analyzed noninstrumented surgery and instrumented surgery to determine whether early instrumented surgery has an impact on primary failure or recurrence in patients with infectious spondylitis.

MATERIALS AND METHODS

The study was conducted as a retrospective study in a total of 155 patients who had received surgical interventions in infectious spondylitis from 2009 to 2014. Inclusion criteria were the patients who had received surgery and who had used antibiotics within 2 week since they were diagnosed with infectious spondylitis. Sixty patients were excluded as they had incomplete records, received treatment with antibiotics for ≥ 2 weeks, and were transferred to another hospital before completing antibiotic therapy. Therefore, this study was performed in a total of 95 patients.

Medical records were reviewed retrospectively for dates such as demographic information, underlying illness/conditions, presumed source of infection, clinical presentation, laboratory and radiological data, medical and surgical treatments, and clinical outcomes. During the study period, antibiotic regimen and dura-

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tion of therapy were determined by infectious disease specialists based on the culture results.

Instrumentation surgery was defined as surgery that involved the use of implanted devices, including titanium cages, plates, screws, rods, and hooks. The level of involvement due to infection and the part were investigated through a contrast-enhanced magnetic resonance imaging.

Clinical outcomes were evaluated by using the information on infection-related death, primary failure, and recurrence. Infection-related death was defined as in-hospital death related to the infection or to its treatment. Primary failure was defined as patients who needed another episode of surgical debridement after surgical intervention before the completion of antibiotic treatment because of signs of uncontrolled infection. Recurrence was defined as patients with recurrent symptoms

and signs after the completion of antibiotic therapy and who received a second course of parenteral antibiotic treatment¹².

All statistical analyses were performed using the IBM SPSS ver. 18.0 (IBM Co., Armonk, NY, USA). Categorical variables were compared using chi-square or Fisher exact tests. Continuous variables were compared using Student t-test or Mann-Whitney U-test. A p-value ≤ 0.05 was considered to indicate statistical significance.

RESULTS

In the 95 patients with infectious spondylitis, surgical debridement alone (noninstrumented surgery) was conducted in 21 patients, while surgical debridement with spinal instrumenta-

Table 1. Characteristics of the 95 patients with infectious spondylitis who underwent noninstrumented surgery and instrumented surgery

Variable	Noninstrumented surgery (n=21)	Instrumented surgery (n=74)	p-value
Age (yr)	64.76±12.49	65.51±13.46	0.710
Male sex	7 (33.3)	42 (56.8)	0.083
Transfer from an outside hospital	5 (23.8)	18 (24.3)	1.000
Underlying illness/conditions			
Hypertension	6 (28.6)	32 (43.2)	0.314
Diabetes mellitus	7 (33.3)	19 (25.7)	0.581
Malignancy	3 (14.3)	13 (17.6)	1.000
Rheumatic disease	1 (4.8)	3 (4.1)	1.000
End-stage renal disease	1 (4.8)	3 (4.1)	1.000
Immunosuppression	0 (0)	1 (1.4)	1.000
Smoking	2 (9.5)	11 (14.9)	0.726
Alcohol	4 (19.0)	7 (9.5)	0.253
Presumed source of infection			
Urinary tract	2 (9.5)	8 (10.8)	0.827
Skin and subcutaneous tissues	0 (0)	1 (1.4)	
Intraabdomen	0 (0)	3 (4.1)	
Endocarditis	0 (0)	2 (2.7)	
Unknown	15 (71.4)	52 (70.3)	
Postoperative infection	3 (14.3)	5 (6.8)	
Other concurrent metastatic infection	1 (4.8)	3 (4.1)	
Clinical data			
Time to diagnosis median days	11.57±13.62	12.80±10.22	0.296
Body temperature >38°C	12 (57.1)	31 (41.9)	0.227
Neurological deficit	8 (38.1)	31 (41.9)	0.806
Laboratory data			
White blood cell count ($\times 10^9/L$)	9,379.52±3,769.78	9,763.51±3,996.59	0.641
C-reactive protein (mg/dL)	56.62±52.33	76.15±68.10	0.817
Erythrocyte sedimentation rate (mm/hr)	73.71±29.53	74.67±29.55	0.228
Positive blood cultures	4 (19.0)	18 (24.3)	0.773
Positive biopsy cultures	10 (47.6)	43 (58.1)	0.459

Values are presented as mean±standard deviation or number (%).

tion (instrumented surgery) was conducted in 74 patients.

Factors such as age, sex, and underlying illness/conditions did not show any differences. With respect to the presumed source of infection, it was mostly unknown in the 2 groups, and infections occurred in the sequence of urinary tract infection and postoperative infection, but there were no statistical differences. The incidence of fever and neurological deficit also showed no statistical differences. Blood culture and biopsy culture also showed no statistical differences between the 2 groups (Table 1).

The surgical methods showed statistical differences depending on the location and the extent of lesion. In case of multiple lesions involving more than 3 levels, 12.2% of the patients received instrumented surgery, while 47.6% of the patients received noninstrumented surgery ($p=0.001$). Also, 95.2% of the noninstrumented surgeries were performed in the lumbosacral spine, whereas 21.6% of the instrumented surgeries were performed in the thoracic spine and 60.8% of the instrumented surgeries were performed in the lumbosacral spine, indicating the difference between the 2 groups. Also, 90.5% of the cases showed presence of epidural abscess and noninstrumented surgery was mainly performed ($p<0.001$). Further, 55.4% of the cases showed presence of psoas muscle abscess and instrumented surgery was mainly performed ($p=0.006$) (Table 2).

With respect to the clinical outcome, the incidences of infection-related death, recurrence, and primary failure in the noninstrumented surgery group were 9.5%, 4.8%, and 9.5%, while the corresponding incidences in the instrumented surgery group were 2.7%, 9.5%, and 1.4%, respectively, showing no differences between the 2 groups (Table 2).

DISCUSSION

Appropriate antibiotic therapy is the most prioritized treatment for infectious spondylitis; however, upon the event of abscess formation, unresponsiveness to antibiotics, intolerable pain, and presence of neurological deficit, surgical intervention may be required^{8,10}. Surgical debridement and spinal instrumentation is used to correct the spinal instability, but it plays a role of a foreign material which enables the existence of bacteria by adhesion to the material, potentially resulting in the occurrence of primary failure and recurrence¹².

Depending on the level of involvement and part of the infection, differences were observed between the noninstrumented surgery group and the instrumented surgery group.

When more than 3 vertebral bodies were involved or there were lesions in the lumbosacral and epidural space, noninstrumented surgery was mainly performed, whereas, when there was a thoracic lesion and a psoas muscle lesion, instrumented surgery was mainly performed.

In a recent systematic review of 30 studies, when instrumented surgery was performed for treating infectious spondylitis, implant removal was undertaken in 12 of the 689 patients with infection recurrence, resulting in the reported recurrence rate of 1.74%¹⁴. In addition, a recent study compared the noninstrumented surgery and the instrumented surgery groups in hematogenous vertebral osteomyelitis. The noninstrumented surgery group showed a recurrence rate of 4.8%, and the incidence of primary failure was 1.1%, and the instrumented surgery group showed a recurrence rate of 9.5%, and the incidence of primary failure was 1.4%. They did not show any

Table 2. Radiological data and clinical outcome in patients with infectious spondylitis who underwent noninstrumented surgery and instrumented surgery

Radiological data	Noninstrumented surgery (n=21)	Instrumented surgery (n=74)	p-value
Involvement levels			
Involvement of ≥ 3 vertebral bodies	10 (47.6)	9 (12.2)	0.001*
Involvement of the cervical spine	0 (0)	4 (5.4)	0.572
Involvement of the thoracic spine	0 (0)	16 (21.6)	0.019*
Involvement of the thoracolumbar spine	1 (4.8)	9 (12.2)	0.450
Involvement of the lumbosacral spine	20 (95.2)	45 (60.8)	0.003*
Involvement parts			
Epidural involvement	19 (90.5)	27 (36.5)	<0.001*
Paravertebral involvement	5 (23.8)	14 (18.9)	0.758
Psoas muscle involvement	4 (19.0)	41 (55.4)	0.006*
Outcomes			
Infection-related death	2 (9.5)	2 (2.7)	0.211
Primary failure	2 (9.5)	1 (1.4)	0.122
Recurrence	1 (4.8)	7 (9.5)	0.680

Values are presented as number (%).

* $p<0.05$, statistically significant difference.

statistical intergroup differences¹²). In our study also, the recurrence rate and the incidence of primary failure did not show any statistical intergroup differences. Rather, in the instrumented surgery group, the incidence of primary failure tended to reduce up to 1.4%.

There is some evidence that asymptomatic colonization of bacteria on the surface of an implant is common and that clinically relevant recurrence after placement of an implant is rare^{6,15}). In a recently developed canine model, bacteria were detected on retrieved spinal implants as well as on the surrounding bone in 80% of animals that underwent instrumentation surgery, using a pyrosequencing method; however, no radiological or macroscopic sign of infection recurrence was observed in any animal⁶). Thus, despite the colonization of bacteria on the implant surface after instrumented surgery, these bacteria seem to be controlled by host immunity, and most patients do not experience a clinical recurrence. In addition, another study observed the prognosis of 24 patients in whom instrumented fusion was performed for infectious spondylitis, for about 10 years. As a result, only 1 patient (4.2%) showed recurrent infection⁴). Also, in 7 cases of implant removal or autopsy, no case of gross, microscopic, culture, or polymerase chain reaction evidence of residual infection or occult colonization was observed⁴).

That patient did not have spinal infection previously, but after having undergone spinal instrumentation, the infection rate was reported as 3.7%–9%^{1,11}). Also, in infectious spondylitis, various recurrence rates ranging from 1.7% to 15.3% were reported after spinal instrumentation^{2,4,12}). In our study, the recurrence rate was 9.5%, which was similar to the recurrence rate in the other study. In addition, our study showed a similar recurrence rate to that in the patients with no spinal infection but who had undergone spinal instrumentation. This finding implies that spinal instrumentation cannot be considered as a substantial risk factor for the recurrence rate.

Our study had several limitations. First, as a retrospective study, the data was incomplete and the decision regarding the treatment method was not consistent. Secondly, as a single center study, it included a less number of patients who received noninstrumentation surgery compared to the number of patients who received instrumentation. It is necessary to perform a comparative analysis through a prospective and multicenter study in the future.

CONCLUSION

In conclusion, the surgical treatment method was determined by the level of involvement and the part of instrumentation for infectious spondylitis, but there were no differences in terms of the incidence of primary failure and recurrence rate. When spinal stability is required in patients with infectious spondylitis, it would be useful to perform instrumented surgery for treatment in the future.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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