CLINICAL ARTICLE

J Korean Neurosurg Soc 38 : 445-449, 2005

Prognostic Factors of Pyogenic Spinal Infections

Young-Jin Jung, M.D., Sang-Woo Kim, M.D., Chul-Hoon Chang, M.D.,
Seong Ho Kim, M.D., Oh Lyong Kim, M.D., Soo-Ho Cho, M.D.

Department of Neurosurgery, College of Medicine, Yeungnam University, Daegu, Korea

Objective : This study is performed to evaluate the clinical manifestations and prognostic factors among patients with pyogenic spinal infections.

Methods : The records and radiologic data of 27 patients treated between 2001 and 2003 were retrospectively evaluated.

Results : All patients (mean age, 55.2yrs) were treated with i.v. antibiotics and 13(48.1%) required surgical treatment. Mean follow up duration was 38.9 weeks. The sixteen patients(59.2%) had previous surgical procedure on spine and six patients(22.0%) had local injections. The ten patients had predisposing factor (such as, diabetes mellitus, UTI, liver cirrhosis, septic condition). The most common symptoms are lower back pain and motor weakness. Causative organisms determined only in ten patients(37%) and Staphylococcus aureus(50%) was most common. C-reactive protein(CRP) and white blood cell(WBC) count were more correlated with clinical outcome than erythrocyte sedimentation rate(ESR).

Conclusion : CRP and WBC level can be significant parameters of treatment and prognosis in pyogenic spinal infection.

KEY WORDS : Pyogenic spinal infection · WBC · CRP.

Introduction

Evidence of infectious disease in the spine has been found in Egyptian and South American mummies[9]. Since then, these have afflicted humans. With the development of an antimicrobial drug, the fatalities caused by this disease have diminished[6], but the occurrence of the disease has increased in people of old age and immunocompromised patients; these have also been an overuse of antimicrobial drugs and surgical procedures[23]. This is a retrospective study evaluating the clinical manifestations, bacteriology and prognostic factors for outcome among 27 patients with a pyogenic spinal infection during the past 3 years.

Materials and Methods

This study is a retrospective investigation of 27 patients treated for pyogenic spinal infection in department of neurosurgery at Yeungnam university hospital from January 2001 to December 2003.

It was conducted through the review of clinical records and imaging studies. The mean follow up period was 38.9 weeks. Suspicious lesion was obtained through a computed tomographic-guided percutaneous biopsy or surgical exploration.

General clinical condition and vital sign were observed, and cultures were analyzed, as well as results of hematologic studies, such as WBC, ESR and CRP. Computerized tomography(CT), magnetic resonance image(MRI) and plain radiography were reviewed by a radiologist.

All cases, antibiotics included 3rd cephalosporin and aminoglycoside were used, in both intravenous and oral forms. Antibiotics treatment usually involved 6~8 weeks of intravenous followed by several weeks of oral administration. Outcome was assessed by using the Macnab's criteria[20].

Results

This study included 17(63%) male and 10(37%) female patients from 19 to 74 years of age(mean 52.2 years). There was greater distribution in those of 40 to 70 years.

Most of the spinal infections occurred in the lumbar spine (25 cases), other were 1 cervical and 1 thoracolumbar spine. The common symptom was lower back pain(24 cases), others are motor weakness(3 cases)(Table 1).

• Received : March 2, 2005 • Accepted : July 11, 2005

• Address for reprints : Sang-Woo Kim, M.D., Department of Neurosurgery, College of Medicine, Yeungnam University, 317-1 Daemyeong-dong, Nam-gu, Daegu 705-717, Korea Tel : +82-53-620-3790, Fax : +82-53-620-3770, E-mail : sw902@yumail.ac.kr

Table 1. Location and symptoms (n=27)

	Number of patients
Level	
Cervical	1(3.7%)
Thoracic	0(0%)
Thoraco-Lumbar	1(3.7%)
Lumbar	25(92.6%)
Symptoms	
Lower back pain	24(89.0%)
Motor weakness	3(11.0%)

Table 2. Predisposing factors (n=27)

Risk factor	Number of patients
Diabetes mellitus	4
Liver cirrhosis	2
Urinary tract infection	3
Septic condition	1
Chronic renal failure	0
Smoking	6
Alcoholism	6
None	5

On the review of past medical history, the underline factors that had association with spinal infection were diabetes(4 cases), chronic liver disease(2 cases), urinary tract infection(3 cases), septic condition(1 case), smoking(6 cases) and heavy alcoholics(6 cases)(Table 2).

16 cases had previous spine operation history and 6 cases had history of epidural steroid injection or acupuncture due to chronic back pain, and 5 cases there were no evidence of surgical procedure or intervention(Table 3).

13 cases, underwent surgical debridement and curettage. We used closed suction-irrigation system for continuous perfusion of antibiotics in some cases. In other 14 cases, we used only antibiotics without surgical exploration. Neurological recovery was obtained in 17 cases. Pain was partially resolved in 7 cases, and there were no symptomatic changes in 2 cases. The symptoms grew worse in 1 case(Table 4).

Organism was cultured in 6/13 cases(45%) via surgical biopsy, and in 3/14 cases (21%) via percutaneous biopsy. The culture rate of the surgical biopsy was higher than percutaneous biopsy, but there was not a statistical significance(Table 5).

Empirical antibiotics was used with the third generation cephalosporin and aminoglycoside until a causative organism was cultured. When an antibiotics resistant microbe was cultured, we changed the antibiotics to vancomycin. In 3 cases which did not respond with antibiotics and did not culture an organism, we changed the antibiotics to vancomycin. The period of intravenous antibiotics depended on the leukocyte count and the level of CRP. The mean period of antibiotics treatment involved 25.6 days of i.v. followed by 34.9 days of oral administration.

Table 3. Probable source of infection (n=27)

	Number of patients
Skin and soft tissue	1
Urinary tract infection	1
Spinal procedure	16
Local injection	6
No source identified	3

Table 4. Outcome result (n=27)

Symptoms	Outcome				Total
	Excellent	Good	Fair	Poor	
Motor weakness	0	2	0	1	3
Pain	17	5	2	0	24

Excellent : No pain, no restriction of activity occasional back pain or leg pain of sufficient severity to interfere with the patient's ability to do normal work or capacity to enjoy leisure hours, Good : Improved functional capacity, but handicapped by intermittent pain of sufficient severity to curtail or modify work or leisure activity, Fair : No improvement or insufficient improvement to enable Poor : Increase in activities, further operative intervention required

Table 5. Microbiology findings

	Open biopsy/Total	Percutaneous biopsy/Total
No growth	7/13 (55%)	11/14 (79%)
Growth	6/13 (45%)	3/14 (21%)
S. aureus	3	2
S. Epidermidis	1	0
Streptococcus	0	1
Salmonella	1	0
Candida	1	0

The results of the hematologic studies in excellent/good-outcome group(n=24), leukocyte count and CRP level were decreased during the antibiotics treatment, but the ESR level was not decreased in spite of an improvement in clinical symptoms(Fig. 1). In a comparison of WBC counts during Week 4~5 and Week 8~9 after i.v. antibiotics treatment for the patients with excellent/good versus fair/poor outcomes, significant differences ($P<0.05$, Mann-Whitney U test, Fig. 2) were observed. And the fair/poor-outcome group exhibits significantly ($P<0.05$, Mann-Whitney U test) higher CRP levels compared with the excellent/good-outcome group during 3~6 weeks (Fig. 3).

Discussion

Spinal infection can be divided greatly in spontaneous and iatrogenic, it can be divided in tuberculous and pyogenic, to be categorized based on their anatomical locus as osteomyelitis, diskitis, epidural abscess[13].

Spinal infection makes ends meet through three kinds of passes. First, it is moved to the vascular that it is in inflammation disorder and infection, pneumonia, laryngitis, drug abuse, furuncle or abscess of skin[2,10,26]. Second, there is case getting a direct spread from such as tumor in psoas muscle, pyelonephritis. Lastly, it can be sorted in infection by spinal surgery,

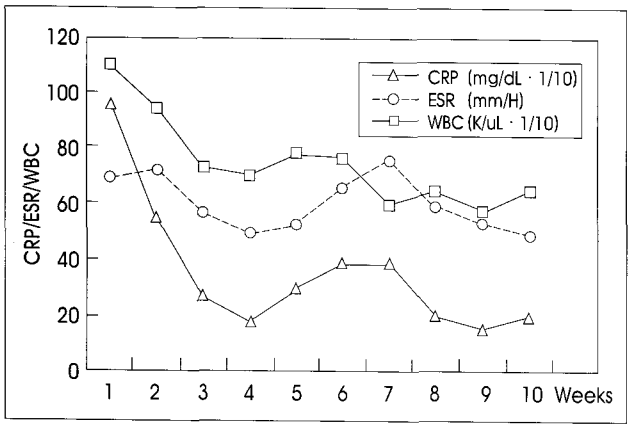

Fig. 1. Time course of CRP/ESR/WBC in excellent/good-group (n=24). CRP : C-reactive protein(mg/dL), ESR : Erythrocyte sedimentation rate(mm/H), WBC : White blood cell(K/uL).

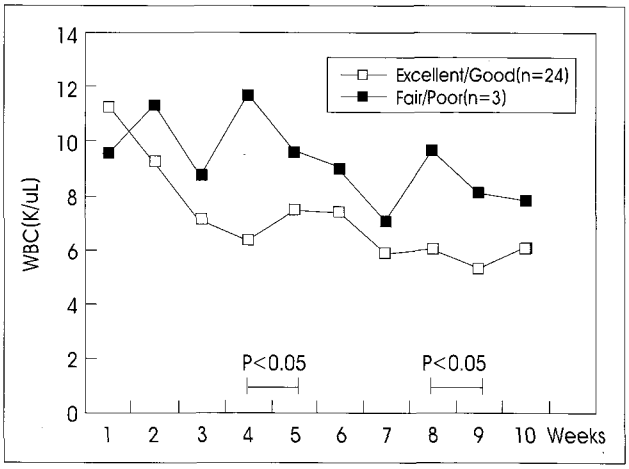

Fig. 2. Difference of time course of WBC count between the excellent/ good cases and fair/poor cases. The fair/poor group exhibits significant (P<0.05, Mann-Whiney U test) higher WBC count compared with the excellent and good cases. WBC : White blood cell (K/uL).

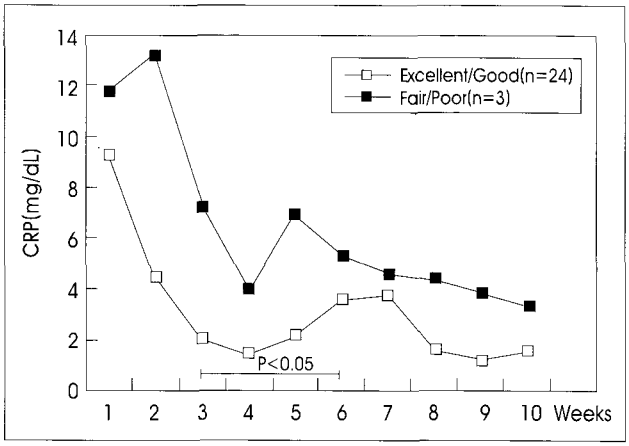

Fig. 3. Difference of time course of CRP between the excellent/ good group and fair/poor group. The fair/poor group exhibits significant (P<0.05, Mann-Whiney U test) higher CRP level compared with the excellent/good group. CRP : C-reactive protein(mg/dL).

spinal anesthesia, spinal puncture, and epidural steroid injection[1,4,18,19,26]. Hematogenic transference is apt to be most.

The incidence and demographics of pyogenic spinal infection have been significant influenced by change in social behavior, and advances in medical technology[14]. The incidence of spinal infections appears to be on the rise[18,19,26], and this trend is particularly seen in the Korean community[12,29].

The incidence of epidural abscess was estimated to be around 0.2 to 2 per 10,000 hospital admissions. Kim reveals the spinal infection rate after an instrument was used to be 4%[16]. These days, a higher frequency is seen[3,11].

Chronic use of the steroid, chronic renal insufficiency, immunosuppression, smoking, and obesity elevate the risk of spinal infection[8,11,14,17]. In the West, acquired immunity deficiency is a serious case and infection by drug intoxication is the most common risk factor for a pyogenic spinal infection[22,24]. However, in Korea, long term steroid, Chinese medicine, and folk medicine are the most common risk factors[29].

For patient who had no risk factors, we thought the procedure (epidural steroid injection, acupuncture) was the cause of the spinal infection. Except tuberculous, the primary spinal infection was only 5(19%) cases. After an invasive procedure, iatrogenic infections were seen in 22(81%) cases. Pyogenic spondylitis is more common in men in the forties. It is more commonly found in lumbar spine[7,8,11,14]. This study have same trend. Clinical features of pyogenic spinal infection can be back pain, fever and motor weakness[11,14]. There were many cases where the chief complaint was back pain and disturbance of motility. Unlike other infections, it is thought that leukocytosis and fever did not accompany the spinal infections, on the other hand ESR was elevated in 92% of the cases[8,11].

In this study, leukocytosis was found in 16 cases(59%), but the ESR was increased in 20 cases(75%). This may have been because the patients had already undergone antimicrobial drug therapy, they had been transferred to a third hospital after a radiologic diagnosis. A decrement in the death ratio was caused by exploration skill and the development of appropriate antimicrobial drugs, mortality rate about 5~20% is still high. In spite of no fatalities in this study, 3 cases(11%) were not able to return to work.

Most commonly found bacteria in a spinal infection are S. aureus, and other gram-positive organism such as S. epidermidis, S. viridans, S. pneumoniae, S. faecalis. Gram-negative organism such as E. coli, Pseudomonas, Salmonella, Enterobacter, Klebsiella, Haemophilus[2,4,10,13,26]. A microbial cultivation survey did not have high percentages in this study, methicillin resistance S. aureus were seen in most cases. Candida and salmonella were each found in one case that was cultured. When a strain is not understood, we doubted that causative organism was staphylococcus and empirical antibiotics was given. After the causative organism was determined and we then changed to the appr-

opriate antibiotics[3,7,28].

When a spinal infection looks suspicious, blood culture and infection site biopsy must be taken to identify the causative organism. According to the record[13], blood cultures are positive only 30~60%, using a CT or fluroscopic guidance can increase the success rate[5,13].

When organization taken during the operation, it was incubated rate was higher, but only 46% remained. In the percutaneous biopsy, 21% were cultured. This is not a technical problem, but it is thought to be the attitude of the doctor toward the patient. When it is not an emergency situation, the causative organism may be isolated first using multiple methods[3,7,13,28], but in many cases intravenous antibiotics are administered before a culture is taken[15].

Concern to the treatment for pyogenic spinal infections, it is very hard to make a decision, whether the patients really sensitive to the antibiotics or resistant to the antibiotics. The efficacy of medical management can be gauged by diminishing pain, malaise, and fever and a decrease of in the ESR and CRP. Medical treatment is finished when, ESR level drop to 2/3 of their initial level and CRP is a normal range[6]. When generally there is only abscess, use some documents for four weeks, that were reported when it was used to eight weeks when there was to osteomyelitis[3,7,28]. The efficacy of treatment in our study was gauged by clinical improvement, lack of leukocytosis, and CRP level that stayed in the normal range for more than a week. The intravenous antibiotics were used for 4 days minimum, 66 days maximum(mean 25.6 days), Oral antimicrobial drugs accompanied the patients for a mean of 34.9 days(7~176 days). When there is no reaction to empirical antibiotics without definite culture and sensitivity are obtained. It is too difficult to make a treatment plan. In this cases, we change antibiotics to vancomycin, but this causes an economic problem for patients and an insurance problem for doctors. Antimicrobial drug was change in 3 cases to vancomycin without being cultured, in these cases there were no improvement of in clinical and laboratory studies despite more than 4weeks of intravenous antibiotics therapy.

Age, neurologic deficit, nerve compression degree before surgery and operative findings influences a patient's outcome[14]. Tang et al.[27] reveal that thrombocytopenia and ESR level was higher than 110mm/h associated with poor outcome. Martin et al.[21] watched inflammatory marker such as WBC count and CRP as prognostic factors for the outcome. In this study, leukocyte count value and CRP level are decreased with time, but ESR does not have changed(Fig. 1). And significant differences of WBC count and CRP level(Fig. 2, 3).

Therefore, it is thought that leukocyte count value and tracing the observation of CRP level is necessary to predict the therapeutic response.

Conclusion

In pyogenic spinal infection, CRP and WBC level can be significant parameters of treatment and prognosis in pyogenic spinal infections.

• Acknowledgement
This research was supported by the Yeungnam University research grants in 2004.
This study was presented during the annual meeting of Korean Spinal Neurosurgery Society.

References

1. Abdel-Magid RA, Kotb HI : Epidural abscess after spinal anesthesia : a favorable outcome. **Neurosurgery 27** : 310-311, 1990
2. Altrochi PH : Acute transverse myelopathy. **Arch Neurol 168** : 111-119, 1963
3. Barker AS, Ojemann RG, Swartz MN, Richardson EP Jr. : Spinal epidural abscess. **N Engl J Med 293** : 463-468, 1975
4. Bergman I, Wald ER, Meyer JD, Painter MJ : Epidural abscess and vertebral osteomyelitis following serial lumbar puntures. **Pediatrics 72** : 476-480, 1983
5. Chew FS, Kline MJ : Diagnositc yield of CT-guided percutaneous aspiration procedures in suspected spontaneous infectious diskitis. **Radiology 218** : 211-214, 2001
6. Crenshaw AH : Campbell's Operative Orthopedics. 8th ed., **Saint Louis** : The CB Mosby company, 1992, pp3802-3823
7. Danner RL, Hartman BJ : Update on spinal epidural abscess; 35 cases and review of the literature. **Rev Infect Dis 9** : 265-274, 1987
8. Del Curling O Jr, Gower DJ, McWhorter JM : Changing concepts in spinal epidural abscess : A report of 29 cases. **Neurosurgery 27** : 185-192, 1990
9. Gerszten PC, Gerszten E, Allison MJ : Diseases of the spine in South American mummies. **Neurosurgery 48** : 208-213, 2001
10. Heusner AP : Nontuberculous spinal epidural infection. **N Engl J Med 239** : 845-854, 1948
11. Hlavin ML, Kaminski JH, Ross JS, Ganz E : Spinal epidural abscess : A-ten-year perspective. **Neurosurgery 27** : 177-184, 1990
12. Hwang GJ, Kuh SU, Chin DK, Cho YE, Kim YS : Management of wound infection after lumbar spine fusion with instruments. **J Korean Neurosurg Soc 35** : 36-41, 2004
13. H. Richard W : Younmans Neurological Surgery, 5th ed. Philadelphia : **Saunders**, 2004, pp4363-4394
14. Khanna RK, Malik GM, Rock JP, Rosenblum ML : Spinal epidural abscess : evaluation of factors influencing outcome. **Neurosurgery 39** : 958-964, 1996
15. Kim H, Oh SH, Choi IS, Bak KH, Kim YS, Kim CH, et al : Acute panspinal epidural abscess. **J Korean Neurosurg Soc 28** : 392-397, 1999
16. Kim HC, Kim CH, Cheong JH, Kak KH, Kim JM, Oh SJ, et al : Instrument-related complications following lumbar trandpedicular screw fixation. **J Korean Neurosurg Soc 31**: 533-539, 2002
17. Kim JH, Lim SJ, Cho TH, Park JY, Lee HK, Suk JK, et al : Clinical analysis of re-operation after thoracic and lumbar spinal fusion surgery. **J Korean Neurosurg Soc 31** : 107-112, 2002
18. Koppel BS, Tuchman AJ, Mangiardi JR, Daras M, Weitzner I : Epidural spinal infection in intravenous drug abusers. **Arch Neurol 45** : 1331-1337, 1988
19. Loarie DJ, Fairley HB : Epidural abscess following spinal anesthesia. **Anesth Analg 57** : 351-353, 1978
20. Macnab I : Nagtive disc esploration. An analysis of the cause of nerve-root involvement in sixty-eight patients. **J Bone Joint Surg 53A** : 891-903, 1971
21. Martin S, Thomas W : Spinal epidural abscesses : Clinical manifestations, prognostic factors, and outcomes. **Neurosurgery 51** : 79-82, 2002
22. Messer HD, Litvinoff J : Pyogenic cervical osteomyelitis. Chondro-osteomyelitis of the cervical spine frequently associated with parenteral drug use. **Arch Neurol 33** : 571-576, 1976

23. Park SB, Lee KC, Park YS, Lee BY, Kang S : A case of spontaneous spinal epidural abscess. **J Korean Neurosurg Soc 22** : 551-557, 1993
24. Rigamonti D, Liem L, Sampath P, Knoller N, Namaguchi Y, Schreibman DL, et al : Spinal epidural abscess : Contemporary trends in etiology, evaluation, and management. **Surg Neurol 52** : 189-196, 1999
25. Sarrel WG, Lafia DJ : Acute lumbar epidural abscess : report of a case. **Engl J Med 250** : 318-320, 1954
26. Strong WE : Epidural abscess associated with epidural catheterization : A rare event? Report of two cases with markedly delayed presentation. **Anesthesiology 74** : 943-946, 1991
27. Tang HJ, Lin HJ, Liu YC, Li CM : Spinal epidural abscess-experience with 46 patients and evaluation of prognostic factors. **J Infect 45** : 76-81, 2002
28. Verner EF, Musher DM : Spinal epidural abscess. **Med Clin North Am 69** : 375-384, 1985
29. Yang TK, Kim KS, Lee JC : Chronic spinal epidural abscess after epidural analgesia. **J Korean Neurosurg Soc 33** : 599-601, 2003