Original Article

J Chin Med Assoc
2004;67:398-402

Postoperative Spinal Deep Wound Infection: A Six-year Review of 3230 Selective Procedures

Chia-Hsiao Kuo[1]
Shih-Tein Wang[1]
Wing-Kuang Yu[1,2]
Ming-Chau Chang[1,2]
Chien-Lin Liu[1,2,3]
Tain-Hsiung Chen[1,2]

[1] *Department of Orthopedics, Taipei Veterans General Hospital,*
[2] *School of medicine National Yang-Ming University,*
[3] *Lotung Poh-Ai Hospital, I-Lan, Taiwan, R.O.C.*

Key Words
instrumentation;
postoperative wound infection;
spinal surgery

Background. Postoperative wound infection remains a troublesome but common complication after spinal surgery. This study presents the 6-year experience of our surgical team with post-operative deep wound infection in Taipei Veterans General Hospital.

Methods. Of 3230 selected operations, 72 cases of wound infection were identified. Thirty patients with deep wound infection were reviewed, including 17 men and 13 women at a mean age of 32 years. The pre-operative diagnoses included spondylolisthesis, scoliosis, spinal stenosis, herniated inter-vertebral disc, spinal fracture and adjacent syndrome.

Results. In this report, different deep wound infection rates were compared between different operative procedures including (1) posterior decompression with fixation and fusion, 1.15%. (2) simple decompression (laminectomy) and disectomy, 0.37%, (3) revision fixation with decompression, 4.4%, and (4) removal of implant. 0.33%. The onset of infection sign was divided into 3 groups: (1) acute (< 2 weeks), 43.3%, (2) subacute (2~4 weeks), 40%, and (3) chronic (> 4 weeks), 16.6%. In 11 patients with deep wound infection, no bacteria was cultured, while 14 patients had Methicillin-resistant *staphylococcus aureus* and another 3 patients had lower-grade toxic *staphylococcus aureus*. All patients received debridement followed by delayed wound closure with effective antibiotics. Instruments were removed in only 8 patients. Twenty seven cases were cured after treatment but 3 patients expired in poor condition.

Conclusions. In this series, total deep wound infection was 0.9% in our 6-year experience. The incidence of postoperative spinal infection increased with the complexity of the procedure. Most patients got completely disease free with antibiotics and surgical treatment.

Post-operative spinal wound infection is a potentially devastating complication, which places the patients at risk for surgical failure, poor outcome, adverse neurological deficit, and even death. Despite the development of more effective prophylactic antibiotics, advances in implants, surgical technique and post-operative care, wound infection is still common problem to be resolved. Many factors have been identified, which can be classified as patient's factor, environmental factor and procedural factor. Successful treatment depends on full course antibiotics, effective wound dressing and debridement. In this study, we review a surgeon team's experience of the postoperative spinal deep wound infection in our institution in an effort to identify the risk factors of infection and to describe a successful treatment protocol.

METHODS

We reviewed 3230 patients who received selected spinal surgery during January 1997 to December 2002 in Orthopedic Department of Taipei Veterans General Hospital. The mean age of these patients, including 1776 men and 1454 women was 59 years. The pre-operative diagnoses included spondylolisthesis, spinal stenosis, scoliosis, herniated inter-vertebral disc, spinal fracture and adjacent

Received: August 29, 2003.
Accepted: April 6, 2004.

Correspondence to: Ming-Chau Chang, MD, Department of Orthopedics, Taipei Veterans General Hospital, 201, Sec. 2, Shih-Pai Road, Taipei 112, Taiwan.
Tel: +886-2-2875-7557; Fax: +886-2-2875-7567; E-mail: mcchang@vghtpe.gov.tw

syndrome. The patients who received spinal surgery due to spinal metastasis tumor or spinal infection such as osteomyelitis or spinal tuberculosis were ruled out. These with post-operative spinal infection transferred from other hospital were also excluded so that focus could be made on the selective controlled surgery.

All patients were operated on under general anesthesia in the prone position using the Telton-Hall frame. The operative procedures included posterior decompression with instrumentation, simple decompression, revision of instrumentation with decompression, and removal of implant. All operations were through posterior, midline approaches. Prophylactic antibiotics were used in each patient according to qualitative controlled protocol. The deep wound infection was defined as extensive infection below fascia layer. Thirty patients suffered postoperative deep wound infection. Relevant patient data included preoperative risk factor, operative procedure, onsets of infection, microbiology, treatment and outcome.

RESULTS

Patient factor

In 6 years under study, deep wound infection happened in 30 patients including 17 men and 13 women. They are significantly older (average: 64.1 ± 2.4 years) than the main group (59.0 years; $p < 0.05$). Eleven patients had hypertension and 7 patients had diabetes. Other patient pre-operative risk factors are listed in Table 1. The ratio of patients with diabetes mellitus in deep-wound-infection group was 23.3 ± 8.3%, significantly higher than that of main group (13.6%; $p < 0.05$). Long-term steroid usage was found in 2 patients and pre-operative poor nutrition status (lower albumin level) was seen in another 2 patients. Poor general condition was uncommon due to selective spinal procedure that might exclude those who were contraindicated to operation.

Procedure factor

The type of spinal procedure correlates with the incidence of postoperative wound infection. According to the usage of instrumentation, we divided patients into 4 groups. The procedure with instrumentation made higher deep wound infection rate compared with the operation without instrumentation. Surgery with revision instrumentation had highest infection rate up to 4.4% in 45 cases. In 2088 procedures of posterior decompression with instrumentation, the average rate of deep wound infection was 1.15%. In 801 operations of decompression without implants including laminectomy and disectomy, the deep wound infectious rate was only 0.37%. Only 1 deep wound infection happened in the 296 procedures of removal of implants (Table 2). In 30 patients with deep

Table 1. Patient-related risk factor

	Case No.
Hypertension	11
Diabetes (fasting blood sugar > 150 mg/dL)	7
Poor nutrition (Albumin < 3.0 gm/dL)	2
Coronary artery disease	3
Malignancy	3
Ankylosing spondylosis	2
Renal failure	2
Liver cirrhosis	1
Steroid usage	2
Nil	9

Table 2. The infection rates in different spinal procedures

group/Year	1997	1998	1999	2000	2001	2002	total	infection rate	Z
Group 1	6/301	4/385	1/395	5/337	6/364	2/306	24/2088	1.15%	1.047
Group 2	1/140	0/141	0/146	1/113	0/186	1/75	3/801	0.37%	-1.65**
Group 3	1/2	0/9	0/7	1/8	0/5	0/14	2/45	4.44%	2.43*
Group 4	0/57	0/70	0/44	0/31	0/50	1/44	1/296	0.33%	-1.075

(Numerator: cases with deep wound infection; Denominator: total operation).
Group 1 = posterior decompression with instrumentation; Group 2 = posterior decompression without instrumentation.
Group 3 = revision of implant; Group 4 = removal of implant.
Standard infection rate in total patients with selective spinal surgery: 0.93%.
* = Significant at $\alpha = 0.05$ level; ** = Significant at $\alpha = 0.10$ level.

Table 3. Surgical level of implant and infection rate

	No. of infection	No. of operation	infection rate	Z
Two-level procedure	7	1251	0.5%	-1.78**
Three-level procedure	7	775	0.9%	-0.28
Over four-level procedure	12	503	2.3%	2.93*
Total	26	2429	1.1%	

Standard infection rate in total patients with instrumentation: 1.1%.
* = Significant at $\alpha = 0.05$ level; ** = Significant at $\alpha = 0.10$ level.

wound infection, 26 persons received operations with instrumentation. Surgical level, which is related to surgical time, range of exposed area and number of implants, has influence on the rate of deep wound infection. In these 28 operations with instrumentation, 7 were 2-level procedures, another 7 were 3-level, while other 12 were over 4-level (Table 3). The over-4-level operations made significantly higher infectious rate than other operations with implants (2.3%; $p < 0.05$).

Clinical characteristics

The duration from operation to infection being found clinically is classified into 1) acute onset - within 2 weeks in 13 patients; 2) subacute onset – 2~4 weeks in 12 patients; and 3) chronic onset - over 4 weeks in 5 patients. The time of infection onset was not correlative to severity of infection or infectious organism and was not indicative to prognosis, either.

Clinical symptoms included fever (> 38.5 °C), persisted or recurrent wound pain, general weakness, pus discharging and neurological deficit (Table 4). Persisted or recurrent wound pain and pus discharging were the most common presenting signs in our series. Fever happened in only 13 patients. Elevated C-reactive protein was noted in 16 patients. Neurological deficit was rare and could be a poor prognosis factor.

Microbiologic analyses

On microbiology, 11 patients didn't have bacteria growth in culture. The most common organism cultured in deep infection was Methicillin-resistant *Staphylococcus aureus*, found in the wounds of 14 patients. Coagulase-negative *staphylococci* were found in 3 wounds. Table 5 lists the bacteria cultured from the wounds. Only 1 patient had more than 1 species grown in culture.

Table 4. Symptoms and sign

	Case No.
Fever	13
Persisted wound pain	18
Recurrent wound pain	10
Elevated ESR & CRP	16
Neurological deficit	1

ESR = Erythrocytes sedimentation rate (normal < 30 mm/HR).
CRP = C-reaction protein (normal: 0-0.5 mg/dL).

Table 5. Microbiology

	Case No.
No bacteria	11
Methicillin-resistant *Staphylococcus aureus*	14
Staphylococcus aureus	3
Clostridium	1
Mycobacterium	1
Multiple infection	1

Treatment

When infection sign happened, first-line intravenous antibiotics were used and wound culture was performed. If bacteria growth was found, change of antibiotics according to drug sensitivity was necessary. In patients whose wound culture revealed no bacteria growth, intravenous antibiotics were kept at least 2 weeks. In whatever situation, treatments must be followed according to wound and patient condition. Persisted discharging wound and fever were the signs indicative of un-controlled infection. Debridement and change of antibiotics should be performed in patients with progressed clinical signs. All of these 25 patients received debridement at least once and there wounds were kept open with wet dressing (Fig. 1). No local antibiotic beads were used in wound. Removal of instrumentation was indicated in patients with poor control of infection (persisted pus dis-

Fig. 1. Open wound care with wet dressing in a patient with post-operative deep wound infection.

Table 6. Antibiotics and surgical treatment

Surgical procedure	Case No.
Debridement once	16
Debridement twice	6
Debridement more than twice	8
Removal of implant	8
Keep implant	18

Duration of intravenous antibiotics	Case No.
< 2 weeks	6
2~4 weeks	10
4~6 weeks	4
> 6 weeks	10

charging over 4 weeks) or failure of fusion. The duration for use of intravenous antibiotics and surgical treatment are listed in Table 6 and it depended on the toxicity of bacteria and wound condition. When the infection wound became stable, intravenous antibiotics would shift to oral antibiotics.

Outcome

Three patients died during the period of treatment and the other 27 patients got complete clinical recovery. One patient expired due to severe ascites induced by underlying liver cirrhosis and the other due to respiratory failure induced by sepsis. Another patient expired because of his poor health status induced by malignancy. In 27 clinically recovered patients, 16 patients kept spinal instrumentation during the period of treatment and 8 patients had their implant removed (before complete fusion in 4 cases and after complete fusion in the other 4 cases). No neurological complication was found in them except residual back pain.

DISCUSSION

Postoperative deep wound infection can present a number of therapeutic challenges. Suboptimal treatment can lead to poor clinical outcomes, including chronic pain, neurological deficits, unstable fusion and osteomyelitis. Actually, the problem is unavoidable because the environment during operation is not absolute aseptic and the most likely time of incubation of the wound is during surgery.

In the retrospective study, 3230 patients who underwent spinal surgery in our department during 6 years were selected according to criteria of surgery and diagnosis that include the most common surgical procedure for spinal disease. The surgery for spinal tumor and pre-operative infection was ruled out due to complicated general condition of patients.

In these 6 years, operation room condition was under quantitative control including air condition, environmental cleaning and sterilized technique. Therefore, environmental factors were not evaluated in this study because we assumed all the patients were under the same operation room condition. Pre-operative prophylactic antibiotics were used in all the patients by the same protocol (first-line intravenous cephalosporin and gentamicin, given before operative 30 minutes) in a rate up to 98% in quantitative reports.

Certain host factors are known to increase the likelihood of postoperative wound infections such as advanced age, malnutrition, obesity, diabetes mellitus, immunosuppression and pre-operative infection. Advance in anesthetic technique and post-operative care allow surgical treatment in older patients. Conversely, poor nutrition and general condition were still common in aged patients. The patients with deep wound infection are on average older than the main group significantly, presenting that increased age is a related risk factor.

The patients with poor control of blood sugar had impaired immune function that would induce delayed

wound healing to increase the risk of wound infection. In these 30 patients with deep wound infection, 7 had history of diabetes mellitus. The ratio of diabetes in these patients was higher than that in main group. Therefore, prophylactic technique for infection must be performed in those with high risk of infection.

Many studies in the general surgical literature report a direct correlation between the duration of surgery and the risk of post-operation infections[1-5,10,11] because most contaminations happened during operation. It is also clear that the type of spinal surgery affects the risk of postoperative infection. The usage of instrumentation had influence on risk of infection due to increased dead space by foreign body effect and prolonged duration of surgery. We divided our patient into 4 groups according to the usage of instrumentation to compared different rates of deep wound infection among them. In the 45 patients who received revision of implant due to adjacent syndrome, the deep wound infection rate was up to 4.4%. Then in the 2088 patients who received primary spinal surgery with instrumentation, the deep wound infection rate was 1.15%. The deep-wound-infection rate was only 0.37% in the 801 patients who received primary spinal surgery without instrumentation. Only 1 deep wound infection happened in the surgical procedure for removal of implants. This finding presents that longer and more complicated procedure have higher deep wound infection rate. Therefore, avoiding contamination during operation becomes an easy but important principle in decreasing wound infection

Treatment of deep wound infection is based on several important principles including adequate wound draining, correct antibiotics usage, and improving patient general conditions.[1-4,8,9,11] Removal of instrumentation is not absolutely necessary as the role of implant is still controversial in the effect of foreign body and fixation. When a deep infection is unlikely to involve the instrumentation, suppressive antibiotics should still be employed. Our patient data showed no neurological deficit happened after antibiotics therapy. All patients who survived got disease free except 3 who expired in poor general condition.

In conclusion, postoperative spinal wound infection is still a frustration for patients and surgeons, and can lead to significant post-operative functional impairment. However, prompt diagnosis and aggressive treatment can eradicate the infection and allow the greatest chance for a successful outcome.

REFERENCES

1. Abbey DM, Turner DM, Warson JS, Wirt TC, Scalley RD. Treatment of postoperative wound infections following spinal fusion with instrumentation. *J Spinal Dis* 1995;8:278-3.
2. Weinstein MA, McCabe JP, Cammisa FP. Postoperative spinal deep wound infection: A review of 2391 consecutive index procedure. *J Spinal Dis* 2000;13:422-6.
3. Thalgott JS, Cotler HB, Sasso RC, LaRocca H, Gardener V. Postoperative infection in spinal implant. *Spine* 1991;16: 187-91.
4. Massie JB, Heller JG, Abitbol JJ, McPherson D, Garfin SR. Postoperative posterior spinal wound infection. *Clin Orthop* 1992;284:99-107.
5. Wimmer C, Gluch H, Franzreb M, Ogon M. Predisposing factors for infection in spine surgery: a survey of 850 spinal procedures. *J Spinal Dis.* 1998;11:124-8.
6. Faraj AA, Webb JK. Spinal instrumentation for primary pyogenic infection report of 31 patients. *Acta Orthopaedica Belgica* 2000;66:242-7.
7. Viola RW, King HA, Adler SM, Wilson CB. Delayed infection after elective spinal instrumentation and fusion. A retrospective analysis of eight cases. *Spine* 2002;22:2444-50.
8. Calderone RR, Thomas JC, Haye W, Abeles D. Outcome assessment in spinal infections. *Orthop Clin North Am* 1996;27: 201-5.
9. Rubayi S. Wound management in spinal infection. *Orthop Clin North Am* 1996;27:137-53.
10. Capen DA, Calderone RR, Green A. Perioperative risk factors for wound infections after lower back fusions. *Orthop Clin North Am* 1996;27:83-6.
11. Heggeness MH, Esses SI, Errico T, Yuan HA. Late infection of spinal instrumentation by hematogenous seeding. *Spine* 1993; 18:492-6.