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Postoperative Infections of the Thoracic and Lumbar Spine

A Review of 18 Cases

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We retrospectively reviewed 18 consecutive patients (age range, 19–81 years; average age, 55 years) with postoperative infections of the spine. Postdiscectomy-laminectomy infections confined to the disc space (n = 2) were treated with percutaneous transpedicle drainage. Open débridement was performed in patients with an epidural or paraspinal abscess (n = 3). Infections after posterior instrumentation that manifested during the first postoperative month were treated with single (n = 3) or multiple débridements and delayed closure (n = 7), with preservation of instrumentation. Infections that presented more than 9 months after the initial operation (n = 3) were treated with open débridement and removal of instrumentation. The minimum followup was 1 year (mean 2 years, range, 1–4 years). Infections in 17 of the 18 patients resolved effectively and one patient with metastatic cancer died of sepsis. Transpedicle drainage resulted in immediate relief of back pain. Instrumentation can be retained safely in patients with infections that manifest during the first month after implantation. Single surgical débridement is effective in selected cases. After repeated débridements, the presence of healthy granulation tissue in the wound and decreasing C-reactive protein activity were associated with safe and effective wound closure. Despite radiographic evidence of hardware loosening in infections manifested more than 9 months after implantation, we removed hardware without destabilizing the spine.

Level of Evidence: Level IV, therapeutic study (case series). See the Guidelines for Authors for a complete description of levels of evidence.

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Each author certifies that his institution has approved the human protocol for this investigation. All investigations were conducted in conformity with ethical principles of research.
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Postoperative infections constitute a serious problem in spinal surgery. Their incidence and severity generally increases with the complexity of the procedure,[26] ranging from 0.6% to 3.7% after discectomy[8,19] to 3.7% to 20% after posterior instrumented fusion.[1,13] Symptoms of spondylodiscitis complicating discectomy usually appear 5 to 15 days after surgery.[16] Infections after posterior instrumentation may appear from 4 to 120 days after surgery[9] and may occur as much as 7 years after surgery.[7]

Optimal management of postoperative infections of the spine is controversial. Infections after discectomy or laminectomy usually are treated nonoperatively with intravenous antibiotics. Open surgical drainage is reserved for patients who have an epidural abscess.[6] However, clinical studies indicate 55% to 77% of patients are unable to resume their previous occupations.[10,15,17,22] Prognosis is better when treatment is instituted early during the infection.[2,16] Minimally invasive techniques such as percutaneous transpedicle drainage have the advantage of acquiring tissue samples for bacteriologic studies and may facilitate infection control and healing.[5]

Surgical débridement and irrigation generally is considered necessary for infections in patients with spinal instrumentation.[11,12] However, the optimal surgical treatment of these infections is debatable. Some think the instrumentation should be removed because it precludes successful treatment.[1,18] Others try to salvage the instrumentation until fusion occurs.[3,9,12,23,27] Furthermore, controversy exists when using single débridement and primary closure versus repeated débridements with delayed closure.[9,23,27] Optimal timing of delayed wound closure has received considerable attention.[27] When the infection occurs after fusion is completed and stability of the spine is not a major issue,

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as in the early postoperative period, removal of instrumentation is almost an established procedure.[18]

We ascertained the effectiveness (resolution of infection: normalization of erythrocyte sedimentation rate [ESR], C-reactive protein [CRP], absence of back pain, swelling and drainage) of transpedicle drainage in a postdiscectomy infection, the outcomes of a single débridement and primary closure without hardware removal in a postoperative infection after posterior instrumented fusion, the outcomes of repeated débridement and the timing of delayed closure for aggressive postinstrumentation infection, and the results of hardware removal for late postoperative infections with evidence of hardware loosening.

MATERIALS AND METHODS

We retrospectively reviewed 18 consecutive patients treated for postoperative deep infections of the spine (any infection under the lumbar fascia that may involve one or more of the following structures: intervertebral disc, vertebra, epidural space, paravertebral muscles and instrumentations). Four patients (mean age, 38.2 years) had infections after discectomy for disc herniation, one patient had an infection after laminotomy–foraminotomy for spinal stenosis (Table 1), and 13 patients had deep infections after posterior instrumented fusion (Table 2). The infections occurred between January 2000 and January 2004. All patients were from our institution. These patients were treated for postoperative infections of the spine by the same surgeons (the first and the last authors). During this time, 216 discectomies–laminectomies, and 332 posterior instrumented fusions were performed by the same two surgeons, with a 2.3% postoperative infection rate after discectomy–laminectomy and 3.9% rate after instrumented fusion. The minimum followup was 1 year (mean 2 years; range, 1–4 years). One patient died; none of the other patients was lost to followup.

All patients with spinal instrumentation received prophylactic antibiotics (cefuroxime, 1.5 g intravenously) during induction of anesthesia, and continued for 2 days. Patient with discectomy–laminectomy received one dose of cefuroxime, 1.5 g intravenously, during induction of anesthesia. Iliac bone autografts combined with plaster of Paris pellets (1:1) were used for fusion. Nine of 13 patients had one or more factors predisposing them to infection (Table 2). Erythrocyte sedimentation rate, CRP (normal range, 0.2–0.8 μg/dL), blood cultures, and tissue cultures from the infected area were performed for every patient. Antibiotics were discontinued for at least 3 days before cultures were obtained. Back pain was measured on a 1 to 10 visual analog scale (VAS). Clinical and radiographic measures were assessed by the operating surgeon. All patients with infections after noninstrumented procedures and six patients after postoperative infections had magnetic resonance imaging.

At presentation, patients with infections after discectomy–laminectomy were febrile and had severe back pain (VAS, 8–10). The mean ESR was 82 mm Hg/hour (range, 59–131 mm Hg/hour) and the mean CRP was 11.3 μg/dL (range, 1.1–2.3 μg/dL). Patients with infection that occurred during the first 5 to 20 days after posterior instrumented fusion had a mean ESR of 116 (range, 98–142 mm Hg/hour) and mean CRP of 21.8 μg/dL (range, 19–28 μg/dL). The leukocyte count was normal or slightly elevated. Blood cultures revealed the offending bacteria in five patients (50%); one of the patients with a positive culture result was afebrile. The patients who manifested the symptoms of infection 10 months or more after the initial surgery had incisional swelling and drainage with low back pain (VAS, 7–8). They had mild elevation of the ESR (mean, 47 mm Hg/hour; range, 36–57 mm Hg/hour) and CRP (mean, 1.76; range, 1.1–2.3 μg/dL), whereas none had fever or an elevated leukocyte count. Plain radiographic imaging was suggestive of hardware loosening (wide radiolucent halo around the whole length of the transpedicle screw) in all three patients.

Patients with postdiscectomy infections confined to the disc space (n = 2) had percutaneous transpedicle drainage of the infected intervertebral space using a previously described technique.[5] Patients with an epidural abscess (n = 2) had open surgical débridement and drainage, followed by primary closure over drainage tubes that remained for 3 days. Patients with infections after instrumentation had aggressive surgical débridement and irrigation. The instrumentation was removed in the three patients with infections that manifested 1.5 years or more after surgery, and the wound was primarily closed over drainage tubes that remained for 3 days. In the remaining patients (n = 10) with infections that manifested during the first postoperative month, extensive débridement was done, while the instrumenta-

TABLE 1. Infections After Surgery Without Instrumentation

Patient Number	Age (years)	Initial Procedure	Type of Infection	Causative Agent	Onset of Symptoms	Predisposing Factor	Treatment
1	55	Discectomy	Epidural abscess	Serratia	2 days	Contaminated irrigation	Surgical débridement
2	81	Laminotomy–foraminotomy	Epidural abscess	Serratia	2 days	Contaminated irrigation	Surgical débridement
3	54	Discectomy	Epidural abscess	S. aureus	11 days	None	Surgical débridement
4	19	Discectomy	Discitis	S. aureus	23 days	Infected facial acne	Transpedicle drainage
5	25	Discectomy	Deep wound infection	E. coli	14 days	Prostatitis	Transpedicle drainage

S. aureus = Staphylococcus aureus; E. coli = Escherichia coli

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TABLE 2. Infections After Posterior Instrumented Fusion

Patient Number	Age (years)	Initial Diagnosis	Hardware	Causative Agent	Onset of Symptoms	Predisposing Factor	Treatment	Outcome
1	65	Spinal stenosis	L3-S1	Negative cultures	5 days	Diabetes, previous surgery	Primary closure	Excellent
2	72	Spinal stenosis	L3S1	S. aureus	17 days	Diabetes, obesity	Delayed closure	Fair*
3	64	Metastasis	T8-L3	Multiple†	8 days	Cancer, Frankel B paraplegia	Repeated debridement	Died
4	57	Metastasis	T11-L3	S. epidermidis	20 days	Cancer, previous Rx	Muscle flap	Good
5	54	Metastasis	T10-L2	S. aureus	11 days	Cancer	Muscle flap	Good
6	58	Fracture	T5T10	S. epidermidis	14 days	Obesity	Delayed closure	Excellent
7	59	Spinal stenosis	L3-L5	S. aureus	16 days	Previous surgery, obesity	Delayed closure	Good
8	67	Spinal stenosis	L3-L5	S. aureus	6 days	None	Primary closure	Good
9	61	Spinal stenosis	L4-S1	S. epidermidis	7 days	Prolonged hospital stay	Primary closure	Good
10	34	Fracture	L2-L4	Enterobac-ter	18 days	Frankel C paraplegia	Muscle flap	Good
11	51	Spinal stenosis	L3-L5	S. epidermidis	18 months	None	Instrumentation removal	Good
12	50	Spinal stenosis	L3-S1	S. epidermidis	10 months	None	Instrumentation removal	Good
13	62	Spinal stenosis	L3-L5	Peptostreptococcus	2 years	None	Instrumentation removal	Good

*Instrumentation was removed after 5 months, pseudarthrosis developed; †S. aureus, Enterobacter cloacae, Escherichia coli; Rx = Radiotherapy; S. aureus = Staphylococcus aureus; S. epidermidis = staphylococcus epidermidis

tion was left in place. In three of these patients with relatively minimal tissue damage and good vascularity, the wound was treated with primary closure over suction drains that remained in place for 4 to 5 days. In the remaining seven patients, the wound was packed open with gauze soaked in hypertonic saline solution. Débridements were repeated every 48 hours until the wound appeared clean. In four patients, after the final débridement the wound was closed by transferring a local paraspinal muscle flap.[27] In three patients, the wound was left open until healthy granulation tissue covered the instrumentation and the wound then was closed successfully by mobilizing local skin flaps.

All patients received intravenous antibiotics according to sensitivity tests for 6 weeks after surgery or the last surgical débridement. After intravenous antibiotics, the patients were prescribed oral antibiotics for an additional 6 weeks. Patients were allowed to mobilize wearing a thoracolumbar orthosis.

RESULTS

The patients who had percutaneous transpedicle discectomies experienced immediate relief of back pain (VAS, 2–3). Disc material obtained during the procedure revealed Escherichia coli in the first patient and Staphylococcus aureus methicillin-sensitive in the second (Table 1), although blood cultures were negative in both patients. The patients with an epidural or paraspinal abscess who had open débridement for infections after discectomy–laminectomy had steadily decreasing back pain during the first 3 months after surgery and were mostly pain free (VAS, 1–4) at 6 months followup. Tissue culture specimens grew Staphylococcus aureus methicillin-resistant (one patient) and Serratia marcescens (two patients). These bacteria also were present in blood cultures. The cases of the two patients with Serratia marcescens that developed after spondylodiscitis were described previously.[4] All patients showed evidence of gradual collapse of the infected intervertebral disc space on subsequent radiographic imaging. Signs of bony or fibrous union of the intervertebral disc space were present at 6 months. At a mean followup of 2 years, no patients reported having back pain or any symptoms of spinal stenosis, and they were able to resume their previous regular daily activities without disability.

Of the 10 patients with early infections after instrumentation, the three treated with primary closure had an uneventful recovery with good healing of the surgical wound. In four patients, after two or three surgical débridements, the wound was closed successfully with paraspinal muscle transfer over the instrumentation and the defect created by the infection. The final three patients had delayed closure after five to six surgical débridements. In the latter group, one patient with metastatic thyroid

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carcinoma in the lower thoracic spine causing severe paraparesis (Frankel C), who underwent posterior decompression and T8 to L3 stabilization with rods and laminar claws, had a deep wound infection develop with extensive dehiscence and cerebrospinal fluid leakage. Despite repeated débridement and irrigation, the wound remained necrotic and without healing. The patient eventually died of sepsis 32 days after the initial procedure. In the remaining patients, the wound healed without sequelae. Another patient experienced hardware loosening that appeared as an osteolytic halo around the transpedicle screws. The instrumentation was removed 5 months after the initial procedure. The patient had pseudarthrosis with chronic back and leg pain (VAS, 8).

In patients with infections that manifested 10 months or more after instrumentation, satisfactory bony fusion was detected during surgical exploration, despite evidence of hardware loosening seen on plain radiography. At surgery, pus was seen around the instrumentation, with an increased concentration under the cross-links. Local corrosion of the hardware and metallosis of the surrounding tissues was present at the sites of hardware loosening. Additional pus came out after screw removal from the pedicle holes. Cultures of the pus grew Staphylococcus epidermidis (n = 2) and Peptostreptococcus (n = 1). All patients had an uneventful postoperative course and reported improvement of back pain (VAS, 2–3 at 3 months followup). No patient had recurrence of the infection at a mean followup of 2 years.

Tissue culture specimens obtained at surgery revealed the causative agents in nine (90%) patients (Table 2), whereas blood cultures revealed the offending bacteria in five patients (50%). Wound healing and improvement of pain coincided with early decline of CRP, while the ESR remained elevated. Magnetic resonance images showed indications of the infections (Fig 1).

DISCUSSION

Postoperative infections of the spine may have serious implications and therefore should be treated expeditiously. However, controversy exists regarding their optimal management. We report the results of various surgical approaches used to treat a consecutive series of patients with postoperative infections of the spine. Surgical intervention ranged from percutaneous transpedicle drainage when the infection was confined to the disc space after a discectomy, to multiple surgical débridements and delayed closure over muscle flaps after spinal instrumentation.

Our study is limited by the relatively small number of patients with infections that presented at different times after spinal surgery. Furthermore, the clinical and radiographic observations were evaluated by the operating surgeon, which might introduce some bias. However, this study provides a scope of the indications and outcomes of different surgical techniques, such as the use of minimally invasive techniques for treatment of postdiscectomy discitis, and the timing of wound closure after surgical débridement for infected posterior instrumented fusions.

Treatment of postoperative infections confined to the disc space usually is nonoperative with antibiotic administration. However, previous experience with percutaneous

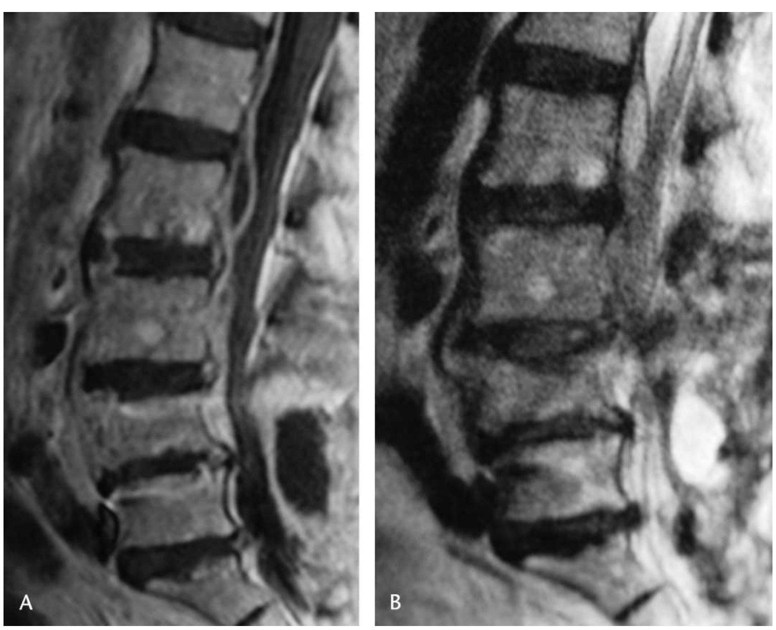

Fig 1A–B. A 72-year-old woman with bilateral leg pain secondary to spinal stenosis, had an L_4 and L_5 decompression laminectomy, bilateral L_5 foraminotomy, transpedicle L_4, L_5, S_1 instrumentation, and bilateral facet fusion. Seventeen days later, she reported having severe back pain. The MRI scans were indicative of spinal infection. (A) The T_1-weighted image shows a lesion with low signal intensity posterior to the L_4 and L_5 laminectomy site, in the paraspinal muscles. (B) The same lesion shows moderately increased intensity on the T_2-weighted image.

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transpedicle discectomy for treatment of primary pyogenic spondylodiscitis,[5] indicates this method can be applicable in selected cases of postdiscectomy infections without instrumentation. This procedure allows for tissue culture and drainage of infection. It also may promote invasion of vascular granulation tissue of the disc space from the subchondral bone region of the vertebral body. This process may accelerate the self-repair mechanisms and increase the bioavailablity of antibiotics to the disc space.[5] The results of two patients in this series were encouraging. When an epidural abscess is present, particularly secondary to highly virulent organisms such as Serratia, aggressive open surgical drainage indicated for primary pyogenic infection,[6] is the preferred treatment.

Treatment of infections that occur during the early postoperative period (usually the first month) after an instrumented posterior fusion is controversial. Although some think the presence of spinal instrumentation precludes successful treatment of spinal infection[1,18] and therefore should be removed, we agree with the majority of surgeons[3,9,12,23,27] who think this option may result in an unstable spine, especially after extensive laminectomy. In this context, the goal is to salvage the instrumentation at least until fusion occurs. Our results concur with those of Picada et al[14] and Weinstein et al[26] that vigorous débridement under appropriate antibiotic coverage can successfully resolve the infection without removing the instrumentation. Some argue one débridement without a second look for removing additional necrotic tissue risks a higher recurrence rate.[26] However, our data suggest that in patients with normal metabolic capabilities who are immunocompetent and who do not seem to be ill from sepsis, a wound that looks clean with relatively minimal tissue damage and good vascularity can be closed primarily closed after one débridement. Early diagnosis and treatment are mandatory before the establishment of glycocalyx formation.

Repeated débridements and delayed primary closure are simple and effective[21] for wounds with moderate to severe tissue necrosis. The timing of wound closure is important. The absence of necrotic tissue and the presence of granulation tissue in the wound, associated with decreasing CRP activity, were the criteria we used. C-reactive protein seems a more sensitive and specific index than ESR for monitoring postoperative infection.[20,24,26] Delayed primary closure may not be suitable for all patients. A higher complication rate has been reported when extensive wounds with exposed bone or hardware are closed in a delayed primary fashion (68%) than when the wounds are reconstructed with muscle flaps (20%).[27] For this reason, we used a paraspinous sliding muscle flap as a primary reconstruction for extensive wound infections of the lumbar spine.[27]

Using these principles resolved the infections in 90% of patients with postoperative infections that manifested during the first month after posterior instrumented fusion. However, the infection failed to resolve in a patient who had metastatic cancer. Severe infections associated with wound dehiscence, a large defect, extensive deep wound myonecrosis with a large defect, and cerebrospinal fluid leak are serious and potentially life-threatening complications. After a minimum followup of 1 year (mean, 2 years), we observed only one case of pseudarthrosis (10%) after an infection in a patient with an instrumented fusion. This is consistent with the results in another study that suggests early postoperative infection after instrumented fusion does not substantially alter the rate of pseudarthrosis.[26]

Some authors have reported pseudarthrosis rates associated with delayed infection after instrumentation range between 20% and 62%,[18,25] suggesting an association between pseudarthrosis and delayed infection of instrumented spinal fusion.[25] Although radiographic signs of transpedicle screw loosening were evident in the three patients with postoperative infections that occurred more than 10 months after initial surgery, a solid fusion mass was detected during surgery in each patient. Removal of hardware and thorough surgical débridement and irrigation led to complete resolution of the infection and substantial improvement of back pain in all three patients.

A transpedicle discectomy seems to be effective for treatment of postdiscectomy discitis in the absence of epidural or paraspinal abscesses. Infections that develop during the first month after an instrumented posterior fusion can be treated with vigorous débridement without removing the instrumentation. The wound can be primarily closed after one débridement in selected patients. The absence of necrotic tissue, the presence of granulation tissue in the wound site, and a decreasing CRP can herald wound closure after repeated débridements. Extensive wounds with exposed bone or hardware can be reconstructed with a paraspinous sliding muscle flap. Despite radiographic evidence of hardware loosening in patients with spinal infections that manifested more than 10 months after implantation, a fusion mass can be adequate to allow hardware removal without destabilizing the spine.

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