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Operative Techniques in
Orthopaedics

Surgical Infections in Traumatic Spine Injuries

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Wound infection after surgical treatment of traumatic spinal injuries is twice more common than after elective spinal surgery. Risk factors include older age, complete neurologic injury, more extensive surgery, posterior surgery, use of high-dose steroids, and prolonged stay in the intensive care unit. Modifiable risk factors should be minimized in the preoperative, intraoperative, and postoperative periods. The key to treatment is prompt irrigation and debridement. Because of the high prevalence of polymicrobial infections, broad-spectrum antibiotics should be administered.
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Wound infections after elective spinal surgery are relatively uncommon with varied reported rates, depending on the extent of the procedure. Known risk factors for infection include diabetes, obesity, rheumatoid arthritis, long-term steroid use, alcohol abuse, poor nutrition, smoking, prior infection, prior spinal operations, extended preoperative hospitalization, posterior approach, the addition of a fusion procedure, use of instrumentation, high blood loss, and prolonged operative time. Patients with acute traumatic spinal injuries represent a unique patient subpopulation. These patients often sustain multisystem trauma with concomitant open wounds and cardiopulmonary instability. A prolonged period of nothing per mouth, immobilization, and stay in the intensive care unit (ICU) often are required. Because of local, systemic, and iatrogenic factors, patients with spinal injury are at a significantly greater risk of postoperative infection. Blam and coworkers[1] found that the rate of postoperative wound infections in 256 patients with acute spinal injury was 9.4%, which is significantly greater than the infection rate of 3.7% in the 2990 patients who underwent elective spinal surgery during the same period.

Risk Factors

1. Older Age

Blam and coworkers[1] found that the average age of patients who developed surgical-site infection after spinal trauma was 55 years, in contrast to 37 years for those who did not develop an infection.

Presence of Medical Comorbidities

Blam and coworkers[1,2] also found that patients with any medical co morbidities were shown to have a 21% rate of infection as compared with 7% for those without.

Site of Injury

Thoracolumbar injuries are associated with a higher rate of infection as compared with cervical injuries. Thoracolumbar injuries tend to require more extensive surgeries than cervical injuries. Thoracolumbar trauma procedures often involve multiple levels with instrumentation and prolonged surgical times, thereby increasing the risk of infection.[2-4]

Type of Injury

Patients with a complete neurological injury have a greater incidence of infection, which is likely related to the higher-energy mechanism, severity of local injury, and associated lack of mobility.[5] These patients are also predisposed to urinary tract infections, pneumonia, and decubitus ulcers, which may serve as potential sources for seeding of the surgical-site infection.[6] Patients with spinal cord injury also develop an obligatory negative nitrogen balance and become malnourished postoperatively, further increasing their chances of developing infection.[7,8]

Postoperative ICU Stay

Patients who stay in the ICU for 1 day or more postoperatively have 6 to 13 times greater risk of infection than patients not requiring any ICU stay postoperatively.[1]

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Smoking

Patients with a long-term history of smoking have decreased and slower wound healing capacity and thus, are at an increased risk of infection.[1]

Use of High-Dose Steroids

Patients subjected to high-dose of steroids for 48 hours have been shown to have a higher rate of infection than those on a lower dose of steroids.[9,10] However, there has not been convincing evidence to indicate increased risk of infection with low-dose steroids.[1,11]

Nutritional/Immune Status

A poor nutritional status, especially protein and protein–calorie malnutrition, leads to poor wound healing, suppression of cellular and humoral immune responses, and increased postoperative wound infections.[12-18] Albumin levels less than 3.5 g/dL and/or total lymphocyte count less than 1500 to 2000/mm^2 represent clinical malnutrition.[14,19]

Bacteriology

Most postoperative elective spinal infections are caused by Gram-positive organisms, such as *Staphylococcus aureus* and *Staphylococcus epidermidis*. The most common causative organisms for traumatic spine surgical wound infections are also Gram positives. However, the traumatized spine is predisposed to polymicrobial infections. In Blam and coworkers's series, 42% of the infections were polymicrobial and included species of *Enterococcus faecalis*, *Enterobacter cloacae*, *Pseudomas aeruginosa*, *Klebsiella pneumoniae*, and *Escherichia coli*.[1] In Rechtine and coworkers's series, the most common causative organisms were Gram-negative bacteria.[5] Also, 67% of their infections were polymicrobial. This high prevalence of polymicrobial and Gram-negative surgical-site infections warrants the use of broad-spectrum antibiotics in the infected traumatized spine.

Diagnosis

Vigilant daily wound inspection is the key to making an early diagnosis. The role of imaging studies in the diagnosis of postoperative spinal infections is controversial. Although magnetic resonance imaging can demonstrate fluid collections in the surgical bed, it cannot distinguish between benign postoperative seromas or hematomas and infected collections.[20] In the overwhelming majority of cases, the diagnosis of infection is made clinically based on wound inspection. Laboratory workup consisting of complete blood count with differential, erythrocyte sedimentation rate, and C-reactive protein levels can be obtained. These markers are helpful in following the course of the infection and effectiveness of treatment, rather for making a diagnosis.

Prevention

Prevention of posttraumatic spinal wound infections involves the minimization of the modifiable risk factors in the preoperative, intraoperative, and postoperative settings. Preoperatively, strong consideration should be made toward withholding steroids in patients with multiple risk factors. Every attempt should be made to avoid delay and intervene surgically as soon as other life-threatening injuries are stabilized. The spine surgeon should coordinate care with the trauma surgical team to ensure that other open wounds and sources of bacterial contamination are treated aggressively. Intraoperatively, an anterior-only approach is preferred to minimize the risk of infection. If an anterior instrumentation construct is adequate to maintain spinal stability, the avoidance of a posterior approach will minimize the risk of infection. As the injury morphology permits, the minimal number of levels necessary to obtain stability should be fused and instrumented. When long constructs with prolonged surgical times are required, prophylactic antibiotics should be redosed at regular intervals to maintain effective serum levels. Postoperatively, patients should be transferred out of the ICU setting as quickly as medically stable to minimize exposure to the nosocomial infections prevalent in the ICU. Drains, catheters, chest tubes, and other sources of bacterial contamination should all be removed as soon as possible. In addition, a nutrition consult should be obtained to help manage the complex and evolving nutritional requirements, particularly for spinal cord injury patients.

Management

Once an infection is recognized, prompt treatment with aggressive surgical irrigation and debridement should be initiated. To minimize bacterial count, all sutures, dead fat, muscle, and fascia should be removed and the wound should be irrigated thoroughly. We generally explore the wound deep to the fascia and to the instrumentation. If the infection appears superficial, we change to a clean set of gloves, gowns, and instruments before exploration deep to the fascia. Because surgical-site infections in the traumatized spine can be caused by a diverse array of Gram-negative and/or Gram-positive organisms, broad-spectrum antibiotics should be administered until deep cultures can guide the appropriate choice of therapy. We generally choose the most appropriate antibiotic therapy with the assistance of an infectious disease consultation.

Wound Reconstruction

The majority of wound infections can be managed effectively with prompt irrigation, debridement, and wound closure over drains. However, if repeated debridements are required, there may be extensive soft-tissue loss, and wound reconstruction may be required.[21] Superficial wounds are above the fascia and have no exposed bone or instrumentation. These wounds can be closed primarily once the infection has been eradicated. If a tension-free closure is not possible, the wound can be allowed to heal by secondary intention or closed with a local skin flap or skin graft. Complex deep wounds are deep to the fascia and the underlying bone, neural elements, and/or instrumentation is exposed. These