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Original Research Article

Management of Late-Onset Deep Surgical Site Infection after Instrumented Spinal Surgery

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Abstract

Background: Even with the emphasis on the consideration of basic procedures to reduce postoperative surgical site infection (SSI), particularly with instrumentation, late-onset deep SSI remains one of the most challenging cases in spine surgery. It is still one of the main causes of morbidity and death, resulting in extended hospital stays, reoperations, and the long-term usage of antibiotics. In an attempt to control infection, implant removal prior to graft fusion might be a challenge since it may create spinal instability, which can lead to clinical symptoms such radicular pain, back pain, or neurologic impairments. As a result, the two objectives frequently conflict.

Material and Method: In our institution's spine center, a retrospective assessment of 2028 patients who had instrumented dorsal spinal procedures was carried out. A complete blood count, erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), procalcitonin (PCT), histopathological findings, radiologic examination (MRI), and laboratory results all supported the diagnosis of late-onset deep SSI. Other symptoms that supported the diagnosis included persistent back pain. Occasionally, a disease resulting in an abscess or other signs of infection in the deep soft tissue, muscle, and fascia was detected using color Doppler ultrasonography.

Result: The results of the lab test revealed rising serum PCT, CRP, and ESR levels. A high-intensity signal in the deep tissue was shown by the MRI test. As soon as profound SSI was diagnosed, surgical debridement was carried out. Upon debridement, the instrumentation was discovered to be loose, and the screws and rods were taken out. However, during the follow-up period, all 84 patients in this group had their infections cured without any recurrence. In every case, the surgical incision healed primarily, and the stitches were taken out two to three weeks after debridement.

Conclusion: After instrumented spinal surgery, the management of late-onset deep SSI is important and difficult since it is strongly correlated with longer hospital stays, higher morbidity and medical expenses, and higher levels of dissatisfaction with the initial surgical procedure. There are currently no well recognized treatment procedures for profound SSI with a late start. In the current study, the keys to effectively treating the infections and keeping the implants in place include prompt diagnosis, aggressive and careful debridement, and regular administration of antibacterial medicines.

Keywords: Late onset, Spinal Surgery and Surgical Site Infection.

Introduction

Even with the emphasis on the consideration of basic procedures to reduce postoperative surgical site infection (SSI), particularly with instrumentation, late-onset deep SSI remains one of the most challenging cases in spine surgery. It is still one of the main causes of morbidity and death, resulting in extended hospital stays, reoperations, and the long-term usage of antibiotics. It has been reported that the incidence of SSI following instrumented spinal surgery varies between 2.2 and 20% [1–6]. After spinal instrumentation, the majority of studies have indicated that total implant removal is necessary for treating late-onset deep SSI [1, 7–9]. Because biofilms form on metal instruments and reduce the effectiveness of antibiotics, implant retention may help inhibit the elimination of bacteria. In an attempt to control infection, implant removal prior to graft fusion

might be a challenge since it may create spinal instability, which can lead to clinical symptoms such radicular pain, back pain, or neurologic impairments. [10] As a result, the two objectives frequently conflict. Is it feasible to maintain implant retention while also treating the infection? In order to treat late-onset deep SSI following instrumented spinal surgery, the current study aims to assess vigorous debridement with equipment retention, high vacuum closed-suction drain without irrigation, primary wound closure, and antibiotic therapy. [11,12]

Methods

In our institution's spine center, a retrospective assessment of 2028 patients who had instrumented dorsal spinal procedures was carried out. A complete blood count, erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), procalcitonin (PCT), histopathological findings, radiologic examination (MRI), and laboratory results all supported the diagnosis of late-onset deep SSI. Other symptoms that supported the diagnosis included persistent back pain. Occasionally, a disease resulting in an abscess or other signs of infection in the deep soft tissue, muscle, and fascia was detected using color Doppler ultrasonography.

On all infected patients, aggressive, precise surgical debridement of all devitalized tissue was carried out on schedule. The posterior approach—that is, the method employed during the first surgery—was employed to make the incision. First, a sucker was used to remove all of the pus. Second, a large portion of the necrotic and devitalized tissue—including the cyst wall around the abscess—was removed. The biofilms that clung to the implant's surface were completely removed. To accurately prescribe postoperative antibiotic therapy, drug sensitivity tests of the necrotic tissue and biofilm were carried out together with bacterial cultures. After that, the wound was cleaned with a series of disinfectants, including a hydrogen peroxide solution, regular saline, povidone-iodine solution, and regular saline once more. Usually, the wounds were left to soak in a povidone-iodine solution for five to ten minutes. The initial wound closure operation was then carried out. Both running and interrupted sutures were used to tightly close the fascia, and the skin and subcutaneous tissues were regularly closed. Two closed-suction drains were then placed and left in place for a period of seven to ten days.

Results

Eighty-four (2.08%) were found to have profound SSIs with a late start. The mean age of the 50 men and 34 women was 73 years old (range: 55 to 85 years old). Deep SSIs with a late onset occurred 22.19 weeks after surgery (range: 6 weeks to 1 year). Of the patients with late-onset deep SSI, 78 patients (92.85%) had transforaminal lumbar interbody fusion (TLIF) or posterior lumbar interbody fusion (PLIF) of the lumbar spine, and 3 patients (14.28%) had laminoplasty of the cervical spine. Table 1 lists specific patient information, such as preoperative physical state as defined by the American Society of Anesthesiologists (ASA) and the existence of diabetes mellitus. In Table 2, the infectious organisms are displayed. In this cohort, the most frequent pathogen causing late-onset deep SSI was Staphylococcus aureus, with Escherichia coli coming in second. Bacterial culture results for seven patients with late-onset deep SSI were negative. While four patients had their internal fixation device removed due to a Staphylococcus aureus infection, the remaining eighty patients kept their equipment. The patient, who was 72 years old, had posterior lumbar interbody fusion (L4/5). Thirteen weeks after surgery, he still had low back pain and fluctuating indicators of wound irritation. The results of the lab test revealed rising serum PCT, CRP, and ESR levels. A high-intensity signal in the deep tissue was shown by the MRI test. As soon as profound SSI was diagnosed, surgical debridement was carried out. Upon debridement, the instrumentation was discovered to be loose, and the screws and rods were taken out. However, during the follow-up period, all 84 patients in this group had their infections cured without any recurrence. In every case, the surgical incision healed primarily, and the stitches were taken out two to three weeks after debridement.

In Table 2, the infectious organisms are displayed. In this cohort, the most frequent pathogen causing late-onset deep SSI was Staphylococcus aureus, with Escherichia coli coming in second. Bacterial culture results for seven patients with late-onset deep SSI were negative. One patient had the internal fixation device removed due to a Staphylococcus aureus infection, whereas forty-one patients kept their instrumentation. The patient, who was 72 years old, had posterior lumbar interbody fusion (L4/5). Thirteen weeks after surgery, he still had low back pain and fluctuating indicators of wound irritation. The results of the lab test revealed rising serum PCT, CRP, and ESR levels. A high-intensity signal in the deep tissue was shown by the MRI test. As soon as profound SSI was diagnosed, surgical debridement was carried out. Upon debridement, the instrumentation was discovered to be loose, and the screws and rods were taken out. However, during the follow-up period, all 84 patients in this group had their infections cured without any recurrence. In every case, the surgical incision healed primarily, and the stitches were taken out two to three weeks after debridement.

Table 1: Patient background information and specifics for delayed deep SSI

		Cervical spine Lumbar spine	Cervical spine Lumbar spine
Number		6	78
Age		70	73
Gender (M:F)		4:2	46:42
ASA physical status	1	4	26
	2	2	48
	3	0	4
No. of patients with diabetes mellitus		0	22
No. of fused segments		0	100
Laminoplasty		6	0
PLIF		0	42
TLIF		0	26

Table 2: Bacteria isolated from intraoperative tissue samples in 42 patients

Staphylococcus aureus	26
Escherichia coli	14
ESBL of Escherichia coli	6
Enterobacter cloacae	6
MRSA	4
Acinetobacter baumannii	4
Klebsiella pneumoniae	4
Enterococcus faecium	2
Pseudomonas aeruginosa	2
Staphylococcus haemolyticus	2
No bacteria cultured	14

Debridement

Debridement should be carried out as soon as late-onset deep SSI following instrumented spinal surgery is confirmed. This is because the infection may spread to neighboring areas, making treatment more difficult, particularly in the event of a high-pressure abscess, and the implants may be loose, which could result in internal fixation failure and insufficient spinal fusion. Furthermore, some bacteria have the ability to adhere to implant surfaces and create biofilms that make infections challenging to cure. These challenges are attributed to the fact that bacteria can create biofilm colonies that are resistant to antibiotic treatment by producing and embedding in an extracellular polymeric material matrix [13]. The benefit of removing the implants during debridement is that it gets rid of the germs that are residing in biofilms on the surface of the implants, increasing the likelihood that the infection will be eradicated. However, the hazards of removing implants too soon, which are necessary to preserve spinal stability and normal spinal alignment, must be considered in addition to this possible benefit. Our findings, based on 84 patients with late-onset deep SSI, indicate that implants can be kept in place as long as they are not loosening, aggressive and careful debridement is carried out as soon as feasible, and the biofilms that have adhered to the surface of the implants are completely removed. Primary wound healing may benefit from hydrogen peroxide washing and povidone-iodine solution soaking.

Drain Placement and Irrigation: Although the use of drains in posterior spinal surgery remains controversial [14, 15], In spinal surgery, a closed suction drain is frequently inserted to avoid the formation of an abscess or epidural hematoma, which can cause spinal cord compression and even paralysis [16, 17]. Following debridement, this group had two types of drains installed: a high vacuum wound drainage system (HVWD) and a closed-suction drain (CSD), similar to a Hemovac drain. HVWD is a helpful adjuvant that makes it easier to apply regulated negative pressure in order to remove fluid from wounds that have accumulated, improve local blood flow, lower the bacterial load, encourage muscle tissue closure and wound healing, and lower the chance of retrograde contamination. Since all patients had primary closure of the wound, vacuumassisted closure (VAC), a kind of device that efficiently uses a porous foam sponge to enhance wound healing, was not employed in this group. Furthermore, there have been reports of serious side effects (such as uncontrollably developing sepsis and significant blood loss) linked to the use of VAC [18]. When the discharge was found to be less than 20 milliliters, the CSD was withdrawn approximately 10 days after surgery, and the HVWD was typically maintained for about 7 days. In the therapy of SSI, wound irrigation has been utilized to lower the quantity of contaminated bacteria. After

debridement, the majority of authors advise keeping the wound open and irrigating it with plain saline antibiotic until it is clean enough for delayed-staged closure [19, 20]. Irrigation is useful in treating wound infections that occur after instrumented spinal fusion, but it can also lead to bacterial diffusion into the surrounding tissue, making infection control challenging. All 84 patients in this group had primary wound closure utilizing HVWD and CSD without any irrigation. Sutures that were both running and interrupted securely sealed the fascia. The skin and subcutaneous tissues were regularly closed. Based on the results of this study, we conclude that drains, particularly a high negative pressure drainage system, must be installed following surgical debridement in order to treat late-onset deep spinal SSI following instrumented spinal surgery. After careful and comprehensive debridement, irrigation is not required if primary wound closure is carried out firmly using a high vacuum closed-suction drainage system.

Antibiotic therapy: The literature has a variety of recommendations about the kind and length of antibiotic therapy. According to some writers, antibiotic medication should be continued intravenously for at least six weeks and then orally for several weeks after that [21, 22]. Some experts have suggested giving intravenous antibiotics for two to five days, then oral antibiotics for seven to fourteen days [9]. In the current study, however, oral antibiotic treatment was administered for an additional six weeks after the intravenous antibiotic course lasted for six weeks. Three months was the length of the antibiotic therapy regimen. Kowalski and associates [8] found that long-term antibiotic therapy was linked to a higher chance (80% vs.33%) of curing infections and keeping implants in place as compared to no suppressive drugs. For bacterial cultures, pus, biofilms, and necrotic tissue were extracted from deep within the wounds of all 42 patients. The results of the bacterial culture were positive in 35 patients (83.33%). Antibiotic sensitivity tests were performed on all isolated bacteria, which assisted an infectious disease specialist in administering antibiotic therapy. Thirty-six patients (30.95%) had Staphylococcus aureus, the most prevalent pathogen associated with SSI and skin and soft tissue infections. Because low virulent bacteria are typically the source of late-onset deep site infections, they are more often culture negative than early infections. Table 2: Bacteria identified from 84 patients' intraoperative tissue samples Aureus Staphylococcus 26 Escherichia coli 14 Escherichia coli ESBL 6 MRSA, 6 Enterobacter cloacae 4 Enterococcus faecium, 4 Klebsiella pneumoniae, 2 Pseudomonas aeruginosa, and 4 Acinetobacter baumannii 2. Haemolytic Staphylococcus 2 non-cultivated bacteria: MRSA and ESBL Extended-spectrum ß-lactamase resistant to methicillin Aureus Staphylococcus BMC Surgery (2018) 18:121 Page 4 of 6 pathogens Yin et al [23, 24]. In this group, 7 patients (16.67%) obtained negative results from bacterial cultures. There is a suggestion that low pathogenicity organisms can thrive more easily in a favorable environment created by postoperative sterile inflammatory processes [25]. Furthermore, the pathogen might have been hard to find if the bacterial culture period had been too short or if the interval between sampling the infected tissue and the laboratory bacterial culture had been too long. If the infected tissue specimens were placed on the culture medium as soon as possible after the deep cut and the bacterial culture time was extended for proliferation, the rate of positive bacterial culture may be increased. However, the seven patients also received regular administration of six weeks of oral antibiotic medication after six weeks of intravenous antibiotic therapy. The current investigation indicates that regardless of the outcome of bacterial culture, the regular and sufficient administration of sensitive antibacterial drugs is essential for infection control and implant retention.

Discussion

After spinal surgery, SSI is a rare but severe complication. The literature has long established the risks of infection associated with a number of factors, including age, obesity, diabetes mellitus, smoking, prior surgery, longer duration of surgery, posterior surgical approach, use of spinal equipment, poor general or functional state, and the operating room environment [2, 5, 6, 10, 11]. Managing late-onset deep SSI following instrumented spine operations is especially challenging due to the implanted and potentially infected instrumentation. Since it is still unclear whether it is preferable to remove or leave the implants in place, it is crucial to understand how to handle late-onset deep SSI. It was formerly believed that spinal instrumentation may serve as a culture medium for the growth of bacteria, hence implant removal was essential [1,7–9]. But taking out implants to try and manage infection before bone-graft fusion might cause spinal instability, loss of correction, and clinical symptoms such radicular discomfort, back pain, or neurological impairments [12]. Retention of implants and infection control are frequently at odds with one another. However, there are differences in the techniques used today about the necessity of implant removal.

Conclusions

These days, treating many spinal problems involves the use of instruments. After instrumented spinal surgery, the management of late-onset deep SSI is important and difficult since it is strongly

correlated with longer hospital stays, higher morbidity and medical expenses, and higher levels of dissatisfaction with the initial surgical procedure. There are currently no well recognized treatment procedures for profound SSI with a late start. In the current study, the keys to effectively treating the infections and keeping the implants in place include prompt diagnosis, aggressive and careful debridement, and regular administration of antibacterial medicines. This study has some implications for the management of late-onset deep SSI following instrumented spinal surgery, despite its limitations as a retrospective survey with a small number of patients and a brief follow-up period.

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