Case Series of the Management of Surgical Site Infection Following Thoracic Spinal Surgeries During COVID Pandemic

Neetin Mahajan[1], Sunny Sangma[1], Jayesh Mhatre[1], Pritam Talukder[1]

Abstract

Introduction: Post-operative spinal wound infection increases the morbidity of the patient and the cost of healthcare. Despite the development of prophylactic antibiotics and advances in surgical technique and post-operative care, wound infection continues to compromise patient outcome after spinal surgery. This kind of infection places the patient at risk for pseudoarthrosis, adverse neurologic sequelae, chronic pain, deformity, and even death. In spite of all preventive measures, the SSI following spinal surgeries are 1% among operated spinal instrumentation.

Case Series: Here, we present a series of three patients who presented to us with post-operative surgical site infection (SSI) in spine surgery in the form of wound, discharge, and other complaints. Out of all, two of them were operated with debridement and skin closure followed by broad spectrum IV antibiotics and one of them managed with vacuum-assisted closure dressing and high antibiotics sensitive to organisms found in wound culture. Optimization by building up hemoglobin, supplementing micronutrients including Vitamin C, D, and B12 and high protein diet was started as adjuvant therapy and all of them was discharged with healthy wound.

Conclusion: SSI in spine surgery is a common but challenging complication, particularly after instrumental spinal arthrodesis. Using meticulous aseptic technique, intra-operative irrigation, prophylactic antibiotics, and optimizing patient factors preoperatively are key to preventing a SSI. In patients who still develop an infection despite efforts at prevention, timely diagnosis and treatment are critical. Instrumentation can be retained while still successfully clearing an early infection, although following fusion, instrumentation can be removed if lifetime oral antibiotic suppression is either not indicated or undesirable.

Keywords: Spine surgery, Postoperative infections, Surgical site infection, Spinal instrumentation.

Introduction

The incidence of post-operative spinal infections increases with the complexity of the procedure and is considered as significant source of morbidity after any spinal procedure. Post-operative spinal wound infections are relatively common, and they are associated with significant morbidity, increased health-care cost, and poor long-term outcomes. It is observed over the period that diskectomy is associated with <1% risk of infection; spinal fusion without instrumentation is associated with a 1–5% risk; and fusion with instrumentation may be associated with a risk of 6% or more. Furthermore, spine instrumentation can cause local soft-tissue irritation leading to inflammation and seroma formation that subsequently provides a fertile breeding ground for micro-organisms to grow. Risk factors appeared to include advanced age, prolonged hospital bed rest, obesity, diabetes, immunosuppression, and infection at remote sites. Operative factors included prolonged surgery (>5 hours), high volume of personnel moving through the operating room, and instrumentation. Post-operative contamination may occur and may be related to prolonged post-operative bed rest, skin maceration (thoracolumbosacral orthoses), and drainage tubes exiting distally from lumbar wounds (toward the rectum) [1].

Postoperative spinal infections present with a diverse degree of severity from superficial skin incision infections to deep subfascial infections with muscle necrosis and often require prolonged hospitalization, daily wound dressing, vac therapy, revision surgical procedures, and long-term intravenous antibiotics. The study has showed that Staphylococcus aureus

[1]Department of Orthopaedics, Grant Government Medical College, Mumbai, Maharashtra, India.

Address of correspondence :
Dr. Sunny Sangma,
Department of Orthopaedics, Grant Government Medical College, Mumbai, Maharashtra, India.
E-mail: Sunnysangma11@gmail.com

Submitted: 05/09/2021; Reviewed: 19/10/2021; Accepted: 25/01/2022; Published: 10/04/2022

Back Bone: The Spine Journal (The Official Journal Of "Spine Association of Gujarat") | Available on www.backbonejournal.com | DOI:10.13107/bbj.2022.v03i01.036

is the most common offending organism responsible. However, an increased incidence of other bacterial agents has been reported, including Staphylococcus epidermidis and more virulent bacteria, such as methicillin-resistant S. aureus (MRSA). The virulence of the infecting organism and the host response influence treatment and determine outcome. Infection after spinal surgery may pose diagnostic challenges and difficult management questions. Awareness of risk factors and preventive measures can lead to improved outcomes. Definitive management is based on etiology, clinical course, and patient risk factors [2].

Case Series

1. A 26-year-old female came to us with complaint of wound at operated suture site and pus discharge for 3 months (Fig. 1) which was a case of D6, D7, and D8 vertebra Pott's spine shown in MRI (Fig. 2) and got operated 1½ year back with a procedure of posterior instrumentation with post-operative X-rays as shown in (Fig. 3). Patient was currently taking antitubercular drugs and on local examination the wound measured 8 × 3 cm in dimension over a suture line associated with a yellowish discharge. On neurological examination, there was no any neurological deficit with bowel and bladder intact and normal reflexes. Patient was thin build on appearance and had a chief complaint of pain and mild swelling around the wound and no any systemic signs of infection were noted like fever. On detailed history, it has come to our knowledge that patient lost follow-up and neglected to show up early due to COVID-19 Pandemic. Patient was admitted and daily cleaning and dressing were done and high protein diet was advised. ESR and CRP were raised and found to be on increasing trend for 3 weeks followed by decrease in range and pus culture sensitivity report of wound showed coagulase negative methicillin resistant staphylococcus and as per sensitivity Inj. Linezolid with Inj. Amikacin IV antibiotic was started and continued for 4 weeks. Pus culture of wound was repeated after 2 weeks which showed no organism and also no any fungus was

Figure 1: showing bleb over surgical suture site when presented to us.

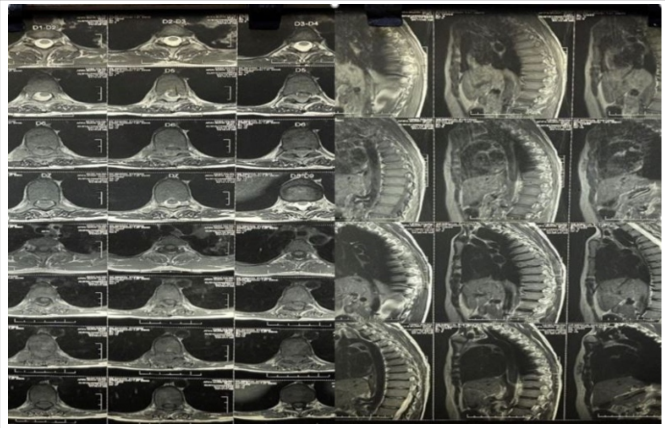

Figure 2: Pre-operative MRI of axial and sagittal view.

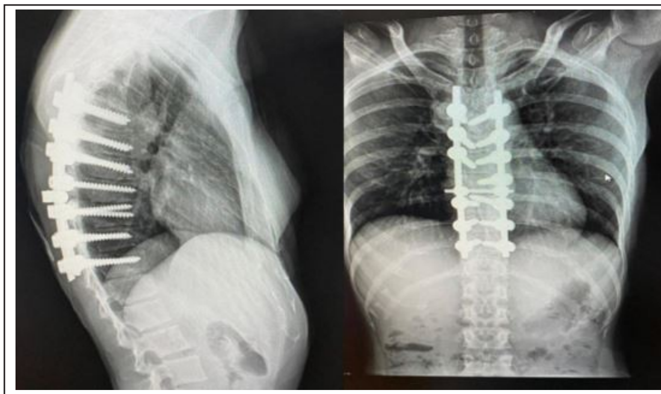

Figure 3: Post-operative X-rays of lateral and AP view.

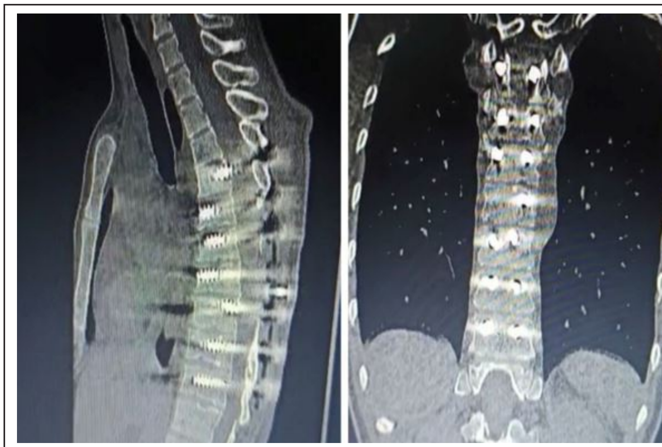

Figure 4: CT scan done postoperatively to look for bony union.

Figure 5: Post-VAC dressing showing healed wound with no any discharge and wound gap.

detected. Category-2 antitubercular drugs was started with bedaquiline regimen daily for 2 weeks followed by alternate day thrice a week. MRI and CT scan was done to see for infection and bony union (Fig. 4). Following cleaning and dressing, two settings of vacuum-assisted closure (VAC) dressing were applied and post-VAC removal as shown in (Fig. 5) showed improved in wound healing.

2. A 42-year-old male presented to us with complaint of mid back pain and paraplegia for 6 days with history of fall with MRI showing subluxation of D4 over D5 associated with D5 vertebra fracture in (Fig. 6). There was no any history of head, chest, and abdomen injury but is a known case of diabetes mellitus on insulin and HbA1c 8.6. Neurological examination findings were lower limb power 0/5, sensation absent below xiphisternum, and involvement of bowel bladder. Patient was seen by physician in view of diabetes and started on new insulin dose and blood sugar was optimized under control. Patient was planned and operated with posterior instrumentation and decompression (Fig. 7) keeping drain suction and the procedure was uneventful. Post-operative patient was reviewed for diabetes and insulin dose was increased with proper HGT charting that was maintained. Wound dressing was done on 3rd day and drain was removed with no any discharge. Till the time sensation was present till T10 dermatome with positive finding of mild flickering seen on the right leg. In between, fluctuation of blood sugar was seen with raised above normal level and sometimes drop to normal value. ESR and CRP were found to be raised postoperatively and broad spectrum antibiotic IV Inj. Piptaz was started. Patient was advised log rolling 2 hourly with Taylor's brace and high protein diet given. On post-operative day 7, surgical site wound was found to be macerated over distal site followed by suture removal on post-operative day 12 with sign of wound gaping and serosanguinous discharge over distal site (Fig. 8). Patient was then posted in OT for debridement and skin closure with intra-operative pictures (Fig. 9) and intra-operative wound culture sensitivity was sent which showed no organism found. On post-operative day 1 of debridement, sensation was present till L2 dermatome and ESR, CRP was raised. All four limb physiotherapy was started and wound dressing was done on post-operative day 3 with no any sign of discharge. On 7th day, post-operative wound looks healthy than before followed by alternate suture removal on post of day 14th. ESR and CRP were found to be in decreasing range and at this time, wheelchair mobilization was started. Suture removal was delayed and kept under observation with broad spectrum antibiotics and high protein diet till post-operative day 26 where complete suture removal was done and wound showed healing (Fig. 9).

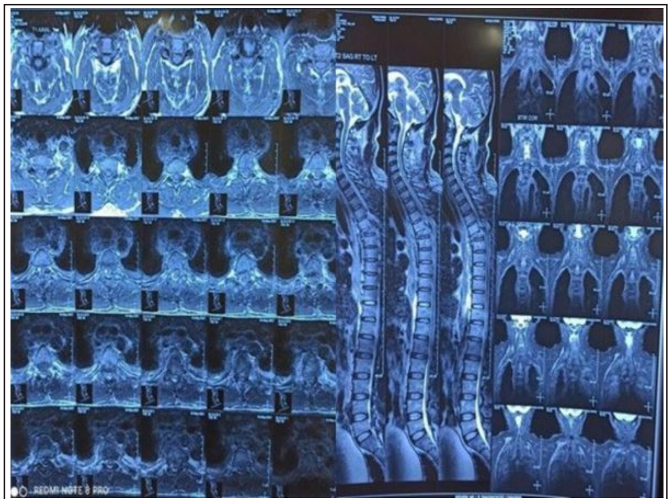

Figure 6: Pre-operative MRI showing subluxation of D4 over D5.

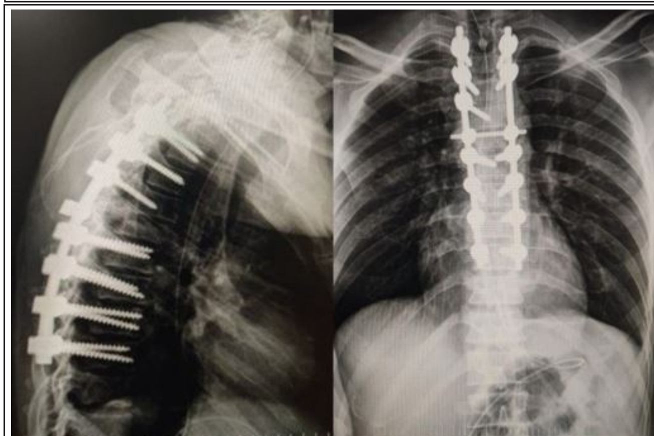

Figure 7: Immediate post-operative X-rays operated with posterior instrumentation and decompression.

Figure 8: Wound dressings on different post-operative day 3, 7, and 12 varying from skin maceration to suture removal with wound gap.

Figure 9: Intra-operative debridement followed by wound dressing on different post-operative day and suture removal with healthy wound.

3. A 26-year-old male presented to us with complaint of bleb over proximal surgical suture site associated with pain and discharge for 1 day (Fig. 10). He was a case of D9 and D10 pott's spine as shown in MRI (Fig. 11) and got operated with posterior instrumentation 1 month back with post-operative X-ray (Fig.12). Patient was admitted and bleb got ruptured on its own whose wound swab culture sensitivity was sent and report showed no organism found. He was started on broad spectrum IV antibiotic Piptaz 4.5 gm and high protein diet was advised. ESR and CRP showed raised in value and were planned to post in OT. He was operated with debridement and skin closure with drain suction intact and intra-operative tissue sample was sent for various test and in report, mycobacterium tuberculosis was detected. We started him on antitubercular drugs and kept under observation. Wound was healthy with no any discharge on post-operative day 3, with small amount of collection in drain which was removed at the time of dressing followed by complete suture removal on post-operative day 13 (Fig. 13).

Figure 10: Bleb over surgical suture site when presented to us.

Figure 11: Pre-operative MRI showing D9D10 Pott's spine.

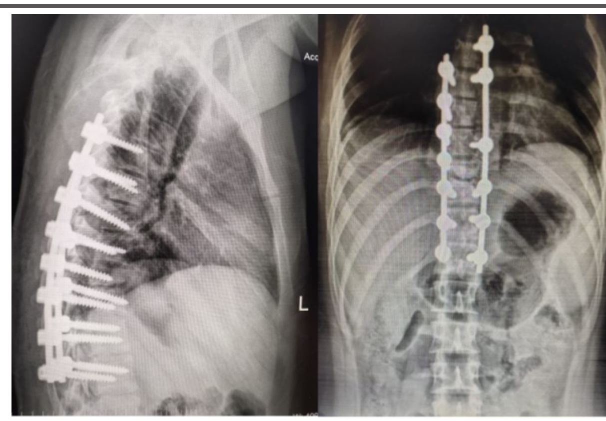

Figure 12: Post-operative X-ray operated with posterior instrumentation.

Figure 13: Post-debridement wound dressing on 3rd day followed by complete suture removal with healthy wound.

Discussion

Post-operative spinal wound infection increases the morbidity of the patient and the cost of healthcare. Despite the development of prophylactic antibiotics and advances in surgical technique and post-operative care, wound infection continues to compromise patient outcome after spinal surgery. Spinal instrumentation also has an important role in the development of post-operative infections. Some reported theories as to the possible causes of delayed infections include intra-operative inoculation of low-virulence bacteria, metal fretting causing sterile inflammation, and hematogenous seeding. Intra-operative seeding often appears clinically as a wound infection that occurs early in the post-operative period [3,4,5].

The bacteria of normal skin flora are thought to be carried into the wound during surgery. Adherence of bacteria to the surface of implants is promoted by a polysaccharide biofilm called glycocalyx that acts as barrier against host defense mechanisms and antibiotics [6,7,8].

It is difficult to prove intra-operative seeding, as a cause for an infection appearing late after surgery. A study was conducted to evaluate the incidence of positive cultures with elective orthopedic surgery and bacterial cultures were obtained from the wounds of 40 patients [9] Twenty-three positive cultures (58%) were found, which contained propionibacterium acnes in 8 cultures (24%) and coagulase-negative staphylococcus in 19 cultures (58%), peptiostreptococus in two cultures, and miscellaneous organisms in four cultures. Of studies that include information regarding cultures obtained for studying the source of infection, low-virulent bacteria are the common finding [10, 11, 12].

Richards [8], in 1995, reported a series of 10 patients who had a delayed infection and four patients had undergone surgery within 4 weeks of when a new instrumentation system was being introduced. The authors reported that they had additional observers in the operating room, which they believe might have been the cause of the infections [8]. Clark and Shufflebarger [13] also mentioned the presence of visitors in the operating room and reported a 1.7% incidence rate of late infection over a 10-year period of time.

Richards and Emara [14] suggest that the operative field be sealed with an adherent plastic barrier that is iodine impregnated. The authors also recommend the use of subcutaneous drains to decrease hematoma formation, which would provide a suitable culture media for bacteria. Finally, reducing the size and number of components to the implant systems should minimize irritation and inflammation that provide a favorable environment for low-virulent bacteria.

Some reports of the late presentation of local drainage indicate that metal fretting or micromotion between the parts of the implant caused a sterile inflammatory response [11, 15]. In the case reported by Hatch et al. [15], the patient had inflammatory adherence of paraspinous musculature to the fusion mass and small pockets of purulent-looking fluid adjacent to the hardware, but the cultures were found to be negative for bacteria organisms. Dubousset et al. [11] reported sterile inflammatory reactions to corrosion of instrumentation in 18 patients, and negative cultures were found for 16 of these patients. Wimmer and Gluch [16] reported aseptic loosening of instrumentation in six patients, which required removal of the implants. All the cultures, tested with 10 days incubation, were negative for bacteria. Richards and Emara [14] point out the need to allow at least 10 days incubation because P acnes requires an extended time before identification can be made. Richards and Emara state that the combination of hematoma formation and soft-tissue reaction to significant amounts of hardware and metal fretting promotes an environment conducive to the growth of bacterial organisms, and they firmly believe that, in spite of the negative cultures found in some studies, delayed drainage is probably caused by a bacterial infection [8, 14].

Heggeness et al. [10] were the first to describe hematogenous seeding as a possible cause of a delayed infection after instrumented spine surgery. The authors reported six cases of spinal infections at 10 months or more after surgery, of which five patients had a distant focus of infection before clinical symptoms of a spinal infection occurred. Possible sources of infection included paraplegia with neurogenic bladder (two patients), pyelonephritis and renal calculi (one patient), and intravenous drug abuse (two patients). The author stated that the infections occurred because the implants were large and there was an intermittent and underlying source of recurrent bacteremia. Although only three of the six patients were reported to have pain, the authors recommended that patients who have late increasing pain should be investigated for infection. All patients described in this present report had a distant focus of infection before clinical symptoms of spinal infection occurred and this author believes that hematogenous seeding was the cause [10].

Clinical symptoms

Out of the various clinical symptoms found in this review of the reported cases, drainage appears to be most common. Many patients had either a fluctuant mass and localized drainage or an abscess. Viola et al. [6] in the case study found that fever is thought to be an uncommon finding, and this appears to be accurate given that only six patients in this review were reported to have a fever. Three of the patients reported to have a fever were part of the series by Heggeness et al. [10]. The other three patients reported to have a fever were part of the 23 patients reported by Richards and Emara [14]. Certainly, a distant focus of infection might cause a fever, but the symptom of a fever was not consistently found in this review. A high level of suspicion for infection must be kept even though the patient is afebrile. Viola et al. [6] stated that increased back pain and elevated ESR are the most reliable indicators of a spinal infection. In their series of eight patients, all had significant increase in back pain before the infection was found. In addition, seven of the eight patients had an elevated ESR of 57 mm/hour. Increased back pain was found in 31 of the 96 cases reviewed in this report. Clark and Shufflebarger [13], however, stated that pain was not a factor in their series. Certainly, unexplained or increasing pain late after surgery deserves further investigation for a possible infection.

Diagnostic imaging

Diagnostic imaging may be of some assistance to determine if an infection is present, especially in recent years when improvements and advancements have been made with diagnostic techniques. In the cases reviewed in this report, only a few mention the use of diagnostic imaging [10, 12, 16]. Robertson and Taylor [12] used plain radiographs, CT, Tech-bone scan, and gallium scan in one of their patients who developed a sinus in the left groin 10 years after cervical fusion. Radiographs, CT, and Tech-bone scan were normal, but the gallium scan showed a deep paraspinal infection. Heggeness et al. [10] used CT for a patient who experienced back pain and fever 1 year after being treated for an L2 burst fracture. The CT revealed a large retroperitoneal abscess contiguous with the instrumentation. Wimmer and Gluch [16] reported on a series of eight patients whose plain radiographs showed signs of implant loosening, and six of those patients experienced painful swelling and a discharging sinus at a mean of 21 months after surgery.

Rigamonti et al. [17] reviewed 75 cases of spinal epidural abscesses at their institution and found that 11 of the patients (15%) had undergone previous spinal surgery. All patients who underwent CT evaluation had findings suggestive of an epidural process. MRI evaluation with gadolinium enhancement was also accurate for all 59 patients who underwent the evaluation. The MRI characteristics showed that the epidural mass was either isointense or hypointense on T1-weighted images but was hyperintense on T2-weighted images. Gadolinium enhancement demonstrated linear enhancement surrounding purulent or necrotic matter. Although MRI with enhancement and CT can be 91% sensitive for detecting an infection [18, 19], the difficulty in diagnosing the infection lies in the physician's clinical suspicion.

Treatment

The most common treatment is surgical site infection (SSI) in spine surgery that can be difficult to manage and often necessitate prolonged hospitalization, extended use of antibiotic therapy, wound debridement, and irrigation or instrumentation removal [6, 12, 20]. Removal of the instrument must be necessary in some cases because it is the glycocalyx substance covering the instrumentation that is usually the source of infection, and only by removing the instrumentation will the glycocalyx and the bacteria be eradicated. However, if the infection occurs before the fusion matures, the instrumentation should remain in place if possible and irrigation and debridement can be used successfully [5].

The traditional protocol treatment of SSI of post-operative spine is early recognition, debridement, irrigation, and culture-specific antibiotic administration, if diagnosed of deep wound infection then patient is planned surgical intervention, where the wound is thoroughly debrided and irrigated under general anesthesia; if the tissue has no necrosis and is clean at the end of the debridement, the wound is closed over suction drain [3, 21]. If after the debridement the tissue looks questionable, the wound is packed open and redebrided in 2–4 days. Many authors agree that it is always useful to obtain a microbial culture of the infected wound to start a specific intravenous antibiotic therapy [3]. The initial step is to obtain cultures in the absence of antibiotics. An immediate Gram stain and culture of the deep wound should be taken. Initially, broad-spectrum antibiotics are administered, including vancomycin, in case, MRSA is present [2]. Short-term parenteral antibiotics followed by oral antibiotics are typically used for spinal infections [6, 14]. Furthermore, Weinstein et al. [3] suggest that definitive treatment depends on the culture results but generally, they consider infections with anaerobes as polymicrobial to be treated with IV broadspectrum antibiotics, such as vancomycin or metronidazole, administered IV for 6 weeks minimum. An infectious disease consultation is strongly recommended. Antibiotics are adjusted or discontinued based on clinical response and inflammatory parameters. Nutritional consultation is encouraged because these patients are malnourished and require high caloric intake. Assessment with serum albumin may help with monitoring patient nutrition levels [2].

Antibiotics likely will fail in a patient with extensive spinal infections in conjunction with instrumentation. However, their use may postpone hardware removal and enable a fusion mass to solidify. In the reports of sterile inflammatory response [11, 16], it is unclear as to how antibiotics were used. In case of infection with a delayed onset of more than 37 weeks, the instrumentation can be removed because the arthrodesis should be solid [4, 21]. Dubousset et al. [11] stated that all the hardware was removed and healing was effective without "extended antibiotics." There is no mention of whether antibiotics were used after removal of the implants in the report by Wimmer and Gluch [16]. If the cause of drainage found in these patients was sterile inflammation from the implants, then removal of the implants should be effective treatment as it is doubt and unclear about the effectiveness of antibiotic. In this review of 97 cases, only six patients did not have the instrumentation removed. Heggeness et al. [10] did not remove the instrumentation in two of the six patients in the series. One patient was treated with a long bore catheter to drain the abscess but refused further treatment. The other patient had soft-tissue swelling at the proximal end of the incision, and although it is not stated, it may have been more superficial and not related to instrumentation. In the case series by Wimmer and Gluch [16], only six of the eight patients who had loose instrumentation experienced a discharging sinus. Therefore, the instrumentation was left intact for two of the patients without symptoms. In the present series, two patients had the instrumentation left intact because they had other health risks, they were clinically asymptomatic and it was believed that the infection could be resolved effectively with intravenous antibiotic treatment. In both cases, it was explained to the patient that surgery would be required if the antibiotic treatment was not effective. Typically, if the infection is found to be contiguous with the instrumentation or the instrumentation is thought to be a cause of the infection, the instrumentation should be removed.

On removal of instrumentation, the patient should be assessed for pseudoarthrosis. The patient should be followed closely to assess for deformity development. Plastic surgery consultation for soft-tissue flap coverage should be considered when extensive soft tissue is removed at the time of debridement [22, 23]. In case of complex wound, post-infection debridement and soft-tissue defects may result in difficult wound management. Depending on wound characteristics, the treatment may consist of granulation by secondary intention with wound vacuum assistance, temporary antibiotic beads, or coverage through muscle flaps. Vacuum-assisted therapy may be used to expedite wound closure. Its usefulness has been demonstrated in complex back wounds with exposed hardware and soft-tissue loss [24].

Conclusion

Despite all the measures to reduce the incidence of SSI in post-operative spine surgery, these remain a dangerous complication. However, prevention is the only way to solve the problem; the risk factors of each patient should be analyzed and the changeable ones should be eliminated. The efficacy of antibiotic prophylaxis appears to be the only action supported by evidence-based medicine techniques that reach the power of recommendation as a standard of the treatment. One meta-analysis indicates that administration of at least a single pre-operative dose of an antibiotic with Gram-positive coverage is effective in reducing the incidence of infection. In both, the short and long post-surgical period, surveillance by the surgeon is vital to an early diagnosis; once the infection is diagnosed, a treatment strategy should be planned. The key points of the treatment are aggressive surgical treatment and targeted antibiotic therapy to eradicate the infection and limit damage to local tissues including the neural structure.

References

1. Massie JB, Heller JG, Abitbol JJ, McPherson D, Garfin SR. Postoperative posterior spinal wound infections. Clin OrthopRelat Res. 1992 Nov;(284):99-108. PMID: 1395319.
2. Sasso, Rick C. MD; Garrido, Ben J. MD Postoperative Spinal Wound Infections, Journal of the American Academy of Orthopaedic Surgeons: June 2008 - Volume 16 - Issue 6 - p 330-337
3. Weinstein MA, McCabe JP, Cammisa FP Jr. Postoperative spinal wound infection: a review of 2,391 consecutive index procedures. J Spinal Disord 2000;13: 422-6.
4. Picada R, Winter RB, Lonstein JE, et al. Postoperative deep wound infection in adults after posterior lumbosacral spine fusion with instrumentation: incidence and management. J Spinal Disord2000;13:42- 5
5. Ido K, Shimizu K, Nakayama Y, Shikata J, Matsushita M, Nakamura T. Suction/irritation for deep wound infection after spinal instrumentation: a case study. Eur Spine J 1996;5:345–9.
6. Viola RW, King HA, Adler SM, Wilson CB. Delayed infection after elective spinal instrumentation and fusion. A retrospective analysis of eight cases. Spine 1997;22:2444–51.
7. Gristina AG, Costerton JW. Bacterial adherence to biomaterials and tissue. The significance of its role in clinical sepsis. J Bone Joint Surg Am 1985;67:264–73.
8. Richards B. Delayed infections following posterior spinal instrumentation for the treatment of isopathic scoliosis. J Bone Joint Surg Am 1995;77:524–9.
9. Dietz FR, Koontz FP, Round EM, Marsh JL. Thee importance of positive bacterial cultures of specimens obtained during clean orthopaedic operations. J Bone Joint Surg Am 1991;73:1200-7
10. Heggeness MH, Esses SI, Errico T, Yuan HA. Late infection of spinal instrumentation by hematogenous seeding. Spine 1993;18:492–6.
11. Dubousset J, Shufflebarger H, Wenger D. Late "infection" with CD instrumentation. Orthop Trans 1994;18:121.
12. Robertson PA, Taylor TK. Late presentation of infection as a complication of Dwyer anterior spinal instrumentation. J Spinal Disord1993;6:256–9.
13. Clark CE, Shufflebarger HL. Late-developing infection in instrumented idiopathic scoliosis. Spine 1999;24:1909–12.
14. Richards BS, Emara KM. Delayed infections after posterior TSRH spinal instrumentation for idiopathic scoliosis. Spine 2001;18:1990–6
15. Hatch RS, Sturm PF, Wellborn CC. Late complication after single rod instrumentation. Spine 1998;13:1503–5.
16. Wimmer C, Gluch H. Aseptic loosening after CD instrumentation in the treatment of scoliosis: a report about eight cases. J Spinal Disord1998;11:440–3.
17. Rigamonti D, Liem L, Sampath P, et al. Spinal epidural abscess: contemporary trends in etiology, evaluation, and management. Surg Neurol 1999;52:189–97
18. Post MJD, Sze G, Quencer RM, Eismont FJ, Green BA, Gahbauer H. Gadolinium-enhanced MR in spinal infection. J Comput Assist Tomogr1990;14:721–9.
19. Smith AS, Blaser SI. Infectious and inflammatory processes of the spine. Radiol Clin North Am 1991;29:809–27
20. Thalgott JS, Cotler HB, Sasso RC, LaRocca H, Gardner V. Postoperative infections in spinal implants. Classification and analysis: a multicenter study. Spine (Phila Pa 1976) 1991;16:981-4.
21. Mehbod AA, Ogilvie JW, Pinto MR, et al. Postoperative deep wound infections in adults after spinal fusion: management with vacuum-assisted wound closure. J Spinal Disord Tech 2005;18:14-7.
22. Dumanian GA, Ondra SL, Liu J, Schafer MF, Chao JD: Muscle flap salvage of spine wounds with soft tissue defects or infection. Spine 2003;28: 1203-1211.
23. Mitra A, Mitra A, Harlin S: Treatment of massive thoracolumbar wounds and vertebral osteomyelitis following scoliosis surgery. PlastReconstr Surg 2004;113:206-213.
24. Yuan-Innes MJ, Temple CL, Lacey MS: Vacuum-assisted wound closure: A new approach to spinal wounds with exposed hardware. Spine 2001; 26:E30-33.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the Journal. The patient understands that his name and initials will not be published, and due efforts will be made to conceal his identity, but anonymity cannot be guaranteed.

Conflict of Interest: NIL
Source of Support: NIL

How to Cite this Article

Mahajan N, Sangma S, Mhatre J, Talukder P | Case Series of the Management of Surgical Site Infection Following Thoracic Spinal Surgeries During COVID Pandemic | Back Bone: The Spine Journal | April-September 2022; 3(1): 24-31.