Management of Postoperative Infections

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75.1 Introduction

Postoperative wound infection after instrumented spinal surgery is still one of the most common complication in spine surgery. It affects the clinical outcome negatively, makes operative debridement necessary and often even multiple revisions may be required, can lead to chronic pain and deformity, extends hospitalization and is therefore also responsible for higher treatment costs [1].

As the most frequent causative agent of postoperative wound infections the literature highlights Staphylococcus aureus and Staphylococcus epidermidis [2].

The incidence of post-operative spinal infection varies widely from 0.7% to 16%. The main reason for this wide range is that different types of interventions have different risks for postoperative infections. Therefore less invasive procedures present with a reduced infection rate compared to surgeries with additional instrumentation showing the highest risk for a postoperative surgical site infection.

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Numerous influences on the development of postoperative infections have been identified and can be divided into subgroups [3, 4]:

75.1.1 Patient Related Risk Factors

- Age (>65 yrs)
- Obesity (BMI >35 kg/m^2)
- Previous spine surgery
- Hyperglycaemia (perioperative (stress) hyperglycaemia in non-diabetics)
- Diabetes mellitus
- Malnutrition
- Nicotine abuse
- Steroid use
- Chronic obstructive pulmonary disease
- Osteoporosis

75.1.2 Procedure-Related Risk Factors

- Implants/instrumentation
- Posterior approach
- Tumor surgery (resection)
- Multilevel spondylodesis with inclusion of the sacrum
- Extended operating time
- Blood loss

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Postoperative wound infections can be classified into early and late infections. The exact onset of a late infection is not defined clearly. Some authors describe a late or delayed infection after more than 4 weeks postoperatively. But generally most of the literature accepts the detection of an infection after >3 months postoperatively as late infection [5]. In late (low-grade) infections the classical signs of infection like fever, night sweats, high white blood cell counts and elevated C-reactive protein can be absent. More often low virulence organisms like Propionibacteria are cultured in low-grade infections [6].

Regarding the therapy of wound infections, there are no uniform guidelines due to lack of reasonable studies. Often several revisions are necessary until a wound infection has been treated successfully. A national multicenter survey of spinal surgeons showed that 55% of the colleagues do not apply a fixed therapy standard to eradicate postoperative infections of the spine [7].

Therefore the next two following cases will demonstrate the different treatment options in an early and a late postoperative infection after spinal fusion surgery and will emphasize the potential problems and lack of evidence in the treatment of this disease.

75.2 Case Description

75.2.1 Early Infection

A 42 y/o male without any relevant comorbidities suffered from severe bilateral leg pain with a reduced walking distance due to ataxia. He presented a mild weakness of the right ankle extensors 4/5. Apart from numbness at the calves bilaterally there was a normal neurological status without any upper motor neuron signs. His MRI demonstrated a disc herniation at the level T11/T12 with spinal cord compression and myelopathy.

The patient was treated surgically and a single level TLIF fusion at T11/T12 with decompression was performed. There haven't been any intraoperative complications and the patient was well after the procedure and mobilized immediately (Figs. 75.1 and 75.2).

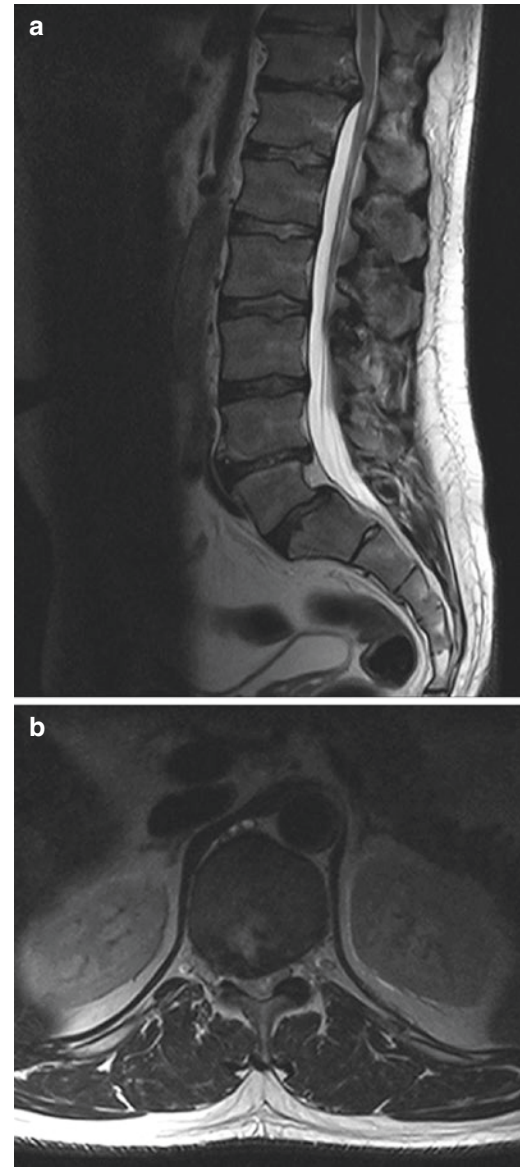

Fig. 75.1 MRI scan on outpatient visit. The MRI scan shows a right sided disc herniation T11/T12 with spinal cord compression and a myelopathy. Secondary finding was a spondylolisthesis L5/S1 (untreated). Sagittal (**a**) and, axial slices (**b**)

After 15 days postoperatively the patient returned to our outpatient clinic without any deterioration of pain but with subfebrile temperature and a leaking wound of the middle/distal part. The wound was covered with a fibrin layer but still attached. The collected blood showed only a

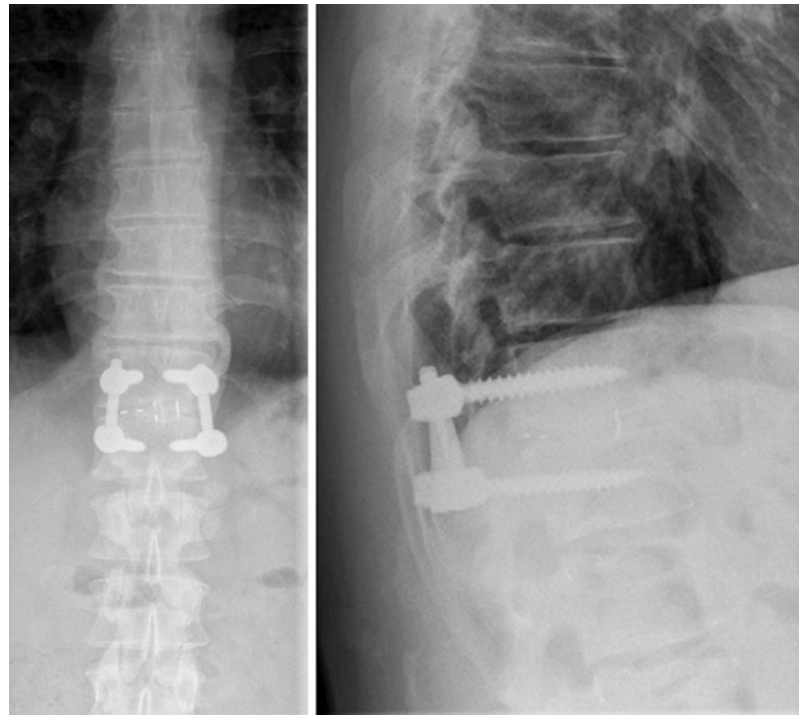

Fig. 75.2 Postoperative standing X-rays. Correct implants with adequate screw and cage placement

mild increase of the white blood cells and the CRP value.

An additional MRI scan was ordered and the patient prepared for revision surgery.

The wound revision with debridement and wash out was performed the next day (Figs. 75.3 and 75.4).

The intraoperative finding was an extensive infection with pus involving the deep soft tissue layers and the metalwork but without any severe muscle necrosis. After thorough debridement and extensive wash with betadine and Ringer's solution including pulsed lavage two deep drains had been inserted.

The multiple microbiological wound swabs confirmed the infection caused by Staphylococcus aureus. The antibiotic treatment (Rifampicin/Levofloxacin – i.v. as an inpatient) was decided according to the resistogram and after discussion with the microbiologists and continued for 4 weeks (orally) postoperatively.

The postoperative wound infection was resolved with a single wound revision and without any further complications.

Fig. 75.3 Postoperative wound status after 15 days. Postoperative wound infection with wound leakage. Sutures are removed already

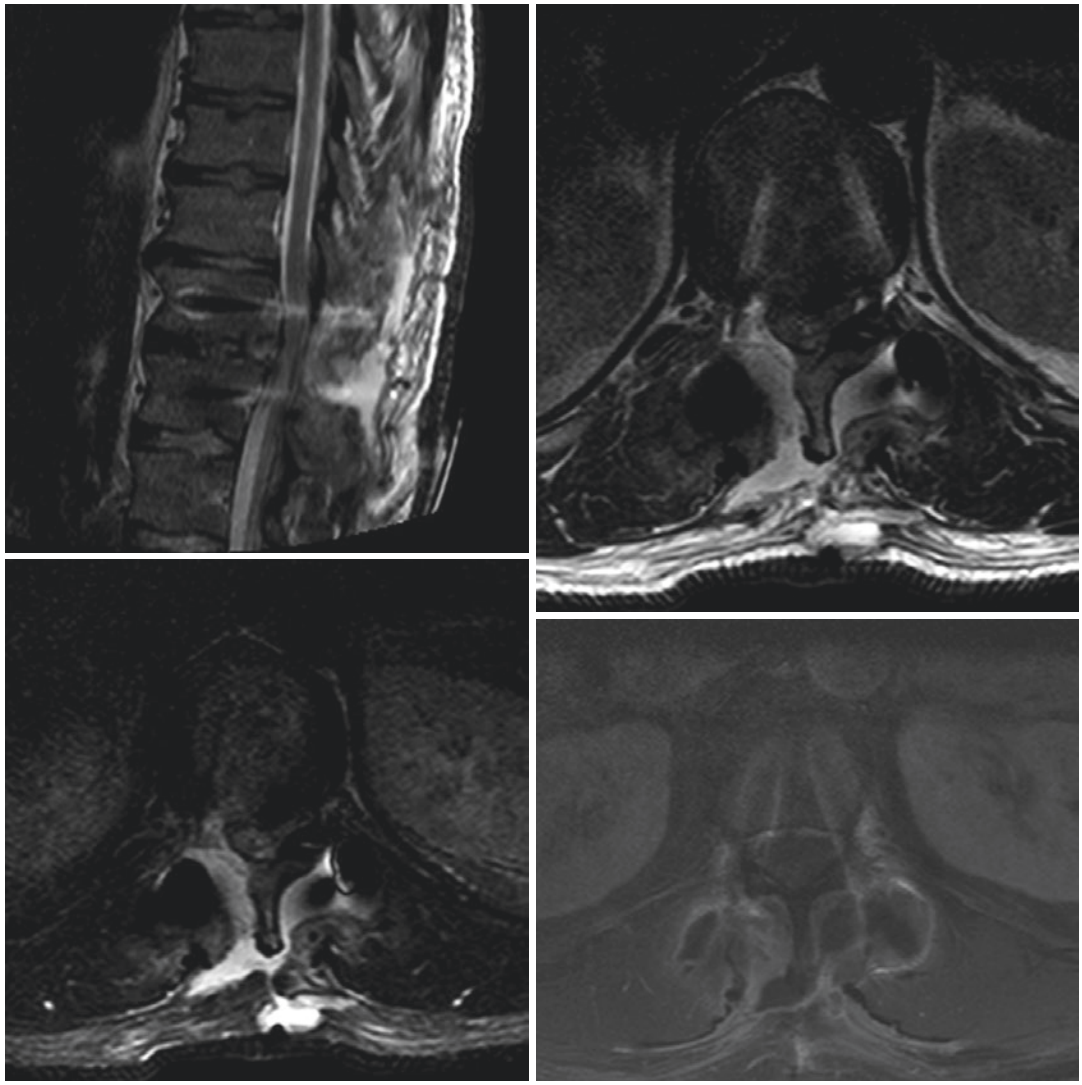

Fig. 75.4 MRI scan prior to revision surgery. MRI confirms a deep fluid collection at the fused segment involving the paraspinal muscles with contrast enhancement

75.2.2 Delayed/Late Infection

A 59 y/o male was referred to our department with a history of a prostate cancer and acute deterioration of a formerly diagnosed metastatic disease involving lungs and liver. Clinically he complained about a progressive unsteady gait and increasing weakness of his left leg (3/5) since weeks. The imaging (X-ray, CT and MRI) demonstrated multiple bony metastases with a maximum at T11 and osteolysis. The tumor mass was invading the spinal canal causing a severe spinal stenosis with spinal cord compression (Fig. 75.5).

The patient was treated surgically from posterior only with stabilization from T9 to L1 with cementaugmented screws, wide decompression and a vertebral body replacement after corpectomy of T11 via costotransversectomy. The postoperative course was uneventful with a normal wound healing without any signs of infection (Fig. 75.6).

Fig. 75.5 MRI scan before admittance. T11 prostate metastasis invading the spinal canal and causing spinal cord compression with myelopathy. Pathological fracture of T11

After 6 weeks postoperatively the patient was sent back to our clinic by his oncologist due to raised laboratory inflammation markers (white blood cells, CRP) and a leaking wound that was healed initially. The neurological status was unchanged (Fig. 75.7).

Due to the wound condition and clinical findings the patient was treated with revision surgery. The intraoperative situation proved a deep purulent infection including thesubfascial soft tissue and metalwork. There were also extensive muscle and soft-tissue necrosis involving the fascia. With these findings the decision was made to insert a deep VAC system first and to consolidate the soft tissue with a staged strategy and a planned re-revision surgery. Before applying the VAC therapy a thorough debridement and irrigation was performed. Then the VAC sponge was positioned bilaterally close to the screws and rods underneath the fascia. Then the wound was closed completely. The VAC therapy was applied with a negative pressure of 125 mm/Hg continuously (Fig. 75.8).

The microbiological results identified a Staphylococcus aureus infection and the antibiotics have been adapted selectively (Cefuroxime). The microbiological recommendation was continuation of antibiotics for 6–8 weeks postoperatively.

The second look revision was performed 5 days later and demonstrated much better local wound conditions but still mild signs of infection so that we repeated the VAC therapy once more in the same manner. The third look revision showed a macroscopic clean wound which allowed the end of the VAC treatment. Before wound closure

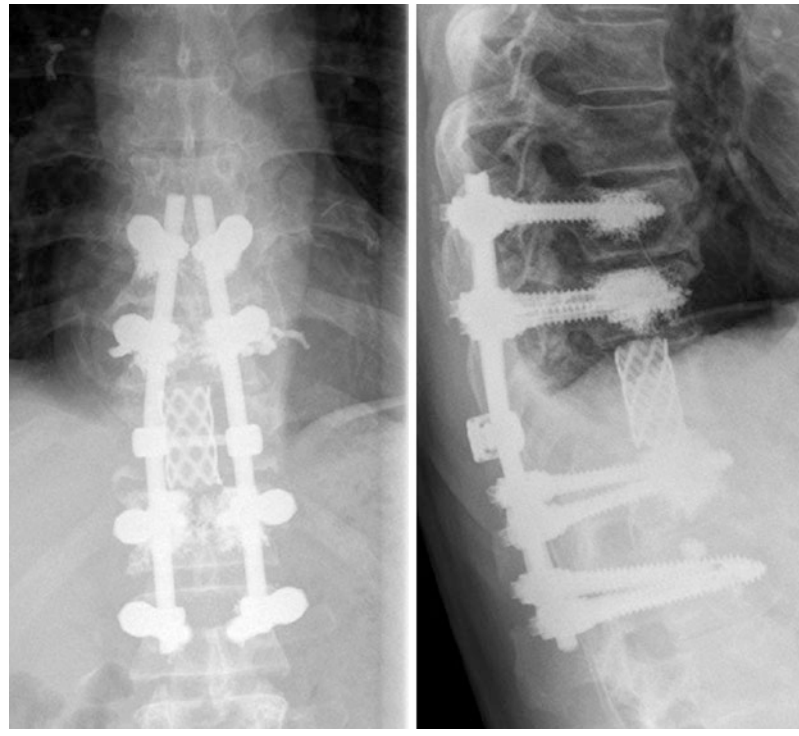

Fig. 75.6 Postoperative standing X-rays. Correct metalwork with adequate screw and cage placement

Fig. 75.7 Postoperative wound status after 6 weeks. Postoperative wound infection with wound leakage. Wound healing disorder distally with pus

two deep drains were inlaid finally. The wound healed nicely without irritations in the further postoperative period. Chemotherapy was restricted for another 4 weeks (Fig. 75.9).

75.3 Discussion of the Case

The first case presenting the early postoperative wound infection was treated with revision surgery, debridement, wash out and drains. An immediate surgical treatment with a thorough debridement is widely accepted and standard of care in the literature [8]. Main indicator for wound revision is the local wound condition. Persistent leaking wounds, necrosis of the wound edges with a fibrin film and dehiscence may require surgical treatment. The authors prefer an immediate revision and no "wait and see" strategy to reduce the extent of infection with concomitant complications (sepsis) and to shorten the hospitalization.

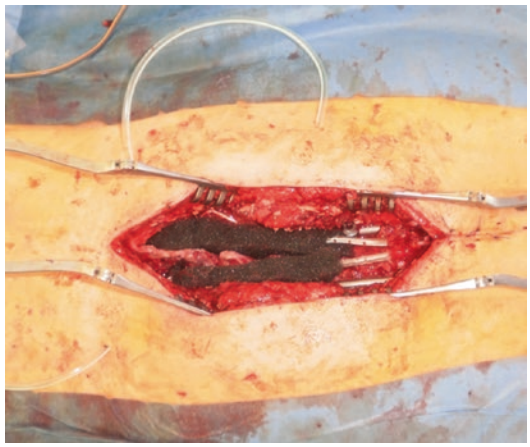

Fig. 75.8 Intraoperative VAC application. The VAC foams are positioned bilaterally close to the screws and rods underneath the fascia

Fig. 75.9 Result after VAC therapy. After three wound revisions the wound has healed nicely

The identification of Staphylococcus aureus as pathogen confirms the statement to be the most prevalent bacteria causing postoperative infection. In some cases it is necessary to repeat the revisions until the wound and soft tissue is consolidated. Rickert et al. showed in their survey which included also wound infections after decompression and microsdiscectomy that on average approximately two revisions are necessary to heal the wound completely. Unfortunately there is no clear evidence for the efficacy of any supportive treatment strategy like antibiotic adjuncts, pulsed lavage or specific wash solutions [7]. For example in case of the pulsed irrigation there are trends in the literature to be more effective in the dorsal muscle layers than the conventional irrigation [9]. But the current literature does not suggest any clear standards of care in case of a wound infection and often there is no detailed treatment algorithm in spinal units [7]. But there is broad agreement that in early infections the implants should be preserved and not removed to maintain the stability of the spine. That is also beneficial for the patient's mobility [8, 10].

The second case demonstrates a delayed or late infection after a tumor surgery with instrumentation, debulking and vertebral body replacement in an immune compromised patient with a metastatic disease. Firstly, due to the late onset and dimension of the infection with extensive muscle and soft tissue necrosis the decision was made to utilize an additional VAC therapy. Secondly there are positive considerations in the literature that VAC with negative pressure therapy leads to advantageous results regarding implant preservation. Especially in that case removal of implants would have led to an unstable

spine and was hence no option. Therefore one of the targets was to eradicate the infection and to leave the implants in place. The VAC therapy leads to a permanent drainage of the wound helps to stimulate wound granulation and to reduce the bacterial load. It also improves the blood supply in terms of microcirculation and neovascularization (vascular endothelial growth factor) [11]. In the authors experience when using VAC it is important to always close the wound completely above the polyurethane foam to avoid retraction of the wound edges. Otherwise this can lead to serious problems for the definitive and final wound closure and can make a plastic surgery necessary. When a patient is treated with a staged strategy and multiple revisions it is mandatory to take microbiological samples each revision so that changes of the pathogens can be detected. Implant removal especially in late infection is still a topic of discussion. There are different opinions in the literature but without any clear evidence from large clinical studies a helpful answer cannot be given. Some authors suggest implant removal only in rare cases with late (>3 months) and recurrent infections when a solid fusion is verified and the implants are suspicious to maintain the infection caused by bacteria living in a biofilm [5].

In both cases the antibiotic treatment was decided in collaboration with the microbiologists and according to the resistograms. For deep wound infections with involvement of the metalwork usually a long term antibiotic treatment up to 6–12 weeks is recommended. If the wound infection is classified to be superficial (only subcutaneous layer involved – fascia intact), antibiotic treatment for 2 weeks postoperative is sufficient [12].

75.4 Conclusions and Take Home Message

Wound infections are an upcoming problem and therefore it is crucial to optimize risk factors preoperatively especially in older patients. As the first case shows wound healing problems are not only concerning the older population with multiple comorbidities even young healthy patients can be affected. Routinely a surgical treatment is necessary for deep postoperative infections to eradicate the infection and achieve an adequate wound healing. In severe cases sometimes multiple revision surgery is required and VAC therapy might be helpful. In times of multiresistent pathogens the antibiotic treatment should be advised by the microbiologists. Postoperative wound infections prolong the patient's suffering, impair the clinical outcome and present a great challenge for the entire treatment team. Therefore all efforts for the avoidance should be made.

Pearls

- Preoperative reduction of risk factors is mandatory
- No "wait and see strategy" early revision and wound exploration
- Surgical treatment with debridement and wash out is accepted as standard of care
- For implant preservation VAC therapy can be helpful
- When using VAC it is important to always close the wound completely above the polyurethane foam

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