

Expert's comment concerning Grand Rounds case entitled “Revision of a lumbar disc arthroplasty following late infection” (by Jeffrey M. Spivak and Anthony M. Petrizzo)

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The authors have presented the case of a late infection of a keeled-TDA and its treatment, including implant removal and fusion. To our knowledge, there is no previously reported case of TDA infection. I would like to commend the authors on this very interesting Grand Rounds cases and their successful outcome. I totally agree with the fact that there is no standard algorithm for approaching an infected disc replacement implant and that this case has two different problems: the first one and the most important is the infection and the second one the persistent pain following the TDA.

I would like to comment on some points about the author's management of this case.

When we look at the standard X-rays on figure one, 9 months after surgery, both prostheses are perfectly well

positioned in the sagittal and coronal plane, but we are surprised by the number of vascular clips. We can see more than 20 clips for the L4–L5 approach. For an uneventful approach to the L4/L5 disc space, we usually need no more than four or six clips for the ligation of the ascending lumbar vein and the ligation of the lumbar segmental vessels [1, 2]. Some questions arise: did the surgeon or the access surgeon encounter difficulties during the anterior approach: abnormal bleeding, anatomical abnormality? A difficult and lengthy approach with significant bleeding would definitively increase the risk of a postoperative infection.

If we consider the lumbar TDA as a mobile joint replacement, the goal of the treatment is to cure the infection, prevent its recurrence, and ensure a pain free, functional joint. This goal can best be achieved by a multidisciplinary team consisting of a spine surgeon, an infectious disease specialist, and a clinical microbiologist. In a field where no evidence-based treatment algorithm exists and in such uncommon event, the orthopaedic surgeon's experience related to peripheral joint arthroplasty infection can be used.

The first step of the strategy is to accurately diagnose prosthetic joint-associated infection.

Infections with virulent organisms (e.g. *Staphylococcus aureus* and gram-negative bacilli) inoculated at implantation is typically manifested as acute infection in the first 3 months (or with haematogenous seeding of the implant, at any time) after surgery, whereas infection with less virulent organisms (e.g. coagulase-negative staphylococci and *Propriobacterium acnes*) is more often manifested as chronic infection several months (or years) postoperatively. In acute infection, severe pain, swelling, abscess, and fever are common. Chronic infection has a more subtle

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presentation, with pain alone and it is often accompanied by loosening of the prosthesis [3].

In the author's case, the patient experienced the infection symptoms 8 months after the index surgery. It should be defined as a delayed infection, but the symptoms of infection were those of an acute infection. Finally, the current case has been classified as an acute infection and we agree with that.

In the algorithm for the treatment of infection associated with a prosthetic joint, according to our experience in joint replacement [3, 4] this case could be managed as followed: debridement with retention is a reasonable option for patients with an early postoperative or acute haematogenous infection, if the duration of clinical signs and symptoms is less than 3 weeks, the implant is stable, the soft tissue is in good condition, and an agent with activity against biofilm microorganisms is available. Intravenous treatment should be administered for 2 or 4 weeks, followed by oral therapy for 6 months according to the unfavourable condition of the surrounding soft tissue. The success rate in this patient population is 82–100% for staphylococcal infections associated with different types of orthopaedic devices [5, 6]. In a study of patients with streptococcal infection, the rate of success was 89% [7]. The main problem is how to do such debridement in lumbar TDA. Preoperatively, general recommendations for revision anterior lumbar surgery are required.

Debridement must be done right after the diagnosis of infection has been made to clean all the infected area. The approach for the debridement could use the opposite retroperitoneal side for L5/S1. The transperitoneal route would be a second alternative, but more risky for the sympathetic plexus. For L4/L5 and above, it is better to stay more laterally to the previous dissection and use an anterolateral retroperitoneal approach [8]. A left ureteral catheter is recommended for all cases approached from the left at L4–L5.

In case of abscess, the infected cavity can realise an access corridor to the infected level, facilitating the approach. Careful debridement is performed on the infected soft tissue. There is no need to retract the vessels. Caution must be taken on the vessels to avoid any critical bleeding. In case of infection, the presence of an anti-adhesion barrier (interposed at the time of the index procedure) could represent a potential additional challenge requiring its dissection and removal from the overlying great vessels. The apparent part of the prosthesis must be cleaned and freed of soft tissues. There is no need to expose the entire prosthesis. An irrigation of soft tissue is recommended for 1 week followed by drainage for 4 days. The collection of multiple periprosthetic tissue specimens for aerobic and anaerobic bacterial culture is

imperative because of the poor sensitivity of a single culture and to distinguish contaminants from pathogens.

If the duration of signs or symptoms of infection exceeds 3 weeks, retention of the implant should not be attempted. The surgical technique would consist of implant removal, careful debridement, and irrigation of soft tissues, followed by fusion [9]. Whatever the option chosen, different points must be emphasised. Antibio-microbial therapy should be discontinued at least 2 weeks before surgery, and perioperative antimicrobial coverage should be deferred until culture specimens have been collected. Periprosthetic tissue cultures may be falsely negative because of previous antimicrobial therapy, biofilm growth on the surface of the prosthesis. Microorganisms form a biofilm on the prosthesis; therefore, if the prosthesis is removed, obtaining a sample from its surface is useful for microbiologic diagnosis. The implant is removed and transported to the laboratory in a sterile jar. After the addition of Ringer's solution, the container is vortexed and sonicated (frequency, 40 kHz, power density, 0.22 W/cm²) for 5 min in a bath sonicator, and the resultant fluid is cultured. This technique is more sensitive and specific than multiple periprosthetic tissue cultures for diagnosing infection of the prosthesis. This technique is particularly helpful in patients who have received previous antimicrobial therapy [3].

For the fusion, the authors have chosen two femoral ring allografts with a nice step cut allograft at L4/L5 to accommodate the removal of the inferior end plate of L4. We prefer to use, like Kostuik recommends [9], a structural autograft rather than allograft in the phase of infection. Likewise the use of Infuse-BMP2 is not validated in this indication. Additional instrumentation with a screw and washer for the anterior fusion would also increase the risk of persisting or recurring infection and is not necessary. Rather, consideration should be given to a posterior procedure. The posterior procedure must require an osteosynthesis and fusion with autologous bone graft. Achieving a nice and solid fusion is the mainstay to eradicate the infection and to alleviate symptoms of pain. The use of a percutaneous posterior fixation without fusion may not achieve the goal of fusion and we, therefore, would not recommend it.

The revision of the L5/S1 level should be discussed. This level was not infected and therefore there was, in our mind, no or little indication to remove the prosthesis at this level. This carried significant risks. The first one is the risk to infect the level L5/S1. The revision of this level is a new surgery, requiring a whole new set up with new prepping and draping, and new instrumentation. The second one is the risk of retrograde ejaculation, as it is directly related to the transperitoneal approach. The transperitoneal spinal approach is associated with a significantly higher risk of

retrograde ejaculation due to the injury of the sympathetic nervous system [10]. The third one is the patient pain assessment. It seems that the revision of the L5/S1 level did not alleviate all the back pain.

As a conclusion, in infected lumbar TDA, we consider that the main goal is to treat the infection. The stability of the implant, the type of microorganism, and the interval between the onset of symptoms and treatment with debridement and antimicrobial therapy are the key factors of the strategy and crucial predictors of success. Symptomatic patients with duration of signs or symptoms of infection exceeding 3 weeks and/or unacceptable arthroplasty positioning (loosening) may require explantation of the device with conversion to arthrodesis (both anterior and posterior). After the cure of the infection, a new assessment of the back complaints should be done to determine the origin of the back pain. Back pain alone cannot justify a revision TDA if the implant is stable and well positioned, because a simple posterior stabilization and fusion can alleviate the pain [11]. Because of the inherent risks of an anterior revision of a disc arthroplasty, even if the patient wishes to have the TDR removed, we prefer not to do it. We therefore agree with the management for the L4/L5 level in the case of persistent infection, for the level L5/S1 we would have assessed the persisting pain after successful treatment of the infection at L4/L5 and decided accordingly.

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