

The use of porous tantalum cages in the treatment of unremitting spondylodiscitis: a case report

Uporaba kletk iz poroznega tantala pri zdravljenju trdovratnega spondilodiscitisa: opis primera

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Abstract

Background: Unsuccessful medical treatment of pyogenic multifocal spondylodiscitis including signs of sepsis and unremitting pain is challenging. The aim of our report was to present a case of multilevel spondylodiscitis successfully treated by posterior lumbar interbody fusion using porous tantalum cages.

Case presentation: A 59-year-old male was diagnosed with spondylodiscitis at T8-T9 level. Although treated with antibiotics, the patient again presented with worsening of systemic signs of infection and back pain. Contrast-enhanced magnetic resonance imaging studies revealed spondylodiscitis at L1 to S1 level. Posterior lumbar interbody bone fusion with tantalum cages from L1 to S1 was performed. The inflammation rapidly subsided. Computer tomography studies showed a stable construct at 24 months.

Conclusion: Porous tantalum cages used in combination with transpedicular fixation seem to be a sound alternative to interbody devices made from other materials when treating spondylodiscitis cases without definite osseous destruction.

Izveleček

Izhodišče: Zdravljenje neodzivnega piogenega večžarišnega spondilodiscitisa s trdovratno bolečino in znaki sepse je zahtevno. Namen našega poročila je predstaviti primer uspešno zdravljenega večnivojskega spondilodiscitisa ledvene hrbtenice z medvretenčno kostno zatrditvijo ob souporabi kletk iz poroznega tantala.

Prikaz primera: Pri 59-letnem moškem smo dokazali spondilodiscitis segmenta T8-T9. Kljub zdravljenju z antibiotiki je pri bolniku prišlo do poslabšanja sistemskih znakov okužbe in bolečin. Slikanje z magnetno resonanco in kontrastnim sredstvom je pokazalo spondilodiscitis od nivoja L1 do S1. Izvedli smo posteriorno ledveno medvretenčno kostno zatrditev od L1 do S1 in pri tem uporabili tantalove medvretenčne kletke. Vnetje se je hitro umirilo. Z računalniško tomografijo smo 24 mesecev po operaciji dokazali stabilno konstrukcijo.

Zaključek: Porozne kletke iz tantala v kombinaciji s transpedikularno fiksacijo se najverjetneje lahko podobno kot medvretenčni vsadki iz drugih materialov uporabljajo pri zdravljenju primerov spondilodiscitisa brez jasne kostne razgradnje.

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1. Background

Spondylodiscitis is an infection which affects the intervertebral disk space and the vertebral body of the associated vertebra. Haematogenous pyogenic spondylodiscitis affects preferentially the lumbar spine, followed by the thoracic and the cervical spine; a multifocal infection is very rare (1,2). *Staphylococcus aureus* (*S.aureus*) is the predominant pathogen in pyogenic spondylodiscitis (3). Medical management with an appropriate antibiotic combination is the first choice for eradicating the infection and alleviating pain. Debridement of the affected disc and decompression of the spinal cord followed by transpedicular instrumentation through a posterior approach with autologous bone grafting and drainage is indicated in case of an epidural abscess in the lumbar spine. Unsuccessful medical treatment, including severely ill patient with signs of sepsis and/or unremitting pain, is also an indication for surgery (4). Titanium mesh cages combined with pedicle screw instrumentation have been introduced for single-stage anterior surgical debridement and reconstruction in the thoracolumbar spine (5,6), and polyether ether ketone (PEEK) cages proved to be reliable in treating spondylodiscitis of the cervical spine (7). We present a case of a 59-year-old man with refractory spondylodiscitis of the lumbar spine treated by the insertion of porous tantalum cages at 5 consecutive levels for anterior support in addition to standard transpedicular fixation after thorough surgical decompression and debridement.

2. Case presentation

A 59-year-old male first presented with a one-week history of thoracic pain. His erythrocyte sedimentation

rate (ESR) and C-reactive protein (CRP) values were elevated (ESR = 55 mm/h; CRP = 104 mg/l) and *S. aureus* was cultivated from his blood culture. Contrast-enhanced magnetic resonance imaging (MRI) of the thoracic spine revealed signs of spondylodiscitis at T8-T9. Fluoroscopically guided needle biopsy, which was still practiced at our institution at that time, revealed the same bacteria species and intravenous antibiotic treatment was started (cloxacillin 2 g/6 h). Patient's pain has gradually resolved, ESR and CRP values have dropped significantly (ESR = 38 mm/h; CRP = 6 mg/l) and endocarditis was ruled out. In accordance with consulted infectious diseases specialist, the patient was discharged from the department after 4 weeks and switched to *per os* antibiotic treatment (ciprofloxacin 750 mg/12 h) for additional 4 weeks. The patient was fully compliant with the treatment.

Eight weeks after discharge the patient was readmitted because of fever, malaise, and lower back pain. Orthopaedic examination revealed severely impaired mobility of the lumbar spine, a bilaterally positive straight leg raise test and no neurologic impairments. Patient's ESR and CRP values were 89 mm/h and 225 mg/l respectively, and *S. aureus* was cultivated again from his blood culture. An intravenous antibiotic combination (cloxacillin 2 g/6 h and ciprofloxacin 400 mg/12 h) was introduced immediately. Contrast-enhanced MRI of the thoracic and lumbar spine showed oedema regression at T8-T9 level and new oedema formation in the vertebral bodies L1 and L2 without the intervertebral disc involvement. Ultrasonography of the heart was performed and no signs of endocarditis were found. The patient experienced



Figure 1: T2 weighted MRI of lumbar spine showing signs of spondylodiscitis from L1 to S1 level.

pain persistence. ESR and CRP values remained elevated (ESR = 95 mm/h; CRP = 186 mg/l). Swelling of his left ankle and right radiocarpal joint appeared; however, both aspirates were negative. *S. aureus* was cultivated again from his blood cultures. Repetitive contrast-enhanced MRI of the thoracic and lumbar spine revealed no dynamics at T8-T9 level and showed enhanced oedema of the vertebral bodies L2, L4, L5, at L1-L2 and L5-S1 disc levels, and soft tissues (Figure 1). After 3 weeks of medical management the patient was still unable to walk due to sharp back pain which was hard to tolerate despite the use of nar-

cotic analgesics. His ESR and CRP levels remained elevated. Infectious disease specialist concluded that the patient's septic state was not under control and he was brought to the operating theatre.

Wide surgical debridement and decompression with laminectomy were performed through posterior approach from L1 to L5. Frank pus was found in the paravertebral soft tissue, epidural space and in the discs L1-L2, L4-L5 and L5-S1, and the material obtained was sent for cultures separately. The discs L2-L3 and L3-L4 were carefully opened and the soft liquid material obtained under pressure was also sent for cultures. It was obvious from the local surgical finding that continuous segments were engaged in the inflammatory disease. The lumbar spine was thus stabilized by transpedicular instrumentation from L1 to S1 with titanium screws and rods, disc spaces were cleaned and porous tantalum cages (TM Ardis™ Interbody System, Zimmer, Warsaw, Indiana, USA) were inserted. Two cages per segment were used at two lower lumbar levels (L4-L5 and L5-S1) for a larger foot-print, and one cage per segment was used at three upper levels (L1-L2, L2-L3 and L3-L4). Taken together, 7 porous tantalum cages were inserted. With the help of a compression device, the construct was fixed in appropriate lumbar lordosis, the wound was thoroughly washed with saline, drained and closed-up in layers. Surgically-taken biopsy showed *S. aureus* growth from paravertebral soft tissue, epidural tissue and all involved intervertebral spaces.

Postoperative course was uneventful, drainage was left in place for 72 hours and at that time rifampicin 450 mg/12 h orally was added. One week after surgery, ciprofloxacin treatment was discontinued. On day 16, when ESR and CRP values have dropped significantly, cloxacillin treatment was replaced

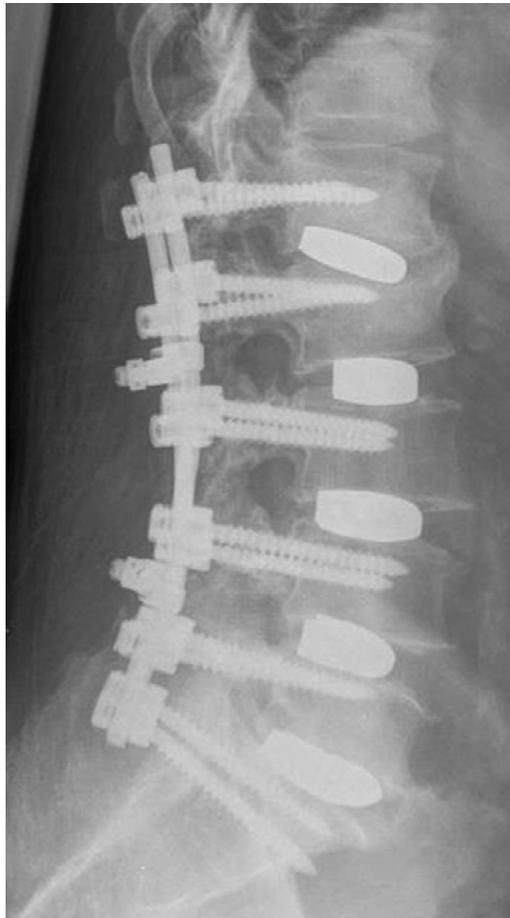


Figure 2: Lateral X-ray of the lumbar spine at 2-year follow-up.

with oral trimetoprim-sulfametoxazole (160 mg/800 mg every 8 hours) in accordance with the antibiogram of the causative microorganism and the patient was discharged. He stayed on combined antibiotic treatment (rifampicin and trimetoprim-sulfametoxazole) for 12 weeks and was followed clinically and radiologically for 24 months. The patient was pain free and his ESR and CRP values were normal (ESR = 16 mm/h; CRP = 6 mg/l). Standard X-rays at the final follow-up showed spontaneous fusion at segment T8-T9 and fusion with subsidence of the cage at L1-L2 through upper end-plate of L2 (Figure 2). Computed tomography (CT) scan at

24-month follow-up showed signs of stable fixation from L1 to S1 but failed to show signs of solid bone fusion at levels lower than L1-L2.

3. Discussion

Antimicrobial therapy has been a mainstay when treating patients with spondylodiscitis with generally favorable results and over 90 % cure rate in population without concomitant endocarditis (8). Intravenous therapy with flucloxacillin is the standard mode of treatment for *S. aureus* spondylodiscitis, but a conversion to oral bactericidal drugs as early as 2 weeks has also been associated with similarly good outcomes (9). An infectious disease specialist has thus prescribed to our patient fluoroquinolones that show excellent per oral bioavailability.

However, studies suggest that rapid emergence of resistance to these drugs precludes their use as single agents against *S. aureus*, which might have contributed to failure of our initial treatment even though it exceeded the recommended 6 weeks (10). If rifampicin were added to fluoroquinolone (preferably levofloxacin), the spread of the infection might have been prevented, unsatisfactory response to drug therapy avoided and surgical intervention would probably not be needed. An alternative to this treatment regime could be clindamycin (10).

Porous tantalum is an open-cell metal structure with overall porosity of 80 % that approximates the appearance of human cancellous bone. Open-pore structure facilitates osteointegration, bone modeling, and vascularization. The material has a low modulus of elasticity, leading to better load transfer and minimizing the stress-shielding phenomenon. Its coefficient of friction is one

of the highest among biomaterials, allowing sufficient primary stabilization of implants (11). Sagomyants et al. have shown that porous tantalum stimulates proliferation and osteogenesis of osteoblasts (12). Due to its unique properties, it has been successfully used in cervical and in a variety of lumbar spine procedures as a sound interbody device (13).

In cases of bacterial spondylodiscitis, the instrumentation screws, rods and cages can be colonized and covered with a biofilm. However, the risk of using spinal instrumentation after debridement is low since only a few colonies adhere to the stainless steel or titanium made devices (14). Calvert et al. recently reported on 15 patients treated for spondylodiscitis with implanted expandable metal cages (15). All patients had clinical resolution of infection with an average follow-up time of 25 months. Radiograph review revealed no extensive osteolysis around the hardware or progressive collapse. The authors concluded that the spine appears to provide a unique environment that permits the use of metal implants in the setting of infection (15).

Walter et al. have shown that PEEK cages, popular in degenerative cases, can also be used safely for implants in cases of cervical spondylodiscitis (16). Schomacher et al. have compared the results of treatment of pyogenic spondylodiscitis with titanium or PEEK cages in addition to 3 month antibiotic therapy and found no reinfection in either group (17). However, a cage subsidence was observed in 70.3 % of all cases. The authors concluded that debridement and fixation with anterior column support in combination with antibiotic therapy appear to be the key points for successful treatment of pyogenic spondylodiscitis and that the application of titanium or PEEK cages does not appear to influence the radiological outcome.

The surgical treatment for pyogenic spondylodiscitis should be considered in patients with significant bone destructions, impending fractures, progressive spinal deformities, neurological impairments, antibiotic-resistant sepsis, recurrent infections and/or epidural abscesses (18-21). In our case, the indication for surgery was an antibiotic-resistant septic state. Significant progress of the inflammatory process was observed at surgery compared to the involvement shown on contrast-enhanced MRI a week earlier, when no changes at L2-L3 and L3-L4 disc levels have been observed.

There are several other drawbacks of our case report. To start with, no preoperative local biopsy was performed for diagnosis confirmation after the spread of infection to the lumbar spine. However, several blood cultures revealed *S. aureus* septicemia and the focus was clearly visible on MRI. Secondly, wide laminectomy could potentially result in the spread of the infection to the epidural space. In our case, the infection was already present in the epidural space, making laminectomy, radical debridement, wash-out and drainage seem obligatory. In addition, long fusion has increased the chance of complications and pseudoarthrosis. An option would therefore be to fuse only the most involved segments, in our case L1-L2 and L5-S1 segments. However, according to surgical findings at exploration, continuous segments were engaged in the inflammatory disease. Left untreated, these segments could possibly lead to further disease propagation necessitating repetitive surgical explorations. Moreover, if left unfused, diseased central lumbar segments in combination with posterior element disruption during laminectomy could rapidly progress to adjacent segment disease. Stable environment is a condition which helps to

eradicate a spinal infection and it is easiest to achieve with hardware fixation.

Furthermore, we could have continued with non-operative management of the patient for a considerable amount of time since there was no abscess formation or neurological impairment. Nevertheless, in this particular case, the burden of the infectious agent seemed to be too large for the patient's immune system to tolerate and we were not able to control the disease with antibiotics alone. Conservative treatment consisting of long-term bed rest and antibiotic intravenous regimen could have detrimental effects on the overall health status of the patient, entailing not only generalized muscle wasting but also the possibility of pneumonia, vein thrombosis or regional pressure ulcers. Minimally invasive screw fixation with limited focal debridement offers an alternative even in the most morbid group of patients, providing the patient with early ambulatory activity while minimizing the drawbacks of open spine surgery.

In the end, the manufacturer states that active local infection in or near operative region represents a contraindication for the use of the TM Ardis™ Interbody System. This is a standard warning regarding the implantation of any orthopaedic implant, it is thus important to note that we have used the implant officially off-label. Other authors have used orthopaedic implants made from titanium and/or PEEK material to successfully treat pyogenic osteomyelitis of thoracic and lumbar spine actually off-label (18). An attempt has been made to clean up all the infected tissue and stabilize the patient's spine, thereby optimizing its healing potential. This was only possible with hardware implantation. Lastly, no postoperative contrast-enhanced MRI was performed to show resolution of the infection. However, the

clinical course after surgery was uneven and evaluation of an MRI after spine surgery with metallic hardware inserted is sometimes difficult to interpret.

Posterior instrumentation combined with autologous bone grafting represents the standard treatment for patients with pyogenic spondylodiscitis of the lumbar spine. Many authors have reported about the safety of harvesting bone grafts in these patients (19-24). Chou et al. have shown that intervertebral titanium and PEEK implants could be safely used as an alternative (25). We did not feel comfortable obtaining autologous bone grafts in our septic patient because we were afraid of spreading the infection. Lack of evidence of bone fusion at all treated levels, apart from L1-L2 where the cage subsided and end plates could come into contact, e.g. sentinel sign on X-rays and CT scans at final follow-up, may be the result of this treatment modification. The producer also advises the use of the devices in combination with autologous bone graft and states that failure to properly fill and/or compress the graft material into the area surrounding the implant may result in delayed healing and/or non-union which can lead to fracture or breakage of the implant. Since this was not the case, bone might have grown through the porous structure of the device. Unfortunately, this could only be proved by histologic examination of the explanted implant.

Although debridement and necrotic tissue excision has been the mainstay of treating patients with spondylodiscitis, providing a stable environment by fixation alone has been shown by Mohamed et al. to provide comparable efficiency (26). Long-segment fixation without formal debridement resulted in resolution of spinal infection in all 15 observed cases, making the authors believe this surgical technique, when combined with aggressi-

ve antibiotic therapy and a multidisciplinary team approach, is an effective way of managing serious spinal infections in a challenging patient population.

4. Conclusion

To the best of our knowledge, porous tantalum cages have not been used in the treatment of pyogenic lumbar spondylodiscitis. According to our results, porous tantalum cages seem to be a sound alternative to traditional methods in cases without definite osseous destruction if

used in combination with transpedicular fixation and not as stand-alone devices. When the approach is problematic because of soft tissue inflammation and the antibiotic-resistant sepsis cannot be brought under control, the surgical procedure is straightforward and relatively simple. However, prospectively performed studies are necessary before routine use of porous tantalum cages in the treatment of lumbar spondylodiscitis could be recommended.

The patient gave informed consent for publication of his case.

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