Authors: Steven Schmitt, Christopher Kepler

QUESTION 10: Is there a difference in the efficacy of vancomycin beads versus vancomycin powder for spinal implant infections?

RECOMMENDATION: It is unclear whether there is a difference in the efficacy of vancomycin beads versus vancomycin powder for spinal implants infections.

LEVEL OF EVIDENCE: Consensus

DELEGATE VOTE: Agree: 93%, Disagree: 0%, Abstain: 7% (Super Majority, Strong Consensus)

RATIONALE

Currently, there are no studies comparing or individually evaluating the efficacy of vancomycin powder and vancomycin beads for the treatment of infections following spinal instrumentation.

3.3. TREATMENT: IMPLANTS

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QUESTION 1: Should a cage be removed in patients with postoperative spine infection?

RECOMMENDATION: No. The interbody cage can be maintained in the absence of clinical and radiographic signs of loosening or displacement of the cage or compression on neural and vascular structures. However, the cage should be removed if the infection persists despite salvage attempts consisting of irrigation and debridement procedures combined with intravenous antibiotic treatment.

LEVEL OF EVIDENCE: Limited

DELEGATE VOTE: Agree: 73%, Disagree: 0%, Abstain: 27% (Super Majority, Strong Consensus)

RATIONALE

The incidence of surgical site infection in the presence of an interbody cage depends on various factors including the type of approach (anterior, posterior or lateral) and whether the cage is stand-alone or associated with posterolateral instrumentation fusion. Series with stand-alone posterior lumbar interbody fusion (PLIF) or anterior lumbar interbody fusion (ALIF) have lower infection rates (up to 3%) compared to those with long constructs in degenerative adult scoliosis (up to 11%) [1]. On the other hand, adding interbody fusion to posterolateral spinal fusion can be a risk factor for infection and a series of posterolateral fusion with interbody fusion reported higher incidence of surgical site infection compared to those without interbody fusion, most probably due to prolonged surgical procedure, increased blood loss and tissue damage associated with interbody fusion (0.3% versus 1.4%) [2].

Spondylodiscitis at the site of an interbody fusion can present with or without signs of superficial wound infection. If superficial infection does not exist, deep infection can be underestimated or ignored initially due to late presentation. In one report, the average time to diagnosis for spondylitis in patients with PLIF was 164.5 days (range 10–410 days) and time to diagnosis longer than three months was the only predictive factor of failure of intravenous antibiotic treatment and need for implant removal [3]. Moreover, the intervertebral disc tissue is a naturally avascular tissue, limiting the efficiency of immune response as well as efficiency of antibiotics for eradication of infection. Delayed treatment of cage infection can be associated with the risk of extension of infection to the neural elements as well as to the vital retroperitoneal organs and major vessels with disastrous consequences [4].

Cage removal is associated with a risk of interbody space collapse, foraminal narrowing, loss of alignment, progression of deformity, loss of fixation, instability and pseudoarthrosis [5]. On the other hand, inappropriate cage retention can establish bacterial colonization and biofilm formation on the surface of the implants, and diminishes the efficacy of antibiotic treatment [6]. Time of presentation (early versus late postoperative infection), chronicity and severity of symptoms are other considerable factors [7,8].

According to the published case series, in most cases of interbody cage infection, the cage can successfully be retained with an initial salvage attempt consisting of irrigation and debridement procedures combined with antibiotic treatment [1,9–15]. Although, there is no agreed definition criteria for failure of salvage treatment, the following conditions have been considered as indication of cage removal: presence of discitis, osteomyelitis, signs of cage loosening, epidural abscess, extension of infection to soft tissues and presence of bone loss [1,4,8]. Most of these criteria are based on the findings of advanced imaging such as computed tomography and magnetic resonance imaging. One study presented 10 cases with uncontrolled infection of interbody cage, all of which were placed via posterior

approaches. In 9 out of 10 cases, solid bone fusion was achieved via an anterior procedure consisting of cage removal and the use of autogenous iliac bone graft to fill the interbody space [16]. An anterior approach for removal of a posteriorly-placed interbody cage prevents complications associated with epidural scar tissue and fibrosis due to the inflammatory response to the original surgery and infection process [16].

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QUESTION 2: Is there a length of time of infection beyond which instrumentation should be removed?

RECOMMENDATION: The data suggests that early infection can commonly be treated with implant retention and debridement followed by intravenous (IV) antibiotics and common oral antibiotic treatment. If the patient has achieved spinal fusion, the implants can be safely removed. In the setting of pseudarthrosis, thought should be given to removal of implants to eradicate infection followed by re-instrumentation.

LEVEL OF EVIDENCE: Limited

DELEGATE VOTE: Agree: 100%, Disagree: 0%, Abstain: 0% (Unanimous, Strongest Consensus)

RATIONALE

The primary goals of treating postoperative spinal surgical site infections (SSIs) are to eradicate the infection, maintain stability and achieve fusion (when warranted). While the decision to retain existing instrumentation in the setting of an acute infection may be necessary for maintaining stability or promoting fusion, this may jeopardize the surgeon's ability to completely eradicate the SSI. The preponderance of available evidence suggests the ability to both retain hardware and successfully eradicate the infection depends on the acuity of the presentation, with early diagnoses of SSI (within 30 to 90 days after index procedure) having higher rates of successful retention after debridement and IV antibiotics, while deep infections over one year commonly require removal.

Several studies have demonstrated successful eradication of infection with debridement and hardware retention for early-onset SSI. Patel et al. reviewed surgical debridement and retention of instrumentation in 17 patients with SSI after spinal arthrodesis ranging from 1 to 6 weeks after the index procedure, noting eradication of infection in all patients and successful fusion in 15 of 17 (88.2%) [1]. Sierra-Hoffman et al. reported successful instrumentation retention with early onset (< 30 days) SSIs with debridement and long-term antibiotics alone, noting eradication of infection in 17 out of 19 (89.5%) patients. However, six of the seven late infections (> 30 days) ultimately required instrumentation removal for eradication of the infection [2].

Pull ter Gunne et al. noted that their management of SSI involved aggressive debridement (89.3%) with hardware retention (if stable) and revision of hardware (if unstable), followed by an average of 40 days of antibiotics. With this protocol, 76% of their deep infections were eradicated with a single debridement, although no comment was made about the chronicity of the SSI prior to reoperation [3]. Kowalski et al. reported on 30 acute SSIs (< 30 days) with 80% successfully retaining implants with surgical debridement and IV antibiotics followed by oral suppressive antibiotics [4]. Tominaga et al. reviewed risk factors for unavoidable