Sp67: What is the role of local vancomycin powder after surgical debridement? Does the use of antibiotic powder mixed with the bone grafts enable better disease healing?

Reuben Soh, Sebastian Bigdon, Jonathan Tan Jiang Hao, Muralidharan Venkatesan, Koji Tamai, Kawaguchi Yoshiharu

Recommendation:
Based on available data, vancomycin is a viable option for use in spinal infections as a form of local antibiotic therapy during surgical debridement with care to avoid the use of high doses to reduce potential risk of pseudoarthrosis.

Level of Evidence: Moderate

Delegate Vote :

Rationale:
Spinal infections can be particularly challenging to manage, with wide variations across different practices and no consensus globally. [1] The commonly accepted mainstay of treatment includes identification of offending bacteria via cultures and early initiation of culture directed antibiotic therapy thereafter. In spine surgery, intervention is generally indicated in event of development of neurological deficits, instability of the spine and/or failure of non-surgical management following administration of long-term antibiotics. The eventual aim is to eradicate infection by first stabilizing unstable segments. Local antibiotic therapy to infected sites have also shown promise in eradicating orthopaedic infections. Ideally, a delivery system able to maintain stable and effective concentrations of antibiotic therapy above the level of the minimum inhibitory concentration over a prolonged duration locally with minimal effects on biomechanical stability would be best suited. *Staphylococcus aureus* is the most commonly identified bacteria in pyogenic spondylodisciitis [2] and hence vancomycin makes an ideal choice of antibiotic treatment.
The local use of vancomycin after surgical debridement in spinal infections has not been fully evaluated yet. Despite the widely accepted use of vancomycin in orthopaedic related infections, this is a unique challenge in spinal infections due to the intrinsic requirement of fusion in affected levels as compared to other orthopaedic related infections such as that of arthroplasty related infections. Some studies have hinted at concerns of pseudoarthrosis with failure of fusion in relation to high vancomycin concentrations, which raise worries of its use in spinal infections in spite of its good gram-positive activity [3-4].
A retrospective cohort study by Slavnic et al [5] reported a fusion rate of 81.8% across 66 levels when poly-methyl methacrylate (PMMA) beads impregnated with vancomycin and tobramycin was used during surgical intervention. There was also a statistically significant improvement in visual analogue scale (VAS) scores for back pain post opratively. However, they did not have long term outcome data as 30 levels had a follow up of <1 year duration.
The use of vancomycin in conjunction with bone grafts have also been studied in various animal studies. Shiels et al demonstrated a decrease in fusion rate when vancomycin infused demineralized bone matrix (DBM) was used as a bone graft as compared to DBM alone in rabbits [6]. This finding is also suggested by Hanson et al, reporting inhibitory effects of vancomycin in osteogenic rat bone marrow-derived mesenchymal stem cell differentiation [7]. However, when coupled with the addition of iliac crest bone grafting, Sheils et al showed that vancomycin infused DBM achieved fusion in a favourable 5/6 rabbits with *Staphylococcus*

aureus inoculation to surgical site, an increase from 2/6 in vancomycin infused DBM use alone [6].

A study by Yang et al showed lower definitive fusion rates of 67.6% using vancomycin infused calcium sulfate beads in transforaminal lumbar interbody fusion for pyogenic spondylodisciitis [8]. They reported complete eradication of infection during their follow up period, with a 84.9% improvement Owestry-disability index (ODI) and 85.3% excellent and good Kirkaldy-Wilis outcome score.

We recommend the use of vancomycin for spinal infections as a form of local antibiotic therapy during surgical debridement, ideally coupled with the use of an osteoinductive, osteoconductive and osteogenic bone graft to provide better chances of fusion across an infected segment. To date, animals models show decreased bony union when bone graft is mixed with vancomycin powder. However more data is required with regard to its in vivo efficacy and long-term reliability as well as the ideal dose concentration per level of affected segment in spinal infections.

References

[1] Duarte RM, Vaccaro AR. Spinal infection: state of the art and management algorithm. Eur Spine J. 2013;22(12):2787-2799. doi:10.1007/s00586-013-2850-1

[2] Aljawadi A, Jahangir N, Jeelani A, et al. Management of Pyogenic Spinal Infection, review of literature. *J Orthop*. 2019;16(6):508-512. Published 2019 Aug 12. doi:10.1016/j.jor.2019.08.014

[3] Ishida W, Perdomo-Pantoja A, Elder BD, et al. Effects of Intraoperative Intrawound Antibiotic Administration on Spinal Fusion: A Comparison of Vancomycin and Tobramycin in a Rat Model. *J Bone Joint Surg Am*. 2019;101(19):1741-1749. doi:10.2106/JBJS.18.00988

[4] Eder C, Schenk S, Trifinopoulos J, et al. Does intrawound application of vancomycin influence bone healing in spinal surgery?. Eur Spine J. 2016;25(4):1021-1028. doi:10.1007/s00586-015-3943-9

[5] Slavnic, Dejan & Tong, Doris & Anton, Gustavo & Bashiti, Rani & Carr, Daniel & Hanson, Connor & Lytle, Evan & Richards, Boyd & Soo, Teck. (2021). Efficacy and Safety with the Use of Antibiotic-impregnated Poly-methyl Methacrylate (AI-PMMA) for Thoracolumbar Spinal Reconstruction in Pyogenic Spondylodiscitis: Retrospective Cohort Study. Interdisciplinary Neurosurgery. 26. 101324. 10.1016/j.inat.2021.101324.

[6] Shiels SM, Raut VP, Patterson PB, Barnes BR, Wenke JC. Antibiotic-loaded bone graft for reduction of surgical site infection in spinal fusion. *Spine J*. 2017;17(12):1917-1925. doi:10.1016/j.spinee.2017.06.039

[7] Hanson K, Isder C, Shogren K, et al. The inhibitory effects of vancomycin on rat bone marrow-derived mesenchymal stem cell differentiation. *J Neurosurg Spine*. 2021;34(6):931-935. Published 2021 Apr 2. doi:10.3171/2020.10.SPINE201511

[8] Yang K, Zhang S, Liu H, Wu W. Transforaminal Lumbar Interbody Fusion with Antibiotics Delivered by $CaSO_4$ Drug Carrier System for Pyogenic Spondylodiscitis. *World Neurosurg*. 2019;132:e447-e454. doi:10.1016/j.wneu.2019.08.118