

Characterizing the Effects of Local Intra-Wound Vancomycin Powder on Fracture Healing and Infection in an Animal Model

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Purpose: The purpose of this study was to investigate the effects of intra-wound antibiotics, specifically vancomycin, on infection prevention and fracture healing. We hypothesize that the application of local intra-wound antibiotics would be effective in preventing the development of surgical site infection, without having a negative effect on fracture healing, in a rat model.

Methods: 48 male Sprague Dawley rats were assigned to 1 of 4 groups: (1) no antibiotics (n = 12), (2) local vancomycin powder (n = 12), (3) systemic cefazolin (n = 12), or (4) both local and systemic antibiotics (n = 12). Half of the animals in each group received an inoculum of methicillin-sensitive *Staphylococcus aureus* (MSSA) (contaminated group) and the other half a control solution (non-contaminated group) at their fracture site, creating a total of 8 groups. The fracture was surgically created by performing a mid-diaphysis osteotomy in the right femur of all rats, followed by stabilization with plate and screws. Local intra-wound vancomycin powder was administered at the fracture (Groups 2 and 4) and when applicable (Groups 3 and 4), animals received systemic cefazolin intramuscularly pre- and postoperatively (every 6-8 hours for 24 hours). Radiographs of the operated leg were taken biweekly and evaluated in a blinded fashion for healing progression and signs of infection. All animals were euthanized 10 weeks after surgery. Samples of soft tissue were collected from the fracture site, along with the fixation material, and processed for microbiological detection.

Results: Microbiological analysis: In the non-contaminated group we found no positive cultures in any of the animals (0/24). The contaminated group showed no positive cultures in the groups that received local antibiotics (0/6), or local and systemic antibiotics (0/6); however, one of the animals that received only systemic antibiotics showed a positive culture (1/6). All animals in the contaminated group that did not receive antibiotics were positive for MSSA infection (6/6). Radiographic analysis: Based on the radiographic evaluation at 10 weeks, high rates of union were observed in all groups (67%-100%), irrespective of antibiotic treatment group. Radiographic scoring for signs of infection was consistent with our microbiological analysis.

Conclusion: Our results demonstrate that local intra-wound vancomycin is effective at preventing infection in the setting of contamination, without significantly compromising fracture healing. However, we did not observe a significant benefit of the addition of local vancomycin over standard systemic antibiotics in terms of infection prevention, and additional investigation of any impact upon bone healing is required. Further analyses of fracture healing are planned, including microCT and biomechanical testing.