Antibiotic Elution Profiles of Two Methods of Nail Preparations

Matthew R. Karek, MD[1]; *Raul Vaidya, MD[1,2]; Nancy M. Jackson, PhD[1,3]; Jeffrey C. Flynn, PhD[1,3]; David C. Markel, MD[1,3];*
[1]Detroit Medical Center/Providence Hospital Orthopaedic Surgery Residency Program, Detroit, Michigan, USA;
[2]Detroit Receiving Hospital, Detroit, Michigan, USA;
[3]Providence Hospital and Medical Centers, Southfield, Michigan, USA

Purpose: Antibiotic-coated intramedullary nails (AIMNs) or guidewires (AIMGs) are accepted treatment options for infected long bone nonunions. While the nails may be locked and structurally more desirable, it is generally felt that the thicker coating on AIMGs provides greater levels and duration of antibiotic delivery. The purpose of this study is to compare the elution profiles of antibiotics from AIMNs and AIMGs to determine if differences exist and if these could be linked to cement porosity or curing temperature.

Methods: 2-cm segments of 8-mm nails or 3.5-mm guidewires were coated with cement containing tobramycin (1 g) or tobramycin (2.2 g) and vancomycin (1 g). Simplex cement was used. All samples were partially cured in 40-French chest tubes as a mold (Atrium). Probe thermometers were used to measure curing temperatures. Micro-CT (Scanco) was used to measure porosity. Segments were soaked in sterile phosphate-buffered saline and entire aliquots were exchanged at scheduled time intervals over a 6-week period. Antibiotic concentrations were measured on a Roche / Hitachi Cobas C system. Bactericidal activity was measured as decreased ABS_{600} in the linear growth phase of *Staphylococcus aureus* cultures. Statistical analysis was performed using the Student *t*-test ($P < 0.05$ significant).

Results: The majority of antibiotics eluted from both devices in the first 48 hours. The elution of tobramycin from 1-g tobramycin-loaded cement was the same for the AIMNs and AIMGs. However, more tobramycin was released from AIMNs than AIMGs when additional tobramycin and vancomycin were mixed into the cement. The antibiotic continued to be released and was bactericidal for up to 6 weeks. The mean percent porosity of the cement was significantly greater ($P = 0.042$) in AIMGs supplemented with vancomycin and extra tobramycin (5.4 ± 2.3) compared to AIMNs (2.9 ± 1.7). The mean peak curing temperature for cement on AIMNs (93°F) was significantly lower ($P < 0.05$) than that of cement on AIMGs (148°F).

Conclusion: Our data demonstrated that AIMNs can provide effective delivery of antibiotics to infected long bone nonunions and do so at a lower curing temperature that may preserve antibiotic efficacy as well as patient tissue viability.

See pages 99 - 147 for financial disclosure information.