INTRODUCTION. Pin tract infection is a major complication [1] in external fixation - it can occur in 17-57% of cases [2, 3]. An antimicrobial coated (AMC) polyurethane sleeve to be fitted over pins and wires has been developed to inhibit bacterial colonization (Figure 1). The AMC sleeve is designed to deliver the wide spectrum antibiotic, gentamicin, directly into the pin tract at concentrations above the susceptible thresholds for pathogens commonly found in infected pin tracts, namely, S. aureus, S. epidermidis, P. aeruginosa, and E. coli. This study reports in vitro elution of gentamicin from AMC sleeves, and compares the estimated pin tract concentration of the antibiotic to minimum inhibitory concentration (MIC) for common pin tract pathogens.

MATERIALS AND METHODS. The AMC sleeve consists of polyurethane tubing, with an antimicrobial coating designed to slowly release gentamicin from both the inner and outer surfaces (Medi-Coat® Antimicrobial Coating, STS Biopolymers, Inc., Henrietta, NY). Elution testing was carried out on AMC sleeves fitted over 6 mm diameter 316L stainless steel pins. Three 5 cm long pin/sleeve constructs in glass vials (n=6), each containing 5 ml of phosphate buffered saline (PBS) were agitated at 37°C for 26 weeks. The eluent was replaced at 2, 24, 48, and 72 hours, and once a week thereafter to 26 weeks. The concentrations of gentamicin in harvested eluents were determined using microbiological zone of inhibition (ZOI) assays on plates seeded with S. epidermidis (NCTC 8853), calibrated against the zone produced by varying concentrations of the European Pharmacopoeia reference gentamicin. The pin tract concentrations of gentamicin were then calculated using assumed pin tract volumes.

The MICs of gentamicin against clinical isolates of S. aureus, S. epidermidis, P. aeruginosa, and E. coli were obtained from the SENTRY Antimicrobial Surveillance Program (1997-2002), which collects data from hospitals worldwide. Only one isolate was used per patient. Susceptibility was determined according to the National Committee for Clinical Laboratory Standards (NCCLS) for gentamicin, which is 4 µg/ml. The MICs were determined from elution testing to 26 weeks.

RESULTS. The estimated weekly pin tract gentamicin concentration decayed with time, as shown in Figure 2. The mean concentration (± standard deviation) ranged from 43.3(±3.36) µg/ml at one week to 3.61 (±0.52) µg/ml at 26 weeks. In comparison, the NCCLS susceptibility breakpoint for gentamicin is 4 µg/ml [4].

The SENTRY Program database for gentamicin against S. aureus, S. epidermidis, P. aeruginosa, and E. coli in surgical wound isolates yielded a total of 1456 isolates. S. aureus was the most common pathogen (58.3%), followed by P. aeruginosa (20.3%), E. coli (19.3%), and S. epidermidis (2.1%). The SENTRY Program data is summarized in Table I. The percent of isolates that were susceptible to gentamicin were 90.4% for E. coli, 81.1% for P. aeruginosa, 82.2% for S. aureus, and 60% for S. epidermidis. The MIC90 values were ≤1 µg/ml for all pathogens, except P. aeruginosa (2 µg/ml).

The MIC90 value for E. coli was 4 µg/ml. The MIC90 values for S. aureus, S. epidermidis, P. aeruginosa were not reported definitively (≥8 µg/ml), because the common test range was between 1 and 8 µg/ml.

DISCUSSION. This study showed that the AMC sleeves elute measurable quantities of the drug for periods up to 26 weeks. Furthermore, up to 20 weeks, the elution was such that the expected concentration of gentamicin in the pin tract was above the NCCLS susceptibility breakpoint of 4 µg/ml. The concentration at 26 weeks (3.61 µg/ml) was below the NCCLS breakpoint. The initial burst and subsequent sustained release above the NCCLS breakpoint (4 µg/ml) for up to 20 weeks will substantially reduce bacterial colonization and the likelihood of biofilm formation on the pins and wires.

The SENTRY Antimicrobial Surveillance Program showed that for infected surgical wound isolates, gentamicin has a high level of bactericidal efficacy, with 83.1% of all pathogens tested susceptible to the drug. Combined, S. aureus, P. aeruginosa, and E. coli accounted for approximately 98% of infected surgical wound isolates, and each of these pathogens were susceptible to gentamicin in greater than 80% of the cases. Susceptibility for S. epidermidis, however, was lower at 60%. It is interesting to note that although S. epidermidis is a common organism on the skin, it was found in only 2.1% of infected surgical wounds.

The surveillance data confirmed that gentamicin has a high level of bactericidal activity against organisms commonly associated with pin tract infections. The AMC sleeves release sufficient levels of gentamicin into the tissue surrounding external fixation pins to inhibit bacterial colonization. Based on these findings the gentamicin coated sleeves fitted over pins and wires may contribute to reducing the pernicious effects of pin tract infection in external fixation.

REFERENCES
4. NCCLS Standards, M100-S12, 2002.

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