Antibiotic-coated pins for prevention of pin-tract infection: a rabbit study

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ABSTRACT

Purpose. To evaluate the efficacy of antibiotic-coated pins for prevention of pin tract infection in a rabbit model.

Methods. 10 rabbits were divided into 2 groups. A unilateral external fixator was applied to the tibia with 4 self-taping 1.8-mm pins. In the test group, pins were coated with hydroxyapatite and antibiotic. In the control group, pins were not coated. All pins were then placed in Staphylococcus aureus-containing media. At postoperative day 5, all 40 pin sites were subcutaneously inoculated with S aureus. The sites were clinically examined for signs of pin tract infection. Nine days later, a piece of soft tissue around the pin site was harvested for microbiologic examination.

Results. In the test group, all except one pin sites appeared clean and without clinical infection, and the culture media remained clear. In the control group, all pin sites showed evidence of clinical infection and yielded positive cultures, and the culture media became dark indicating growth of S aureus.

Conclusion. Antibiotic-coated pins were effective in preventing pin tract infection.

Key words: anti-bacterial agents; external fixators; surgical wound infection

INTRODUCTION

External fixators are widely used for treatment of comminuted fractures, open fractures, osteomyelitis, nonunion or pseudoarthrosis, lower-extremity deformities, limb length inequality, and arthrodesis. Complications of external fixators include pin tract infections, pin loosening, pin irritation, pin/wire breakage, malunion, delayed union, non-union, joint contracture/subluxation, wound dehiscence, osteomyelitis, and compartment syndrome.1,2 Among these, pin tract infection is the most common problem during limb lengthening involving external fixation.3 The rates of pin tract infection vary,4-10 and can be as high as 95%.4 Minor inflammation or superficial infection is usually treated with...
antibiotics, local wound care, and occasionally, pin removal. Osteomyelitis warrants operation and sequestrectomy. Pin tract infections can affect the stability of fixation. This study evaluated the efficacy of antibiotic-coated pins for prevention of pin tract infection after external fixation.

**MATERIALS AND METHODS**

The protocol of animal experiments was approved by the local animal protection agency and the ethics committee of the hospital. 10 white male rabbits weighing 1.2 to 1.5 kg were divided into 2 groups. All rabbits were anaesthetised by intravenous ketamine hydrochloride (20 mg/kg) and xylazine (5 mg/kg) of their body weight. The tibia was drilled using a 1.5-mm Kirschner wire. An osteotomy was created between the second and third pins using a fine wire saw (Fig. 1). A unilateral external fixator (Orthofix M-100) was applied to the tibia with 4 self-taping 1.8-mm pins.

In the test group, pins were coated with hydroxyapatite and antibiotic (Fig. 2). 10 g of hydroxyapatite in 30 to 50 μm thick was applied by a Plasma-Technik A-3000S. The pins were then placed in 5 g of vancomycin solution for 48 hours. In the control group, pins were not coated. All pins were then placed in *Staphylococcus aureus*–containing media.

On postoperative day 5, all 40 pin sites were subcutaneously injected with 1 ml of bacterial suspension containing 3x10⁶ colony-forming units of *Staphylococcus aureus* (ATCC 29213). The sites were clinically examined for signs of pin tract infection every day. Nine days later, a piece of soft tissue around the pin sites was harvested for microbiologic examination (gram staining and culture in general and selective media). The 2 groups were compared using the Mann-Whitney *U* test with Monte Carlo sig (2-tailed). A *p* value of <0.05 was considered statistically significant.

**RESULTS**

In the test group, all except one pin sites appeared clean and without clinical infection, and the culture media remained clear. In the control group, all pin sites showed evidence of clinical infection and positive cultures. The difference between the 2 groups was significant (*p*<0.005, Table), and the culture media became dark indicating the growth of *S aureus* (Fig. 3).

**DISCUSSION**

In pin tract infection, the most common organisms are gram-positive bacteria (*S epidermidis* and *S aureus*), followed by *Escherichia coli*. These organisms

<table>
<thead>
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<th>Rabbit no.</th>
<th>Purulent drainage at pin site</th>
<th>Colony-forming unit</th>
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usually grow in biofilms around the implant, which is associated with the chronic nature of the subsequent infections and inherent resistance to antibiotic chemotherapy. Systemic administration of antibiotics may have side-effects and prolong hospitalisation. Application of local antibiotics to prevent pin tract infection is preferred. Silver-coated pins and stainless steel pins have no detectable difference in the rates of pin tract infection. Gentamycin-coated polyurethane sleeves fitted over the pins enable higher concentrations of antibiotics in the pin tract for at least 20 weeks. This higher level of local antibiotic can prevent colonisation of infecting organisms around external fixator pins. Lipid-stabilised hydroxyapatite/chlorhexidine coating for external fixator pins resulted in lower rates of pin tract infection. The poly(D,L-lactic acid) coating thickness affects in vitro vancomycin release from a hydroxyapatite carrier.

DISCLOSURE
No conflicts of interest were declared by the authors.

REFERENCES