Examining Pexiganan Effects on Pin Track Infection in a Transcutaneous Implant Model

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Introduction: Infection prevention is a challenge that remains with transcutaneous osseointegrated implants intended for prosthetic attachment in amputees [1]. Previous studies have shown pexiganan acetate to be a broad spectrum anti-infective agent, effective against gram-positive and gram-negative bacteria [2]. However, no study appears to have examined its ability to prevent pin track infection in a transcutaneous implant model. The purpose of the study is to determine if the topical application of pexiganan will reduce the pin track infection rate compared to those not receiving an antimicrobial.

Materials and Methods: IACUC approval was obtained for performing this study with New Zealand white rabbits. A titanium implant, free of surface finish, was placed through both cortices of the tibia similarly to Gerritsen, M. et al.’s rabbit model [3]. The implant was 36-mm long with a hexagonal cross-section that was 2.7-mm in diameter. The implant penetrated skin, muscle, and bone on the lateral side (Fig 1). A cerclage wire helped to stabilize the implant.

Eleven rabbits in the untreated Group 1 did not receive an antimicrobial. Eight rabbits in the treated Group 2 received topical pexiganan (LOCILEX™, Genera Corporation) the day after surgery and then daily starting on the fifth day following surgery. The five day gap minimized handling during the post operative recovery. Two weeks after the surgery and weekly thereafter, untreated Group 1 and treated Group 2 rabbits were inoculated with $1 \times 10^8 S. aureus$ in 0.5 - 1.0 ml of saline for an increased infection challenge [3]. The rabbits were euthanized when they showed clinical signs of pin track infection or at the end of the 24-week trial.

Using aseptic technique, samples were obtained of muscle, blood, and bone at euthanasia for culturing and histological analysis using Hematoxylin & Eosin, Periodic acid–Schiff, Brown-Brenn stains. The rabbit was classified as infected if 1) the rabbit had grade II clinical signs of infection [4] as well as a positive culture and/or positive histology indicative of infection for one or more of the tissue samples or 2) the rabbit had a positive culture and a positive histology indicative of infection for the same tissue sample regardless of achieving grade II clinical signs for pin track infection. Statistical Analysis, for comparing infection rates, was a log-rank test for equality of survivor functions.

Results: One rabbit died of unknown causes and one rabbit had a tibia fracture in the untreated Group 1. Three rabbits had tibia fractures in the treated Group 2. Despite the lower remaining sample size, the data demonstrated that the treated Group 2 had a statistically lower pin track infection rates as compared to the untreated Group 1 ($p=0.019$, Fig 2). The primary organisms found from culturing and histological analysis were $S. aureus$ and $E. coli$.

Fig 1 - Titanium implant traversed skin, muscle, and bone on the lateral side to represent the tissue layers at the distal end of human residual limbs following amputation. The implant remained transcutaneous for an infection pathway as in the osseointegrated implants for prosthetic attachment [1]. The arrows show the placement of the cerclage wire for implant stability.

Fig 2 - Kaplan-Meier curve showing that daily application of pexiganan (Group 2) lowered pin track infection rates relative to the untreated controls (Group 1) ($p=0.019$).

Discussion: Pexiganan could be an important antimicrobial for transcutaneous osseointegrated implants since it appeared to prevent organisms from traversing the skin barrier in 75% of the rabbits in Group 2 compared to 0% in the untreated Group 1. However, the 25% infection rate in Group 2 may not be clinically significant since this rate is still too high by most orthopaedic standards. This rabbit model was limited since the rabbits appeared to remove the topical pexiganan cream shortly after it was applied. Future studies should use an alternative model to Gerritsen’s et al.[3] when testing topical antimicrobials. A model with more controlled exposure to topical pexiganan may determine if pexiganan can prevent pin track infection around osseointegrated implants for prosthetic attachment.


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