Pretreatment with Vancomycin Prevents Staphylococcal Biofilm Formation on Marlex Mesh

Christina A Chao, Tyler Hoskins, Mohammed Hammad, Suenghwan Jo, Mathias P G Bostrom, Alberto V Carli

INTRODUCTION: Polypropylene (PPE) mesh is a popular surgical treatment for extensor mechanism disruption in revision knee arthroplasty, but development of infection following PPE mesh placement can be catastrophic. Pretreating orthopedic materials with antibiotics has precedence in the literature, but this strategy has not yet been described for PPE mesh. The purpose of the current study is to determine if mesh pre-treatment with vancomycin could effectively prevent biofilm formation.

METHODS:

Sterile PPE mesh was cut into 10mm diameter circles. PPE circles were soaked in saline for 20 minutes with one of the following vancomycin concentrations: 1) 0.625mg/ml, 2) 1.25mg/ml, 3) 2.5mg/ml, 4) 5.0mg/ml, and 5) 10.0mg/ml. To simulate surgeons irrigating the wound prior to closure, all pretreated were rinsed with saline 0, 1, 2 or 3 times to simulate surgical irrigation. Nine circles were tested per experimental group. Rinsed PPE circles were placed in a 48-well plate, inoculated with 10^5 colony forming units (CFUs) of Methicillin sensitive Staphylococcus Aureus, cultured in tryptic soy broth for 24 hours, rinsed to remove planktonic bacteria, and sonicated in fresh media for 30 minutes. Sonicated fluid was plated, serially diluted and CFUs were counted. The finding of zero CFUs was defined as successful infection prevention. PPE circles were imaged with scanning electron microscopy (SEM) to visualize vancomycin crystals and biofilm.

RESULTS:

Pre-treatment of PPE mesh with 10mg/mL of Vancomycin was the only condition that prevented S. Aureus biofilm formation in all conditions, even after three rinses. SEM confirmed that vancomycin pre-treatment deposit antibiotic crystals on the mesh surface and that biofilm was not present (Figure 1).

Low and high magnification scanning electron microscopy images: A) Sterile Marlex mesh; B) Mesh with 24-hours MSSA biofilm visualized as cocci in clusters (red arrows); C) Mesh pre-treated with 10mg/ml vancomycin with crystal visible on surface (blue arrows); D) Pretreated Mesh after being grown in broth containing Methicillin sensitive Staphylococcus Aureus. No biofilm is present

DISCUSSION AND CONCLUSION:

Vancomycin pre-treatment of PPE mesh can prevent biofilm formation even after rinsing. Surgeons should consider pretreating PPE mesh with 2g of vancomycin in 200ml of normal saline for 20 minutes when utilizing mesh in revision knee arthroplasty.