Limiting BioFilm-Based Infection of In-Place Catheters

Treatment of Staphylococcus epidermis infection of medical-grade catheter with Delmopinol rinse

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Introduction

Hydrocephalus is the excessive accumulation of fluid within the brain. Medical professionals place shunts with catheters to drain this fluid [3]. Biofilm producing bacteria create infections that are difficult to treat [4]. In this experiment, the use of an FDA approved mouthwash [2] was investigated as a means of treatment for infections caused by S. epidermis.

Hydrocephalus

- Hydrocephalus is when there is an increase in intracranial cerebrospinal fluid (CSF) caused by congenital brain structure defects, injury, or infection. This excess of CSF causes swelling and brain damage [3].
- The most common treatment of hydrocephalus is the surgical insertion of a shunt-catheter medical device made of silicone which drains the fluid into the stomach or other tissues that can reabsorb it. 10-22% of shunts experience infection [3].

Staphylococcus Epidermidis and Biofilms

- S. epidermis is a bacteria that lives on human skin and mucosal membranes. It is one of the leading causes of infection on internally placed medical devices [4].
- The bacteria form a biofilm that strengthens the colony, making the infection resistant to antibiotics [4].

Delmopinol Rinse

- Delmopinol mouthwash, containing the compound (+)-3-(4-propylheptyl)-2-(2-hydroxyethyl) morpholine hydrochloride is used as a rinse to remove plaque from teeth [2].
- This compound works by breaking up the matrix of plaque biofilms, leaving bacteria susceptible to mechanical removal and antimicrobial agents [1].
- Delmopinol has been shown to break up various bacterial biofilms [1,2] and thus has potential to treat infections of catheters.

Experimental Approach

1. Sterilize 3 pieces of medical grade silicone catheter, each 35 mm. long, in a glow discharge machine.
2. Pour 4 mL of staph epi suspension in broth into 2 separate sterile 15 mL polypropylene Corning centrifuge tubes and 4ml of sterile broth into a third sterile tube.
3. Place one sterile catheter piece into each centrifuge tube and incubate in broth for 24 hours at 37 ºC.
4. Using 2 new centrifuge tubes, fill one with 4 mL of Delmopinol and one with 4 mL of Distilled Water.
5. Using sterile forceps, remove infected catheters from the centrifuge tubes and place one into each new centrifuge tube, filled with either Delmopinol or Distilled Water. Invert the tubes and soak for 1 hour.
6. Using sterile forceps remove the catheter in the Delmopinol centrifuge tube and place on agar plate, use sterile cotton swab to roll on plate, cover plate and allow sterilization of agar plates and catheter segments was experience throughout this experiment. We would like to thank Dr. Baier and Dr. Meyer for their time and effort. We also like to thank Lynn Mikulski for teaching us lab wrap in plastic wrap. Successful.
7. Repeat step 6 with catheter piece in centrifuge tube containing Distilled Water.
8. Repeat step 6 with control catheter from the tube of sterile broth.
9. Place agar plates in incubator and observe bacterial colony growth after 24 hours.

Results

- The control plate showed no bacterial growth, indicating that the trypsic soy broth used was sterile prior to purposeful growth of S. epidermis and that the sterilization of agar plates and catheter segments was successful.
- The agar plate with the delmopinol treated catheter showed no visible bacterial growth.
- The agar plate with the water-treated catheter showed significant growth of S. epidermis across the area the catheter was rolled.
- This shows that soaking an infected catheter in delmopinol rinse significantly diminishes the infection.

Conclusions & Further Considerations

- Delmopinol is an effective treatment to reduce biofilm infections of silicone catheters in vitro. It significantly decreased the amount of S. epidermis attached to the catheter surface.
- Delmopinol rinse is already FDA approved for oral use, and thus has potential to be approved for this new use.
- Further experiments are needed to replicate results achieved here and test the rinse on other bacterial strains.
- These results can also be a stepping point for research on infections in urinary catheters and other silicone medical devices.

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References