BETTER CATHETER DESIGN WITH IMPROVED LIQUID FLOW THROUGH TUBES

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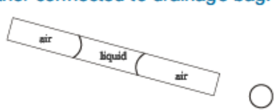
Is it possible to reduce fatality rate due to bacterial infection for patient with catheter insert?

Introduction

- Catheter associated bacterial infection is the most common health care associated infection worldwide [1].
- Between 15% and 25% of patients admitted to a general hospital will be catheterized at some point during their stay [2].
- All patients will become bacteriuric if catheterized long enough, even with excellent care [2].
- Infection due to catheterization is estimated to result in an additional 900,000 hospital days a year, and additionally directly causes 1000 deaths and indirectly contributes to an additional 6500 deaths a year in the United States [2].
- Infection can be prevented by maintaining a closed drainage system, keeping high infection control standards, and preventing backflow from the catheter bag. The present study will focus on preventing backflow from the catheter bag.
- It is difficult for liquid to flow efficiently in a drainage tube, since both ends of the tube are closed with one end attached to the bladder and the other connected to drainage bag.



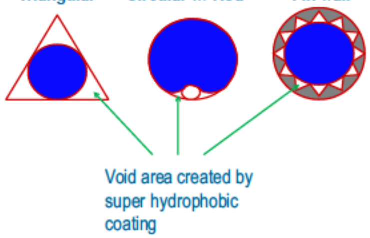
Liquid flows through a closed tube in the presence of confined bubbles. Air bubbles slowly rise and allow passage of urine. The resistance of this film flow is significant.

- Our objective is to allow the liquid to flow without being impeded from gas bubbles confined in the tube. The use of tubes of differing cross sections to avoid this impedance is explored in this poster.

Method

•In order to create flow in a closed tube, a super hydrophobic coating would needed to be applied to an angular cross section.

•Three angular cross sections were chosen for this experiment.



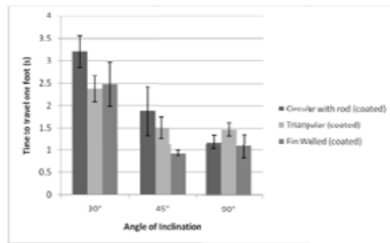
• The voided area will provide spaces for air to pass around the fluid.

•The experiment was conducted with tubes of four different cross sections: a circular cross section, a triangular cross section, a fin walled cross section, and a circular tube with a rod placed on the inner diameter.

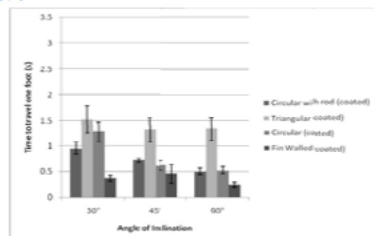
• Each of the five various cross sectional areas were tested with and without the super hydrophobic coating .The group without the super hydrophobic coating served as the control group.

•The tubes was oriented at three different angles, 30° , 45° , and 90° , to see if the angle of inclination had any effects on the travel time. A timer was used to determine the time elapsed for the water to flow one foot. The data was then recorded. Each trial was repeated several times and the averaged was then calculated to determine the travel time for each tube under different conditions. The process was then repeated for the case that the tubes were not closed up at the ends in order to test the flow of the liquid under normal air pressure.

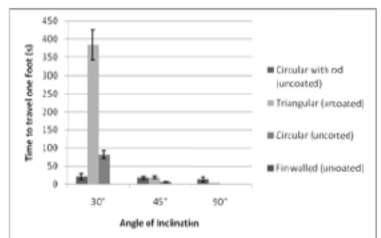
Result



The time taken for the fluid to travel one foot in a tube with both ends closed was measured in coated tubes of various cross section. No flow was observed in the tube with circular cross section.



The time elapsed for the fluid to travel one foot in a tube with both ends open was measured in coated tubes of various cross section. Notice that the travel drops significantly for tubes of the same geometry.



The travel time for the fluid to travel in a foot within a tube with both ends open was measured for uncoated tubes of various cross section. In general, the travel time for the fluid to travel increased by a significant amount without the hydrophobic coating.

Discussion

- There are factors that have affect the results. As the experiment was being repeated several times, the super hydrophobic coating on the tubes got worn off which would cause a higher time. Because only a normal stop watch was used to time the flow of liquid, there could be human errors in the data.
- A conceptual advance: The use of a super hydrophobic tube, in conjunction with certain cross section geometry (fin walled, triangular, and circular rod) is presented to allow improved catheter and drainage bags for discharging urine or other bodily fluids and to improve the design for efficient liquid drainage in the presence of confined bubbles in a closed tube. This advance has the potential to greatly reduce the rate of urinary tract infections during catheterization, currently the most common healthcare associated infection worldwide. Additional tests will be conducted to quantify the design parameters for potential applications in medicine or liquid transport in space application.

References

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