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Basic science: biofilm pathophysiology

DEVELOPMENT OF AN IN VITRO NOVEL DEVICE THAT SIMULATES THE REAL LIFE OF THE BIOFILM FORMATION ON CATHETERS UNDER BOTH STATIC AND DYNAMIC SYSTEMS

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Objectives: Biofilm model systems are essential to explore the development and the nature of the microbial community within the biofilm as well as the mechanism of their resistance. The aim of this work is to develop an *in vitro* novel device to simulate the real life of the biofilm formation on catheters under both static and continuous fluid flow systems.

Methods: The device comprises a test chamber in the range of 10-50 cm (height) x 0.8-2.5cm (diameter) and a body that has three ports, which can be blocked by removable closures. The ports in the upper and lower ends of the device are designed to mount the tested catheter. The design allows the fluid to be pumped through the inner lumen of the implant tube before filling the inner chamber. *Staphylococcus epidermidis* and *Candida albicans* were used to validate the device. The viability of the microorganisms within the biofilm was demonstrated quantitatively by viable count and semi-quantitively by visualizing the biofilm communities using SEM and CSLM. The shear stress on the inner and outer surfaces of the catheter was determined at different flow rates of the culture medium (1-100 ml/h).

Results: For *S. epidermidis*, the log value of the number of cells contained in the biofilm under static system was 6.41 ± 0.22. This value was significantly higher ($p < 0.001$) than that of the biofilm which formed under continuous fluid flow system (5.18 ±0.13). Significant population variability ($p = 0.012$) was also observed with the biofilm of *C. albicans* where the log value of the number of cells was 6.44 ± 38 and 5.47 ± 0.05 respectively, The shear stress on the inner and outer surfaces of the catheters were in the range of 0.0028- 0.28 and 4.01×10^{-5}- 0.004 N/m^2 respectively
Conclusions: The device enables the formation of a reproducible biofilm of bacteria and yeast on the catheter surface under both static and continuous fluid flow systems. It is not only simulating the real biofilm environments, but also could be modulated to contain most catheter and tubes and readily allows biofilm formation under different experimental conditions.