

Perfluorocarbon Omniphobic Treatment Prevents Bacterial Colonization Of Urinary Catheter In A Rat Model

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ABSTRACT

Background:

The bacterial colonization of urinary catheters is a major source of hospital acquired urinary tract infections (HAUTI). Bacteria repellent coatings could lower HAUTI prevalence and minimize antimicrobial usage. We report a model of spontaneous bacterial colonization of an intravesical catheter in a spinalized rat model, and the first in vivo proof of the efficacy of Lubricant-Infused Catheters (LICs) in preventing bacterial colonization.

Methods:

LICs preparation: Oxygen plasma treated polyethylene catheters were immediately placed in a vacuum desiccator and 200 μ L of trichloro (1H,1H,2H,2H-perfluorooctyl) silane) was placed beside the catheter segments. The vacuum pump connected to the desiccator was turned on with the exit valve closed once a pressure of -0.08 MPa was achieved. The chemical vapour deposition process was initiated for 4 hours. Catheters were removed from the desiccator and placed in an oven at 60°C for a minimum of 12 h in order to complete the modification process. Catheters were saturated with a biocompatible fluorocarbon-based lubricant (perfluorodecalin) prior to implantation.

Thirty centimeters long native catheters and LICs were surgically implanted in the bladder of rats spinalized 19 days prior and programmed to undergo cystometry experiments 48 hours later. Each rat was maintained individually in a cage with food and water ad libitum until bladder functional evaluation, and benefitted from a of trimethoprim sulfadoxine and fluoroquinolone prophylaxis. At the end of the cystometry experiments, the animals were euthanized and the bladder catheter was removed. A 1cm section from the intravesical end of the catheter was cut and placed in 1 ml of Amies medium (eSwab, Copan), vortexed and sonicated. 10 μ L of the suspension was plated on URIselct4 medium (Bio-Rad, Hercules, Ca) for bacterial enumeration.

Results:

A significant reduction in bacterial colonization with *Enterobacteriaceae* and *Enterococci* was observed in the LICs group (N=6, below 100 CFU threshold) compared to the native catheter group (N=5, average 8200 CFU) ($p < 0.002$).

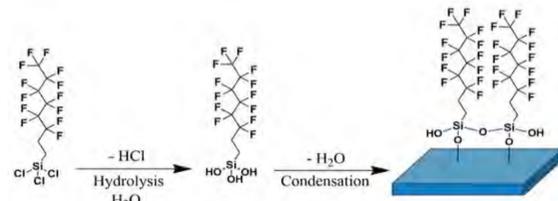
Conclusion:

Lubricant-infused catheters effectively prevent bacterial colonization in vivo and provide an attractive and non-selective option for HAUTI prevention.

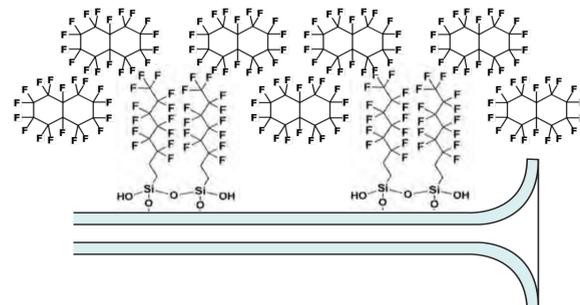
METHODS



1) Catheter surface activation
Oxygen Plasma treatment of the polyethylene catheter

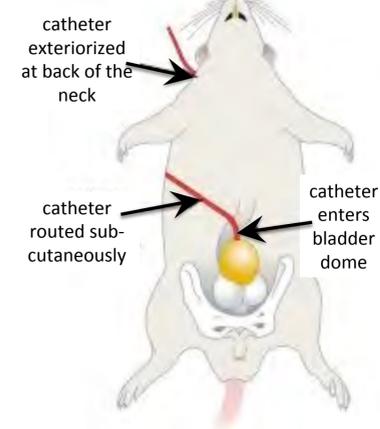


2) Chemical Vapour Deposition of
trichloro(1h 1h 2h 2h-perfluorooctyl)silane
on the catheter surface

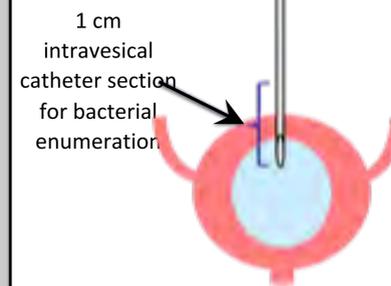


3) Saturation of the functionalized catheter with
perfluorodecalin to achieve omniphobicity

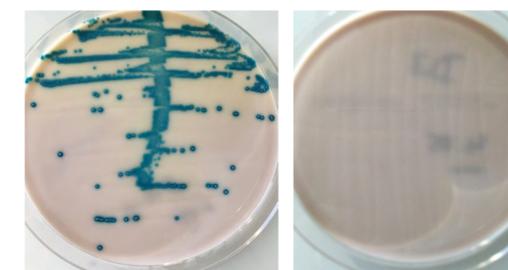
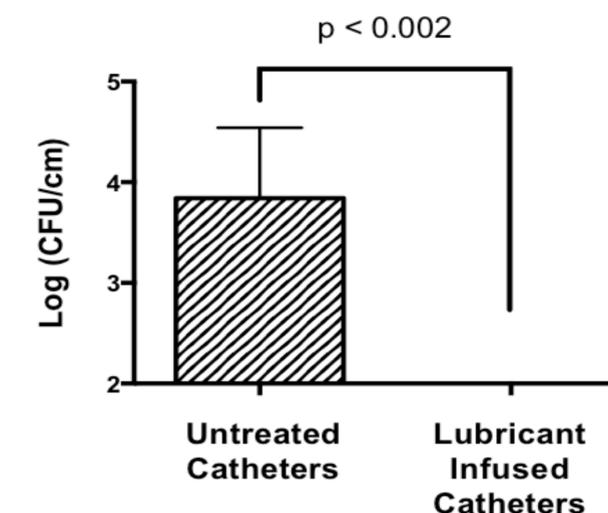
Schematic positioning of Urinary Catheters



Saline infusion for
bladder pressure
measurement



RESULTS



CONCLUSIONS

In spite of antimicrobial prophylaxis, untreated intravesical bladder catheters are significantly colonized with bacteria in the course of a 48h cystometric urodynamic exploration in the rat model. In contrast, The lubricant infused catheters were found to be bacteria-free in the same condition.

The coating needs to be evaluated in the absence of antibioprophyllaxis, and the duration of the protective effect needs to be determined in vivo.