UVC fluencies for preventative treatment of pseudomonas aeruginosa contaminated polymer tubes

Exposing Pseudomonas aeruginosa biofilm grown on the inner surface of Teflon and silicone tubes to UVC light (265 nm) from light emitting diodes (LED) has previously been shown to substantially reduce biofilm growth. Smaller UVC fluencies were required to disinfect Teflon tubes compared to silicone tubes. Light propagation enhancement in tubes can be obtained if the refractive index of the intra-luminal saline solution is higher than that of the polymer. This condition is achieved by using Teflon tubes with a low refractive index (1.34) instead of the polymers with a high refractive index (1.40-1.50) normally used for tubing in catheter production. Determining whether or not UVC light exposure can disinfect and maintain the intra-luminal number of colony forming units (CFUs) at an exceedingly low level and thus avoid the growth and establishment of biofilm is of interest. The use of UVC diodes is demonstrated to be a preventative disinfection treatment on tubes made of Teflon, which enhances the UVC light propagation, and on tubes made of a softer material, ethylene vinyl acetate (EVA), which is suitable for catheters but much less suitable for UVC light propagation. Simulating an aseptic breach (∼103-104 CFU ml-1), the UVC disinfection set-up was demonstrated using tubes contaminated with planktonic P. aeruginosa. After the tubes (10-20 cm) were inoculated with the bacterial solution for 3 h, they were emptied and filled with saline solutions (0.9-20%). Next UVC fluencies (0-21 mJ cm-2) were applied to the tubes 3 h after inoculation. Colony counts were carried out on liquid samples drawn from the tubes the first day after UVC treatment and liquid and surface samples were collected and analyzed 3-4 days later. A fluence of approximately 1.0 mJ cm-2 was noted as being sufficient for no growth for a period of 3-4 days for the Teflon tubes. Determining the fluence threshold for the EVA tubes was not possible. Almost all of the UVC-treated EVA tubes were disinfected simply by filling the tubes with a saline solution. Direct UVC treatment of the contaminated EVA tubes revealed, however, that a fluence of 21 mJ cm-2 killed the bacteria present in the tubes and kept them disinfected for a period of 3-4 days.

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