Antimicrobial effect of TiO_2-coated catheters

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Abstract

The use of permanent catheters remains an integral part of medical care for a large number of patients in intensive care units, but also in daily life outside the hospital. These medical devices carry a constant risk of infection at the interface between the skin and the environment, so innovative and flexible solutions must be found to minimize this health risk.

The use of titanium dioxide as a powerful photocatalytic agent can have a major effect in combating the spread of pathogens through heavily contaminated surfaces. When UV light impinges on titanium dioxide coated surfaces, highly oxidative reactive oxygen species are formed that can attack the cell membrane of adherent microorganisms and lead to cell death. For this purpose, various catheter materials such as polyvinyl chloride, silicone, latex as well as polyurethane were coated with titanium dioxide at critical points using the sol-gel process. The thickness of the coating and the adhesion behavior under mechanical stress were determined. Subsequently, the coated catheters were cultured with the pathological microorganisms Escherichia coli and Staphylococcus aureus to investigate the antimicrobial effect of the coating. The surfaces were cultured with the appropriate microorganisms for ten days, and the coated areas were irradiated with UV light for one minute daily. The germicidal effect was determined in comparison to the negative control and UV irradiation alone using live-dead cell staining. A bacteriostatic or antimicrobial effect was demonstrated for the coated catheters studied. The results show great potential for flexible disinfection of catheter areas with a high risk of contamination, such as drainage catheters (transurethral indwelling catheter, suprapubic drainage) or probes for artificial feeding of intensive care patients via percutaneous endoscopic gastrostomy (PEG), which can be performed by hospital staff as well as by the patients themselves. The economic large-scale use of appropriately coated catheters requires further research.