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SELF-STERILIZING CATHETERS COATED WITH TIO_2 PHOTOCATALYST THIN FILMS FOR CLEAN INTERMITTENT CATHETERIZATION

Aims of Study

Clean intermittent catheterization is the superb method for managing neurogenic bladder. But a lot of disposable catheters or much disinfectant for non-disposable catheters are needed for this purpose.

Titanium dioxide (TiO_2) as photocatalyst is chemically activated only by light energy. It can safely decompose materials of our choice, e.g., dirt, grime, bacteria, etc by powerful oxidizing action under lighting. The materials coated TiO_2 have been already used in practice for tiles, mirrors, tents and so on. Additionally, TiO_2 is chemically and physically stable and safe enough to be used an additive for food and cosmetics. We have developed successfully the technology of coating TiO_2 on silicone rubber. Here we have made the TiO_2 coated catheters for clean intermittent catheterization using this technique. We examined the photocatalytic anti-bacterial effect and the safety of them for practical use.

Methods

[TiO_2-coated catheters]: We made TiO_2-coated silicone catheters by pretreatment of the silicone surface with a sulfuric acid solution. [1)] The TiO_2 film adhered to the silicone substrate strongly against tensile and bending stresses.

[Antibacterial quality]: A 100µl aliquot of the *E.coli* cell suspension (2×10^5 cells/ ml) filled a TiO2-coated catheter, and then it was illuminated with a 15-W black-light lamp (light intensity, 1000µW/ cm^2) After illumination, the bacterial suspension was collected in 0.15M aqueous sodium chloride solution. This solution was spread onto a nutrient agar medium and incubated to determine the number of viable cells in terms of colony-forming units. Same examinations were done using *S. aureus, P. aeruginosa* and *S. marcescens*.

[Safety study]: We implanted a tip of TiO_2-coated silicone catheters into subcutaneous tissue of mice. Bodyweight curves and histological tissue changes within a certain period of time were observed.

Results

(1) The survival ratio of *E coli* in the liquid inside the catheter decreased to a negligible level within 60 min. under blacklight illumination. The survival ratio of *S.aureus, P.aeruginosa* and *S.marcescens* also decreased to a negligible level within 60 min. (2) We rarely recognized the difference of body weight and foreign body reaction in subcutaneous tissue of mice between TiO_2-coated catheter and the control through 9 weeks after the implantation of TiO_2-coated silicone catheter.

Conclusions

Our TiO_2-coated silicone catheters are easily sterilized under certain light source like sunshine or in the portable lighting equipment that we are proposing. And these catheters are safe in animal experiments. The TiO2 coated catheters for clean intermittent catheterization could be non-disposable and eco-conscious catheters for the future.

Reference: 1) .J. Biomed Mater Res 58:97-101,2001