Title: Biofilm Decontamination by Cold Atmospheric Plasma for Endoscope Reprocessing

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Abstract

Objective: This study evaluates the application of a plasma discharge for the decontamination and removal of bacterial biofilms in small-diameter polytetrafluoroethylene (PTFE) tubes. The latter simulates the environment of the therapeutic channel of a flexible endoscope. Methods: Biofilm models using Pseudomonas aeruginosa in 3 mm PTFE tubes were created. The plasma discharge was generated in the same PTFE tube, as shown in Figure 1, using water vapor in addition to argon or helium. Hydrogen peroxide (H₂O₂) production was measured by TiOSO₄ spectrophotometric titration. After plasma treatment, the decontamination efficacy was assessed through bacterial regrowth assays and biofilm violet crystal staining. Results: An argon with water vapor discharge effectively decontaminated the tube and partially removed the biofilm over a 30-minute treatment. However, 5-minute and 10-minute treatments were insufficient. Conclusions: An argon plasma with addition of water vapor effectively decontaminates biofilms grown in PTFE tubes, enabling a potential use for medical devices reprocessing such as endoscopes. Even if bacterial elimination is achieved with short treatment under certain conditions, full biofilm removal requires further optimization of the discharge parameters or additional pre-drying methods. This study suggests an interest for endoscope decontamination but highlights the need to refine plasma parameters for rapid biofilm removal.

Key words: Plasma medicine, Decontamination, Biofilm generation, Endoscopes