Visualization of Clinically Relevant Biofilms During Exposure to Disinfectants

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ABSTRACT

The main objective of this study was to directly visualize the effect of commonly available disinfectants on clinically relevant biofilms to reveal novel insights into their mechanisms of action. This was achieved by integrating a live/dead stain (BacLight) with an automated high-content screening system, which has the potential to determine in real-time the proportion of live and dead cells in a biofilm. The results demonstrated that different disinfectants exhibit varying degrees of effectiveness in killing biofilm cells. This is the first study that has directly visualized bacterial cell death during the course of exposure to disinfectants and a variety of antimicrobial agents. This study provides new insights into the mechanisms underlying disinfection and has implications for the development of more effective infection control strategies.

INTRODUCTION

The use of disinfectants is the primary means employed at the community, institutional, and household levels to prevent transmission of pathogenic organisms. These products are typically used to kill or inhibit the growth of bacteria and fungi on surfaces. However, the effectiveness of disinfectants on biofilms is less well understood.

METHODS

Biofilms were grown in a microchannel flow cells for 8 days. Following inoculation, the biofilms were treated with 0.2% Betadine, 0.3% H2O2, or 0.3% CHLOROX bleach. The fluorescence microscope software was used to set up a timeseries protocol to capture images of the biofilms during treatment. Microphotographs were taken at defined time intervals to allow for a direct comparison of live and dead cells. The results demonstrated that different disinfectants exhibit varying degrees of effectiveness in killing biofilm cells. This is the first study that has directly visualized bacterial cell death during the course of exposure to disinfectants and a variety of antimicrobial agents. This study provides new insights into the mechanisms underlying disinfection and has implications for the development of more effective infection control strategies.

RESULTS

DISINFECTANTS

Products available on the market include: (A) 70% isopropyl alcohol, (B) 0.3% H2O2, (C) 0.05% H2O2, (D) 0.3% CHLOROX bleach, and (E) 0.3% Betadine. The results demonstrated that different disinfectants exhibit varying degrees of effectiveness in killing biofilm cells. This is the first study that has directly visualized bacterial cell death during the course of exposure to disinfectants and a variety of antimicrobial agents. This study provides new insights into the mechanisms underlying disinfection and has implications for the development of more effective infection control strategies.

CONCLUSIONS

Effects of disinfectants on biofilms depend on product formulation, as well as test strain.

Products containing high levels of alcohol (70%) require longer exposure times to achieve complete killing of biofilm cells.

The hypothesized mechanism of action requires a larger exposure time from which biofilm cells are killed. Further research is necessary to determine the exact mechanism of action of these products.

This study presents a novel method for microscopic assessment of biofilms that allows for immediate visualization and measurement of cells over the course of exposure to disinfectants and a variety of antifungal agents.

REFERENCES


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