



X-ray μ CT has good potential as a direct, non-invasive, non-destructive technology to image biofilms in CVCs, as well as other in vivo medical components in which biofilms accumulate in concealed areas” Niehaus et al (2016).

Abstract:

Bacterial infections of central venous catheters (CVCs) cause much morbidity and mortality, and are usually diagnosed by concordant culture of blood and catheter tip. However, studies suggest that culture often fails to detect biofilm bacteria. This study optimises X-ray micro computed tomography (X-ray μ CT) for the quantification and determination of distribution and heterogeneity of biofilms in in vitro central venous catheter (CVC) model systems. Bacterial culture and scanning electron microscopy (SEM) were used to detect *Staphylococcus epidermidis* ATCC 35984 biofilms grown on catheters in vitro in both flow and static biofilm models. Alongside this, X-ray μ CT techniques were developed in order to detect biofilms inside CVCs. Various contrast agent stains were evaluated using energy dispersive X-ray spectroscopy (EDS) to further optimise these methods.

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Catheter material and biofilm were segmented using a semi-automated MATLAB script and

quantified using the Avizo Fire software package. X-ray μ CT was capable of distinguishing between the degree of biofilm formation across different segments of a CVC flow model. EDS screening of single and dual compound contrast stains identified 10 nm gold and silver nitrate as the optimum contrast agent for X-ray μ CT. This optimised method was then demonstrated to be capable of quantifying biofilms in an in vitro static biofilm formation model, with a strong correlation between biofilm detection via SEM and culture. X-ray μ CT has good potential as a direct, non-invasive, non-destructive technology to image biofilms in CVCs, as well as other in vivo medical components in which biofilms accumulate in concealed areas.

Reference:

Niehaus, W.L., Howlin, R.P., Johnston, D.A., Bull, D.J., Jones, G.L., Calton, E., Mavrogordato, M.N., Clarke, S.C., Thurner, P.J., Faust, S.N. and Stoodley, P. (2016) Development of X-ray micro-focus computed tomography to image and quantify biofilms in central venous catheter models in vitro. *Microbiology*. July 6th. .

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