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The succesful pathogenic role of biofilms in Carbapenem-resistant Escherichia coli IMP-type and Klebsiella pneumoniae NDM-1 bacteria in their increased prevalence in biofilm-associated infections.

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Abstract

In light of the limited therapeutic options and significant threat associated with infections caused by Carbapenem Resistant Enterobacteriaceae (CRE) pathogens, understanding the pathogens' biology, specifically, the ability of form the biofilms and biofilm related gene expression are utmost important to the treatment of the biofilm-associated infections caused by these CRE pathogens. To understand the pathogenic role of the biofilms, the study investigated amount of biofilm formation and biofilm-related gene expression in in CRE strains, Escherichia coli IMP-type and Klebsiella pneumoniae NDM-

1. The amount of biofilm formed was measured using Tissue Culture plate assay at different time points (6, 12, 24 and 48 hours) of incubation, assuming the time points were corelate with the stages of biofilm development stages; initial attachment (6 hours), microcolony formation (12 hours), maturation of biofilms (24 hours) and dispersion of biofilm (48 hours). Biofilms were quantified under static and shaking incubator conditions and under two different growth media; nutrient poor (AB broth) and nutrient rich media (LB broth) media. In parallel, Quantitative Real-time PCR (qPCR) was applied for invitro biofilm development stages. The amount of biofilms formed and the biofilm-related gene expression results were compared with structural analysis using Confocal Laser Scanning Microscopy (CLSM) at different growth conditions.

For both CRE strains irrespective of incubation condition and growth media, varying amount of biofilm was observed and was corelated with the biofilm development stages. Maximum amount of biofilm development was observed at 24 hour time period of incubation indicating the maturation of biofilm development. Similarly, the same pattern of biofilm-related gene expression was observed, where majority of gene expressed at 24 hour time point. In related to the above analysis CLSM also, showed that aggregation of the different cellular products, corresponding to each biofilm development stage. These findings suggested that, for both CRE organisms' biofilm formation and biofilm-related gene expression profiles are not affected by the various growth conditions tested, indicating the successful pathogenic role of biofilm formation by adopting to different environmental conditions. The findings suggest that adoptability of biofilm under different environmental conditions plays a significant role in the carbapenem-resistant Escherichia coli IMP-type and Klebsiella pneumoniae NDM-1 bacteria in their increased prevalence in biofilm-associated infections.

Speaker Biography:

Dr S. Samarasinghe's research career commenced with securing a highly internationally competitive Darwin Trust of Edinburgh doctoral scholarship to work under a world-leading Molecular Microbiologist, Professor Steve Busby, FRS (University of Birmingham) to study the molecular mechanisms that control the gene expression in Escherichia coli. After completing her doctoral studies, she complted a Post-doctoral Research position (2008-2011) at the University of Leicester to understand the molecular mechanisms that control the cell division of higher Eukaryotic Microbes. During that time she was selected as a Visiting Research Fellow at a most prestigious Molecular biology research Lab, European Molecular Biology Laboratory, (EMBL), and Germany. Presently, the focus of her scientific research is to understand the underlying genetic characteristics of antibiotic-resistant bacteria associated with Urinary Tract Infections (UTIs), and how these characteristics can be manipulated to combat resistance via developing novel anti-microbial therapies.

Abstract Citation:

Klebsiella pneumoniae is an opportunistic pathogen that commonly causes nosocomial infections in the urinary tract,

respiratory tract, lung, wound sites and blood in individuals with debilitating diseases. Klebsiella pneumoniae is still a cause of severe pneumonia in alcoholics in Africa and Asia, and the predominant primary pathogen of primary liver abscess in Taiwan and Southeast Asia, particularly in Asian and Hispanic patients, and individuals with diabetes mellitus. In the United States and Europe, K. pneumoniae infections are most frequently associated with nosocomial infections. The emergence of antibiotic-resistant strains of K. pneumoniae worldwide has become a cause of concern where extended-spectrum β-lactamases (ESBLs) and carbapenemase-producing strains have been isolated with increasing frequency. The pathogen's ability to form biofilms on inserted devices such as urinary catheter has been proposed as one of the important mechanisms in nosocomially acquired and persistent infections, adding to the increased resistance to currently used antibiotics. In this review, infections caused by K. pneumoniae, antibiotic resistance and formation of biofilm will be discussed.

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