Microbubbles for Clinical Biofilm Treatment: Tackling Antimicrobial Resistance in New Ways

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Background: Biofilms are structured microbial communities attached to surfaces, embedded in a polysaccharide extracellular matrix (ECM). Most human infections involve a biofilm and affected surfaces may be synthetic (e.g. urinary/vascular catheters, pacemakers, orthopaedic implants) or natural (e.g. gastrointestinal-tract, heart valve, tooth). Biofilms have profound significance in biomedicine as the normal microbiota (colonizing flora) and the majority of infections involve microorganisms growing in biofilms:

- >80% of infections are caused by micro-organisms in biofilms;
- Micro-organisms in biofilms are more resistant to antibiotics;
- Biofilm infections cause failure of biomedical devices, including implanted devices;
- Chronic inflammatory diseases, cancer: linked to aberrant responses to biofilms;
- Regenerative therapies must succeed at sites constantly exposed to biofilms.

Unfortunately, biofilms are often refractory to eradication by antimicrobial agents and host defences because of altered cellular metabolics and physical protection, particularly via the ECM.

There is a pressing clinical need for novel methods to treat biofilm infections.

Project Outline: Our aim is to use nano/microbubbles (MBs) and the highly energetic processes associated with ultrasound bursting of microbubbles to disrupt and eradicate bacterial biofilms *in vitro*.

Combinations of physical (MB and ultrasound) and chemical (antibiotic) approaches to biofilm disruption will be evaluated.

Key elements of your project will be to develop: i) to investigate nano/micro-bubble / biofilm interactions in microfluidics systems, ii) optimisation of ultrasound aided microbubble disruption of biofilms, iii) US/MB aided penetration of antibiotics, antimicrobials into biofilms.