Biofilms: hard to detect, easy to underestimate, but most definitely here to stay

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Biofilms are found in most natural environments and are probably the most common form of microbial existence (Costerton et al, 1995). They are relatively stable, three-dimensional communities of microbial cells encased in a complex mixture of extracellular polymers. Biofilms normally form at interfaces after adherence of free-living (planktonic) cells, which grow and divide to form clusters. The cells generate chemical signals that aid communication between members of the same species. As the numbers of cells and signals within clusters increase and a critical level (or quorum) is exceeded, gene expression within the cells changes and biofilm development is initiated.

In mature biofilms microbial cells exhibit altered characteristics compared with their planktonic counterparts. In humans biofilm cells have increased virulence and resistance to immunological defences, and decreased sensitivity to inhibitors such as antibiotics and antiseptics. Such biofilms have been linked to persistent infections such as osteomyelitis, periodontal disease, cystic fibrosis, otitis media, prostatitis, endocarditis and infections associated with medical devices (Costerton et al, 1999). After years of speculation, a definitive study significantly associated biofilms with chronic rather than acute wounds using scanning electron microscopy and confocal scanning laser microscopy (James et al, 2008).

The routine methods employed in conventional diagnostic bacteriology fail to demonstrate the presence of biofilms in clinical samples because adherent and encased cells are not effectively collected from biofilms and recovered cells do not reflect typical biofilm features. Biofilms cannot, therefore, be easily detected in wounds and are likely to be underestimated. Molecular techniques have recently provided insight into the range of bacterial species found in microbial communities and have shown that organisms not cultured by conventional methods were present (Dowd et al, 2008). It has also been suggested that interactions between bacteria present in biofilms in diabetic foot ulcers generate pathogroups which cause pathological events in chronic wounds that are not attributable to individual members (Dowd et al, 2008).

Increased prevalence of antibiotic-resistant microbial strains has increased the difficulty of treating infected and colonised wounds. Reduced rates of growth in biofilm members compound the problem by further reducing antimicrobial susceptibility (because antimicrobial agents normally target biosynthetic pathways in actively growing cells), making biofilms extremely difficult to eradicate. Many novel approaches to control biofilms have been suggested but most rely on laboratory data rather than clinical evidence. To date only one clinical study using an anti-biofilm strategy of sharp debridement coupled with topical application of lactoferin and xylitol in patients with critical limb ischaemia has been reported (Wolcott and Rhoads, 2008). Further therapies have yet to be developed and a combination of therapies is likely to be used. Inhibiting quorum sensing may be an answer, but more research is needed.

Most wound care specialists are aware of the presence of biofilms in wounds, but the concept is not universally accepted. Currently, biofilm detection relies on sophisticated techniques which are expensive and time-consuming. They cannot be diagnosed by sight, and slime or a thin film does not necessarily indicate the presence of a biofilm. Reliable, inexpensive and rapid detection methods must be devised, optimised, validated, implemented and evaluated. This will allow the prevalence of biofilms in wounds to be established, and their role in pathogenesis to be fully explored. New ways of controlling biofilms have to be developed and clinically evaluated. In turn, new management algorithms may have to be devised. Our belief in evidence-based medicine to inform clinical practice means that it is going to be years before we can confidently diagnose and effectively treat wound biofilms routinely so it appears that they will be providing a challenge to wound care specialists for a long while to come. WUK

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