

Preface

The use of biomaterials in modern medicine has greatly contributed to patient care allowing less-invasive patient monitoring, improvements in the administration of medicines, and enhanced patient mobility contributing to improvements in quality of life. Relatively early in the evolution of medical devices, however, it was realized that the use of implanted biomaterials also results in an increased susceptibility to infection. This increase in infection susceptibility appears to be present across all biomaterials classes, regardless of form or function and has remained to this day as one of the most common, yet unresolved problems associated with the use of implanted biomaterials. With an aging society, and increasing use of biomaterials to ensure restoration of function and quality of life, the problem of biomaterials associated infection (BAI) may be expected to increase in the coming decades. In this book we aim to provide the reader with an overview of the problem of BAI with a particular emphasis on the pathogenesis of BAI and opportunities available through biomaterials research for reducing its incidence.

Medical devices and the biomaterials from which they are composed are clearly central players in the pathogenesis of BAI. The presence of an implanted biomaterial causes a local defect in host immune defenses that contributes to the failure of the host to efficiently clear contaminating bacteria in a certain percentage of cases. The processes of BAI then progress from bacterial adhesion to the biomaterial and colonization of adjacent tissues through to formation of an antibiotic recalcitrant bacterial biofilm. A better understanding of this process from microbiological, pharmacological, immunological, and biomaterials science perspectives is required if significant reduction in BAI incidence is to be achieved.

One area in which considerable research has been performed is that of bacterial virulence and the pathogenesis of BAI. This theme is discussed in depth in the first part of the book, with a number of chapters dedicated to the pathogenic process of BAI for the most common causative microorganisms *Staphylococcus aureus* and *Staphylococcus epidermidis*, as well as a focus upon the increasingly acknowledged opportunistic pathogen in BAI, *Propionibacterium acnes*. There is also a growing body of data available on the host response to biomaterials, although a clearer understanding of the interplay between the local immune activation resulting from the biomaterials and subsequent impact upon the contaminating bacteria are required if we are to fully elucidate the pathogenic process of BAI and develop successful

interventions. The immune response to biomaterials is also discussed in the book with contributions discussing the role of the foreign body response and dendritic cell activation by biomaterials.

Biomaterials research presents the single largest target, with most potential for clinical impact, in achieving reductions in BAI. Modern biomaterials science has provided a vast array of modification and activation strategies to impart anti-infective properties upon biomaterials. In this book some of the most commonly applied approaches to anti-infective biomaterials design are discussed, such as antibiotic-loaded materials and coatings, anti-adhesive surfaces, surface-functionalization with silver, and also a more novel and contemporary approach, prevention of infection by medical-grade honey. Furthermore, with clinicians and insurance providers demanding reductions in BAI incidence, research into new anti-infective biomaterials and the clinical introduction of devices with anti-infective properties represent the front line in modern translational research. Ultimately, the most promising anti-infective biomaterials solutions must be tested in the clinics and hospital wards, where treatment outcomes and efficacy information may be collated. Clinical data is already available for some antimicrobial devices such as catheters, endotracheal tubes, periodontal implants, and orthopedic devices. The case histories of several of these devices are presented in this book together with a frank discussion of their impact on reducing or preventing BAI and potential future use based on the latest clinical data. Careful attention to, and continuous observation of, the clinical results associated with the use of antimicrobial devices is expected to provide the necessary direction for future biomaterials research. In this book we have aimed to provide an overview of the most crucial parameters in both preclinical and clinical fields allowing the reader to obtain a complete understanding of the problem of BAI from all of the most important perspectives.

The Editors

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