
Preface

The recently acquired knowledge on the pivotal role played by biofilm-growing multidrug-resistant microorganisms in healthcare-related infections has given a new dynamic to detection, prevention and treatment of these infections.

As a consequence, the investigation of biofilm-based infections is currently one of the “hottest” research areas in microbiology and infectious diseases. Particularly, an increased awareness of the possible causative role of bacterial and fungal biofilms in a number of healthcare-associated infections has emerged in the last two decades as a result of the progressive improvements in our knowledge on the structure and physiology of single- and multi-species biofilms. In fact, the milestone paper published in the *Journal of Bacteriology* back in 1991 by John Lawrence in collaboration with Bill Costerton reports horizontal and sagittal optical sections of *Pseudomonas aeruginosa* and *Vibrio parahaemolyticus* biofilms obtained by using a confocal laser scanning microscope and viable fluorescent probes. In this paper, bacteria were described as fully immersed in a highly hydrated matrix constituting 73–98% of extracellular substances, with the presence of large void channels allowing the circulation of nutrients, signalling molecules and microbial metabolites. The tridimensional structure of these microbial communities, the dynamics of their sessile growth and the cell–cell interactions as well as those with the surrounding environment strongly differentiated the sessile growth condition from the planktonic one. On the basis of scanning electron microscopy investigations performed in the mid-1990s at the Center for Biofilm Engineering in Bozeman (USA), Bill Costerton proposed the well-known mushroom model schematically drawn by Peg Dirckx in his widely used cartoon. This new outlook of the microbial world has led basic microbiologists and clinicians to the awareness of the predominance of biofilm-growing microorganisms, especially, but not only, in cases of foreign-body infections. In the last years, an impressive series of microbiological and clinical data have widely demonstrated the key role of biofilms as causative agents of severe, and often relapsing, infections in both immunocompetent and immunocompromised patients admitted to acute care hospitals and long-term care facilities.

The explosion of the interest of microbiologists, hygienists and infectious disease specialists in this field is also due to the recalcitrance of biofilm-

growing microorganisms to antimicrobial treatments. In fact, with respect to planktonic cells, it has up to 100–1,000 times higher tolerance to antibiotics and antiseptics has been reported for biofilm-growing bacteria. Even if a comprehensive model is still lacking for this multifactorial phenomenon, significant issues have been identified in the reduced antibiotic diffusion due to the exopolysaccharide matrix acting as a mechanical barrier and in the anaerobic conditions that are created in the inner part of the biofilm that, as it is well known, make ineffective a number of antibiotics including aminoglycosides, beta-lactams and fluoroquinolones. On the other hand, “persister cells” developing in a small percentage within the biofilms are also known to be highly tolerant to antibiotics and have been typically involved in causing relapses of infections. Furthermore, the development of resistance to antibiotics is highly promoted by the horizontal gene transfer between biofilm-growing bacteria, and the classical mutational mechanisms play a major role in this process. In addition, recent studies have demonstrated that mutagenesis is intrinsically increased in biofilms, and hypermutations are able to play an important role in these phenomena.

Most of the currently available methods to investigate bacterial and fungal biofilms as well as their antibiotic resistance have been exhaustively illustrated and critically annotated by authoritative scientists, well known for their relevant expertise in the respective fields, in the 25 chapters of the recent book by Humana Press titled *Microbial Biofilms – Methods and Protocols* (G. Donelli Ed., Springer 2014).

In the present two volumes of the book *Biofilm-Based Healthcare-Associated Infections*, a collection of 20 chapters written by leading scientists covering well-investigated areas of biofilm-related infections is offered to the attention and desirable appreciation of all the interested “biofilmologists”. The chapters deal with biofilm-based human infections affecting the oral cavity, the respiratory system, the gastrointestinal tract and the urogenital apparatus as well as other bacterial and fungal infections associated with orthopaedic surgery and breast implant, the use of gel fillers in cosmetic and reconstructive surgery, neonatal enteral nutrition and the insertion of various medical devices in the human body, including central venous catheters, endotracheal tubes and voice prostheses. A separate chapter is also dedicated to the persister cells in biofilm-associated infections, while other chapters focus on recently developed anti-biofilm strategies, including antimicrobial polymers, innovative drug delivery carriers and antimicrobial photodynamic therapy. On the whole, readers will have at their disposal a precious reference book that can be used as a working tool to recognize and treat biofilm-based infections also in the light of the most recent knowledge on the reduced antimicrobial susceptibility of causative agents.

I would like to express my gratitude to all the chapter authors for their excellent contribution to this book. Their efforts in writing comprehensive reviews on topics in such a fast-moving research field should be considered a generous gift to the scientific community. I am sure that readers will highly appreciate this book as it has happened to me.

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