Medical Implications of Biofilms

Human tissues often support large, complex microbial communities growing as biofilms that can cause a variety of infections. As a result of an increased use of implanted medical devices, the incidence of these biofilm-associated diseases is increasing: the non-shedding surfaces of these devices provide ideal substrata for colonisation by biofilm-forming microbes. The consequences of this mode of growth are far-reaching. As microbes in biofilms exhibit increased tolerance towards antimicrobial agents and decreased susceptibility to host defense systems, biofilm-associated diseases are becoming increasingly difficult to treat. Not surprisingly, therefore, interest in biofilms has increased dramatically in recent years. The application of new microscopic and molecular techniques has revolutionised our understanding of biofilm structure, composition, organisation, and activities, resulting in important advances in the prevention and treatment of biofilm-related diseases. The purpose of this book is to bring these advances to the attention of clinicians and medical researchers.

Michael Wilson is currently Professor of Microbiology in the Faculty of Clinical Sciences at University College London. Wilson's research interests include biofilms, antibiotic resistance, and bacterial virulence factors. Wilson has authored more than 200 scientific papers as well as six books, including *Bacterial Disease Mechanisms: An Introduction to Cellular Microbiology* (Cambridge, 2002).

Deirdre Devine is currently a Senior Lecturer in Microbiology at Leeds Dental Institute, University of Leeds. In addition to biofilms, Devine's research interests include antimicrobial peptides in control of resident microflora, oral anaerobes, and environmental regulation of bacterial virulence factors.

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Edited by

MICHAEL WILSON

Eastman Dental Institute
University College London

DEIRDRE DEVINE

Leeds Dental Institute
University of Leeds

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Preface

Biofilms are increasingly recognised as the preferred mode of growth of bacteria in a wide range of sites, including the many, and varied, habitats present in man. Until approximately 10 years ago, biofilms were regarded as consisting simply of an accumulation of bacteria and their products on a surface. But recent technical advances have significantly changed our understanding of biofilm organisation and function. Non-destructive methods of examining organisms in their living, hydrated state (for example, confocal laser scanning microscopy) have revealed that they have an ordered structure, often permeated by water channels, which can function as a primitive circulation system. Modern molecular techniques have identified genes that are up- and down-regulated in different regions of a biofilm – this has important implications for assessing the behaviour of organisms in biofilms (for example, virulence potential, susceptibility to antimicrobiol agents, and host defence mechanisms). Furthermore, the discovery of population-dependent gene regulation (quorum sensing) in bacteria has meant revising our concept of bacteria as being independently operating cells. Quorum-regulated gene regulation is, obviously, likely to play an important role in determining the collective properties of bacteria in biofilms.

During the last few years, interest in microbial biofilms has increased dramatically and now encompasses a broad range of disciplines – microbiology, molecular biology, microscopy, medicine, engineering, ecology, and marine biology. This increased specialisation within the field has led to a need for books that focus on particular aspects of biofilms. This book is concerned with the roles played by biofilms in infections of man, including those associated with prosthetic devices (catheters, implants, etc.) and teeth (caries, periodontitis, stomatitis), as well as certain lung, gut, and vaginal infections.

This book consists of four main sections. The opening chapters review key general aspects of the subject – gene expression and quorum sensing in biofilms – as well as the susceptibility of these communities to antimicrobial agents. Succeeding sections then deal with the three types of infection with which biofilms are associated – those of prosthetic devices, teeth, and shedding surfaces.

This book is written by leading researchers in the field and will be of interest to both scientists and clinicians.

List of Contributors

Yuehuei H. An
Orthopaedic Research Laboratory
Medical University of South Carolina
Charleston, South Carolina, USA

Samir Bhagwat
Department of Medicine
University of Rochester
Rochester, New York, USA

Werner Bokranz
Department of Cell Biology
Gesellschaft für Biotechnologische Forschung
Braunschweig, Germany

David J. Bradshaw
Bioscience Department
Quest International
Ashford, Kent, UK

Michael R. W. Brown
Department of Pharmacy and Pharmacology
University of Bath
Bath, UK

Robert A. Burne
Department of Oral Biology
University of Florida
Gainesville, Florida, USA

Yi-Ywan M. Chen
Department of Oral Biology
University of Florida
Gainesville, Florida, USA

Teresa R. de Kievit
Department of Microbiology
University of Manitoba
Winnipeg, Manitoba, Canada

Richard J. Friedman
Orthopaedic Research Laboratory
Medical University of South Carolina
Charleston, South Carolina, USA

Ulrich Gerstel
Microbiology and Tumorbiology Centre
Karolinska Institute
Stockholm, Sweden

Sean P. Gorman
School of Pharmacy
Medical Biology Centre
Queen's University of Belfast
Belfast, UK

Hend A. Hanna
Department of Infectious Diseases
Infection Control and Employee Health
University of Texas M.D. Anderson Cancer Center
Houston, Texas, USA

Christine Heilmann
Institute of Medical Microbiology
University of Münster
Muenster, Germany

Christopher M. Hill
Orthopaedic Research Laboratory
Medical University of South Carolina
Charleston, South Carolina, USA

Barbara H. Iglewski
Department of Microbiology and Immunology
University of Rochester School of Medicine and Dentistry
Rochester, New York, USA

Kimberly K. Jefferson
Channing Laboratory
Department of Medicine
Brigham and Women's Hospital
Harvard Medical School
Boston, Massachusetts, USA

David S. Jones
School of Pharmacy
Medical Biology Centre
Queen's University of Belfast
Belfast, UK

Philippe Lejeune
Laboratoire de Microbiologie et Génétiquè
Institut National des Sciences Appliquées de Lyon
Lyon, France

Yunghua Li
Faculty of Dentistry
University of Toronto
Toronto, Ontario, Canada

C. Y. Loo
Boston University, Goldman School of Dental Medicine
Department of Paediatric Dentistry
Boston, Massachusetts, USA

Heinrich Lünsdorf
Department of Microbiology
Gesellschaft für Biotechnologische Forschung
Braunschweig, Germany

G. T. Macfarlane
MRC Microbiology and Gut Biology Group
University of Dundee
Ninewells Hospital Medical School
Dundee, UK

S. Macfarlane
MRC Microbiology and Gut Biology Group
University of Dundee
Ninewells Hospital Medical School
Dundee, UK

Philip D. Marsh
Department of Oral Microbiology
Leeds Dental Institute
Leeds, UK

Manfred Nimtz
Department of Structural Biology
Gesellschaft für Biotechnologische Forschung
Braunschweig, Germany

Gerald B. Pier
Channing Laboratory
Department of Medicine
Brigham and Women's Hospital
Harvard Medical School
Boston, Massachusetts, USA

Issam Raad
Department of Infectious Diseases
Infection Control and Employee Health
The University of Texas M.D. Anderson Cancer Center
Houston, Texas, USA

Wolfgang Rabsch
National Reference Centre for Salmonellae and
Other Enteric Pathogens
Robert-Koch-Institut
Wernigerode, Germany

Ute Römling
Microbiology and Tumorbiology Centre
Karolinska Institute
Stockholm, Sweden

Anthony W. Smith
Department of Pharmacy and Pharmacology
University of Bath
Bath, UK

Helmuth Tschäpe
National Reference Centre for Salmonellae and
Other Enteric Pathogens
Robert-Koch-Institut
Wernigerode, Germany

Zezhang Wen
Department of Oral Biology
University of Florida
Gainesville, Florida, USA

Xhavit Zogaj
Microbiology and Tumorbiology Centre
Karolinska Institute
Stockholm, Sweden