Infections Associated with Indwelling Medical Devices

THIRD EDITION
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PREFACE

Modern medical practice, both hospital based and ambulatory, has developed a variety of artificial devices to assist in the performance of important physiological functions. These devices either are inserted into the human body for short periods of time, such as with catheters, or are meant to remain in place permanently, such as with artificial heart valves. The implants create an interface between human tissues and various prosthetic materials, such as ceramics, metals, and polymers. The prosthetic surfaces themselves undergo changes, such as oxidation and friction damage, and they interact with the surrounding tissue by activating various biological systems, such as coagulation, fibrinolysis, inflammation, hyperergic reaction, or tissue integration. It is not surprising that such changes at the interface will create new biological conditions, one of them being a high propensity for infection: any foreign or prosthetic material is associated with an increased risk of infection after implantation. These infections, wherever they are located, have some invariant characteristics: they have a well-defined microbiological profile, with gram-positive organisms—mostly staphylococci—as the major etiological agents; they require an exceedingly low inoculum in order to develop; once present, they respond poorly to antibiotics, are characterized by recurrences, and often require the removal of the prosthetic material for definitive cure; and they can be prevented in many cases by creating an antibiotic-rich climate surrounding the prosthetic material at the time of its insertion.

The development and implantation of prosthetic aids and materials are likely not only to continue but also to increase in the near future. More artificial implants will be used in orthopedic surgery, such as joint replacements and posttrauma reconstructive surgery. There will be more heart valve and vascular replacements, as well as pacemaker and defibrillator implantations. The use of stents, designed to keep the flow through various conduits unobstructed, can also be expected to increase. Finally, ambulatory care and prolonged therapeutic procedures often require permanent venous access devices.

There is also more to come. Subcutaneous physical and chemical microsensors, artificial extracellular matrix, drug delivery systems, tissue engineering, and other new developments at the interface between micro- and nanotechnology and biology will soon be available. These innovations may increase the risk of local, medical device-associated infections.

In addition to the clinical problems mentioned above, prosthetic material-associated infections raise a variety of important questions at a basic level. What are the physical properties of foreign material and its surroundings that are conducive to microbial nidation and multiplication? What are the mechanisms leading to a local decrease in host defense? How are gram-positive organisms selected for in a receptor-ligand reaction that allows them to adhere to foreign surfaces which are rapidly coated with extracellular matrix components? What factors allow adherent bacteria to survive in the presence of otherwise active antibiotics? Can new technology produce surfaces that are not considered foreign by the host—or by microorganisms?
Research at both the basic and the clinical levels has made considerable progress in recent years. In recognition of this rapidly expanding scientific field, a first edition of this book was published by the American Society for Microbiology in 1989. The intent of this book was to define the state of the art both at the laboratory level and in the clinical setting. The second edition, published in 1994, served the same purpose and expanded our knowledge in basic research as well as in clinical applications. The success of the second edition prompted the American Society for Microbiology to commission this third edition. Chapters of this version have been rewritten, and others have been totally revised. This edition covers such topics as the physical factors responsible for bacterial adherence; the molecular and genetic basis of adherence of staphylococci; new clinical problems; novel therapeutic or preventive approaches, such as treatment of ambulatory-care prosthetic material-associated osteomyelitis; identification and therapy of infected dental implants; and prevention and treatment of catheter-related infections.

We are deeply grateful to all contributors for their exhaustive and comprehensive treatment of the complex problems related to medical-device infections. We hope that this new edition will be helpful to both clinicians and researchers as a reference to their questions. Finally, we hope that the present state of knowledge will generate the questions and controversies that engender new concepts and ideas and ultimately lead to the control of these "diseases secondary to medical progress."

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