

Host Response to Biomaterials

The Impact of Host Response
on Biomaterial Selection

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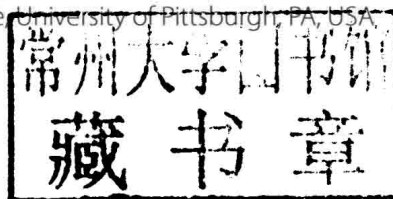
HOST RESPONSE TO BIOMATERIALS

THE IMPACT OF HOST RESPONSE ON
BIOMATERIAL SELECTION

Edited by

STEPHEN F. BADYLAK

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HOST RESPONSE TO BIOMATERIALS

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FOREWORD

The evolution and emergence of new biomaterials, medical devices, and prostheses is continuously marked by disruptive technology and innovation; however, success or failure in the clinical setting is ultimately dependent upon the host response following *in vivo* placement. Therefore, an understanding of the host response to biomaterials is both timely and necessary. This text provides an understanding of our current knowledge of the host response and identifies areas of ongoing research that will play a significant role in not only our further understanding of the response to biomaterials but also provide design criteria for new biomaterials. The respective chapters in this text target specific types of responses, but overall the text provides a basis for current and future understanding of the following: factors that promote implant success; rates, patterns, and mechanisms of implant failure; effects of patient and medical device factors on performance; the determination of dynamics, temporal variations, and mechanisms of tissue–material interactions; future design criteria for medical devices; and the determination of the adequacy and appropriateness of animal models.

Many factors may play a role in the failure or success of medical devices, e.g., blood/material interactions or mechanical property mismatch, but the host response will continue to be the most significant factor in determining downstream clinical efficacy.

While many implant failures can be characterized as implant- or material-dependent or clinically or biologically dependent, many modes and mechanisms of failure are dependent on both implant and biological factors. This text focuses on biological factors in the context of the host responses and provides not only an understanding of our current knowledge of this response but also relevant information for the safety (biocompatibility), efficacy (function), and the future design and development of next generation biomaterials, medical devices, and prostheses.

Dr. James Anderson

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PREFACE

This textbook is intended to be a resource and guide for biomaterial scientists, tissue engineers, biomedical engineering instructors and students, and importantly, for clinicians and surgeons with an interest in understanding the factors that influence the host (patient) response to biomaterials. There are many textbooks and journals that describe and characterize the physical, mechanical, and material properties of biomaterials, and great effort is expended in customizing the properties of biomaterials for specific clinical applications. Although these characteristics are certainly important, they are typically relevant only at the time of implantation since the host begins an immediate and relentless response to the presence of any foreign material. The integrity of these biomaterial properties at 6 months, 1 year, 10 years and beyond will ultimately determine clinical success. The host response to the biomaterials following implantation is clearly the driving factor in determining eventual success (or failure).

The host response is dependent upon a combination of factors including surgical technique, biomaterial properties, host factors, and an understanding of the innate and acquired immune systems when designing biomaterials. This textbook provides the perspective of experts within each of these disciplines. Exposure to different viewpoints regarding host response is important, and attempts have been made to identify where differences in opinion exist. The chapter by David Grainger describes the effects of age-related factors upon the host response. The concept of biocompatibility is addressed in Chapters 2 and 3 by Drs. James Anderson and Buddy Ratner, respectively, but is also discussed in numerous other chapters since it is such a fundamental concept and in some ways synonymous with the host response. The role of dendritic cells, the innate immune system, and the acquired immune system are covered by Drs. Keselowsky, Mantovani, and Wood, respectively. The surgical perspective of the clinical disciplines within orthopedics and urogynecologic surgery is provided by Drs. Goodman and Moalli in Chapters 12 and 13, respectively. Drs. Kyriakides and Tang discuss the important concepts of protein deposition on the surface of biomaterials and methods for evaluating various aspects of the host response.

This textbook is certainly not exhaustive since the breadth of disciplines involved in the host response is great. However, it is hoped that the contents of this book provide a useful guide and stimulate further investigation and discussion of the host response to biomaterials.

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