Martin J. Tobin

重症监护理论与实践

Principles and Practice of Intensive Care Monitoring

世界图书出版公司

Principles and Practice of Intensive Care Monitoring

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McGraw-Hill, Inc.

Health Professions Division

New York St. Louis San Francisco Aukland Bogotá Caracas Lisbon London Madrid Mexico City Milan Montreal New Delhi Paris San Juan Singapore Sydney Tokyo Toronto

(陕)新登字 014

陕版出图字　著作权合同登记　25-1998-111 号

ISBN　007-1167943

This edition is permitted by arrangement with McGraw-Hill Book Co. Singapore

Principles and Practice of Intensive Care Monitoring

重症监护理论与实践

by M. J. Tobin

任卫军　重印责任编辑

世界图书出版西安公司　重印发行

（西安市 南大街 93 号　邮编 710001）

中国人民解放军 7226 印刷厂印刷

787 × 1092 毫米　开本 1/16　印张 97.25

1998 年 12 月第 1 次重印

ISBN 7-5062-3986-8/R·328

定价：535.00 元

Principles and Practice of Intensive Care Monitoring

世界图书出版公司
西安 北京 广州 上海

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To Kieran, Kate, Damien and Sareen;
to Teresa, Eamon, Paddy and Mary;
and to Freshford, County Kilkenny

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PREFACE

Patients are admitted to an intensive care unit for two major reasons: to facilitate the delivery of mechanical ventilation and to more closely monitor a patient's condition. *Principles and Practice of Intensive Care Monitoring* has been developed to provide a comprehensive and authoritative compendium of the current state of knowledge on monitoring in the intensive care unit, to serve as a companion volume to *Principles and Practice of Mechanical Ventilation*. These two textbooks cover the features of critical care medicine that are most unique to the subspecialty.

A subspecialty emerges from a primary medical discipline when a core of knowledge is considered sufficiently large and unique to benefit from such a separation. Secession from an ancestral discipline is propelled by the parallel development of a cadre of diagnostic tests distinctive to that subspecialty. Thus, invasive electrophysiologic studies are confined to the cardiologist and body plethysmography is restricted to pulmonologists. The diagnostic procedures peculiar to an intensive care physician are the repeated assessments of vital functions, or monitoring. Distinctive features of this form of evaluation include the brief interval between repetition of a test, the need to make rapid decisions, and the strong link with titration of therapy. By instantly displaying waveforms and on-line computations, monitors can also serve as powerful educational tools. In few areas of medicine is the connection between testing and treatment as close as with intensive care monitoring. Because of the expectation of improvement in patient outcome, monitoring is subjected to closer scrutiny than most other diagnostic procedures.

The word "monitor" is derived from the Latin *monēre*, which means "to warn". While alerting a physician to a significant change in a patient's condition is an important goal, the scope of monitoring is broader. When planning this book, I realized that the definition of monitoring was not straightforward, and the distinction with diagnostic testing was sometimes blurred. As the chapters rolled in, a uniform definition of monitoring did not emerge. Some authors regard monitoring as the serial performance of diagnostic tests at frequent intervals. However, even attempting to specify the interval between measurements is problematic; when a signal has a very high frequency content, obtaining 50 samples per second may not be sufficient to capture a critical data point. When planning the book, I toiled with the ambiguities in the term monitoring and vacillated over the inclusion and exclusion of certain topics, since defining the boundaries of a book is a major responsibility of the editor. I agree with the Mad Hatter in Lewis Carroll's satire, *Alice's Adventures in Wonderland*, that communication is difficult when a generally accepted definition does not exist. However, the lack of a precise definition is not unusual in biological sciences, and Peter Medawar pointed out that "a definition, as the word itself connotes, has a quality of finality that is often unjustified and misleading and may have the effect of confining the mind instead of liberating it . . . There is no true meaning. There is a *usage* that serves the purposes of working biologists well enough." Along those lines, the word monitoring is employed operationally throughout this book to refer to what physicians and allied health personnel do with monitors.

By its very nature, monitoring involves machines. The intensive care physician needs a good understanding of the workings of these machines, or otherwise she or he will be enslaved by them rather than being their master. To know how to operate a machine and interpret the data it provides, a physician needs something more than a manufacturer's brochure and manual. In some medical centers, the intensivist can draw on the help of allied health professionals in running the machines, but staff still looks to the physician for direction. This book provides detailed information on every monitoring system, with discussions of the principles of the devices, how to operate them, the reliability of the measurements, the range of normal values, the indications, contraindications and complications of the techniques, and how to troubleshoot technical problems that frequently arise. While knowing how to operate a machine is critical, it is at least equally important to interpret the data correctly, and know how to effectively employ this information in clinical decision making and patient management algorithms. A monitoring device per se has never cured anybody; it is the user's response that decides the outcome. For each monitoring modality, the author provides the reader with the fundamental core of knowledge essential for interpretation, grounded in both the basic sciences (physiology, biochemistry, and cell and molecular biology) and the applied science of clinical medicine. The most effective use of a monitoring system requires a large body of knowledge, which, combined with the wisdom gained from experience, forms the basis of excellence in clinical practice.

The opportunities offered by monitoring technology come with new challenges. Attempting to cope with the avalanche of data generated by monitors is a daunting task. To gain perspective beneath the mounds of detail, we depend on additional technologic systems to synthesize, integrate and display information. The use of monitoring technology must never become an end in itself, but instead should prepare the way for a more focused, and also more reflective, approach to patient management. It is as important to know when to withhold action as it is to redirect management based on monitoring data. The increased focus on technological prowess combined with the decline of the pastoral role of the physician has made medicine appear remote and dehumanizing, and a sense of disquiet and doubt has arisen among

the public. No matter how excellent a physician's science, without compassion and care he or she cannot heal and give comfort. By placing too much faith in gadgets and their numbers, we run the risk of losing our clinical heritage. It is my belief that physical examination, with the laying on of hands, is much more than a diagnostic method; it affirms the spirit of mutual goodwill and understanding that forms the core of the doctor-patient relationship. Physicians examined the body in a perfunctory manner until the turn of the nineteenth century, when the stylized acts of today's physical examination gradually emerged. Those who view monitors with misgiving should recognize that systematic scrutiny of the body was originally viewed with disquiet by patients and doctors. Too much touching and groping was considered indelicate and beneath the dignity of a genteel physician. When Queen Victoria died in 1901, she had never undergone a complete physical examination by her personal physician of twenty years.

In a field evolving as rapidly as intensive care monitoring, the distinction between research and clinical practice is never sharp. Much of the excitement of practicing critical care medicine is sparked by applying the newest information. By providing a source where clinicians can find the answers to all their questions concerning intensive care monitoring, it is hoped that the information will aid in the care of the critically ill patient. Although authors were requested to focus primarily on material of importance for the practicing clinician, they were also asked to discuss techniques currently confined to the research domain but likely to move into the clinical arena in the near future. When I began my training in critical care medicine in 1982, several techniques that are standard features of monitoring today were then considered research tools, and some had only reached the drawing board. In medicine, we focus on problems that we can assess, but this does not diminish the importance of less penetrable problems. Likewise, we tend to monitor that which we can, rather than that which we need to. Accordingly, some of the chapters in this book deal with pathophysiological abnormalities of major importance for critically ill patients, although the methods for monitoring them are either crude or arcane and in need of enormous refinement. By highlighting these deficiencies, it is hoped that the book will serve as a stimulus for future research in intensive care monitoring.

In dealing with one of the most swifly moving fields in medicine, I realized from the outset that my enemy would be the early obsolescence of the material included in the book. To minimize this risk, I solicited clinicians and scientists at the forefront of work in their discipline, since they are in the best position to provide the most up-to-date analysis of work in that field. Authors were invited to speculate on where they see their field moving, providing a futuristic perspective of a dynamic discipline. Communication was rapid, and only a few months separated completion of the first and last chapter. For the book to serve as a reference source, special emphasis was placed on compiling a comprehensive and current bibliography with more than 9,000 pertinent references, including hundreds to publications appearing in 1996 and 1997. The book is heavily illustrated, with more than 950 figures. To make information easily accessible, almost 400 tables are provided, including several on troubleshooting that reflect wisdom gained from years of hands-on experience. To permit detailed coverage of a topic without unduly interrupting the flow of the narrative, some overlap between chapters was allowed. A striking feature is the geographical diversity of authors, reflecting the international base of significant advances in this field.

This book does not present a monolithic viewpoint on intensive care monitoring, and given the large number of authors it is not surprising to find differences of opinion regarding the merits of different aspects of monitoring. To ensure a balanced perspective, such differences of opinion were welcomed provided they were supported by relevant data. Monitoring techniques differ in their effectiveness: some prompt the institution of life-saving measures, others effect little benefit and mainly consume resources, and some techniques can kill patients. Authors differ in their enthusiasm for techniques, and exuberance for a technique is always balanced by a discussion of its limitations. Discussion of a technique should not be misconstrued as an endorsement for its use. At present we are facing a time in critical care medicine like none before, and many cardinal precepts have been called into question. Technology carries risks, and we owe it to patients that the benefits and hazards are fully evaluated, especially at a time of spiraling health-care costs. Simultaneously, expectations of patients and doctors have increased, and the absence, or presence, of monitored data forms a major component of many malpractice claims. As was the case with pharmacotherapy at the end of the last century, a nihilist perspective on monitoring is understandable, but the cynic should contemplate managing the sickest patient in an intensive care unit where all the screens are blank.

This book would have been impossible to produce without the help of several people, and to them I am extremely grateful. First are the 130 authors, whose knowledge, wisdom and commitment to scholarship form the core of this book. I am grateful to Geraldine Osmolak, Glinda Fitzgerald and Malinda Mazur for invaluable assistance at several stages of the project. I thank Patrick J. Fahey, MD, Chairman of Medicine at Hines and Loyola for his support of scholarly activity. The faculty and fellows in the Division of Pulmonary and Critical Care Medicine at Loyola-Hines provided insight, criticism and encouragement. Joe Hefta, my editor at McGraw-Hill, fostered the book from beginning to end, and provided immense help towards its successful completion. Pam Touboul skillfully guided the book through the galley and page proof production phase. Finally, I am especailly grateful to my family for their forbearance, and I apologize for the time taken from them.

Martin Tobin
November 1997

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