MGH TEXTBOOK OF emergency medicine

SECOND EDITION

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Emergency Care as Practiced at the Massachusetts General Hospital

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To the House Staff of the Massachusetts General Hospital, who have manned the front lines of the Emergency Ward.

Preface to Second Edition

The first national medical specialty board was recognized in 1917. In September 1979, 62 years later, the American Board of Emergency Medicine (ABEM) became the 23rd specialty board. A resolution adopted by the American Board of Medical Specialties recognized the ABEM as a conjoint board of the American Board of Family Practice, the American Board of Internal Medicine, the American Board of Obstetrics and Gynecology, the American Board of Otolaryngology, the American Board of Pediatrics, the American Board of Psychiatry and Neurology, the American Board of Surgery, the American College of Emergency Physicians, the American Medical Association's Section on Emergency Medicine, and the University Association for Emergency Medicine. Like the American Board of Family Practice, the ABEM is structured by means of "horizontal categorization" rather than the conventional "vertical categorization." Because of this cross-disciplinary framework, Emergency Medicine must be prepared to provide diagnosis and treatment for the entire spectrum of problems cared for by the sponsoring boards. This is a mighty challenge!

The coming-of-age of the specialty of Emergency Medicine has brought added responsibilities. Foremost among these are medical education, the development of standards of care for emergency departments as well as patterns of follow-up care that compensate for the episodic nature of the doctor-patient relationship, the formulation of mutually acceptable working arrangements with other specialties, and research into the common problems that are encountered in this broad field.

This textbook is directed toward the difficult task of education in perhaps the broadest specialty of all. Its contents originally stemmed from lectures presented to participants in the 2-week practical course sponsored by the Department of Continuing Education at the Harvard Medical School and the Massachusetts General Hospital (Emergency Care: An Extended Workshop). This course is now in its 14th year, and the present course director, Dr. Peter L. Gross, has been added as associate editor of this second edition.

Textbook preparation has been an immense task. An attempt has been made to avoid an encyclopedic treatise and to maintain a physically manageable size, while providing an in-depth approach to specific patient problems. The purpose has been to include material covering all aspects of medical care in the emergency department, to help bridge the sometimes difficult transition from emergency department to hospital specialty care, and to provide insights into subsequent diagnosis and therapy that may be affected by decisions made in the first moments of care. A criticism of the first edition was that it was largely written by traditional specialists and not by emergency physicians. Although this is still the case, every effort has been made in the second edition to heed specific suggestions of earlier critics.

The basic format of five sections has been maintained. In section 1, Life Support, a chapter on the treatment of the patient with multisystem trauma has been added, and in section 2, Medicine, chapters have been added on environmental hazards (including hyperthermia, radiation, barotrauma, and bites and stings) and on states of altered consciousness. In addition, Chapter 14, (new Chapter 17) Toxicologic Emergencies, has been reorganized. In section 4, Administration, the two chapters on the Massachusetts General Hospital Emergency Ward have been deleted; teaching hospitals that found this information useful can still refer to the first edition. Chapter 36, Emergency Medical Services Systems, is new, and describes the development and management of the excellent prehospital system of patient care in the city of Boston; this chapter was written by two authorities from the Boston City Hospital, which is the resource hospital for Medic IV, the regional emergency medical services system project. Finally, section 5, Illustrated Techniques, has been expanded, with the continued excellence of principal artist Mrs. Edith Tagrin.

The editors wish to express special gratitude to Ms. Catherine P. Fitzgerald, Editorial Associate, and to Mrs. Jane S. McDermott, who has skillfully handled the entire task—familiar to all editors—of coaxing authors, correlating material, and meeting deadlines.

EARLE W. WILKINS, JR., M.D.

Preface to First Edition

In many large urban centers, the emergency ward has become the focus of a number of medical activities. An emergency ward (1) may function as a 24-hour diagnostic and treatment facility for urgent medical problems, (2) may provide access to hospital admission for acutely and chronically ill patients, (3) may train residents, emergency physicians, and emergency medical technicians, (4) may initiate and participate in municipal emergency medical service systems, and (5) may take the lead in planning hospital response to disasters in the community.

The changing role of the emergency ward has resulted from many unrelated phenomena. Medical education since World War II, with its emphasis on specialization, has led to the disappearance of the general practitioner from the inner city; patients now expect sophisticated treatment in the hospital rather than at home. The postwar population explosion and migration to the city have made a large impact on the metropolitan hospital emergency facility. A dramatic rise in the accident rate has resulted from high-speed driving and the burgeoning use of alcohol and drugs. Increasing longevity has resulted in a new emphasis on emergency problems of the elderly. The effect of these developments is reflected in the census of users of the emergency ward of the Massachusetts General Hospital in the last 25 years, from 15,000 in 1951 to almost 100,000 (including those seen in the walk-in clinic) in 1976.

Until this decade, the response of urban hospitals to the growth in numbers and types of patients had been unplanned and inadequate. Several factors are probably responsible for this. No single method of planning, directing, staffing, or operating an emergency facility had become obviously superior, and therefore, time was required to develop patterns of care and to train innovative medical leadership. In addition, the specific role of the emergency ward was unclear, with the often conflicting purposes of treating the walk-in or "convenience" patient, managing the critically ill or injured patient, and serving as an admissions unit at times of high hospital census. Hospital administrators concerned about financial responsibility and confronted with escalating deficits from emergency facilities often deliberately delayed improvements to avoid attracting greater numbers of patients. Finally, it has taken an unexpectedly long time for the speciality of emergency medicine to develop and to gain acceptance.

Emergency medicine has, however, now become a recognized career. Training programs are available for both the graduating physician and those already in practice. Medical schools, responding to the stimulus of the University Association for Emergency Medicine, are offering courses in emergency medicine for undergraduates, and some hospitals and medical schools offer residency programs in emergency medicine. The American College of Emergency Physicians is the principal sponsor of a program of continuing education. A board of emergency medicine has not yet been approved. The development of emergency medical services systems nationwide has been led and funded by the Division of Emergency Medical Services of the Department of Health, Education, and Welfare (now DHH).

Despite this improvement, however, a formidable challenge remains. Community hospitals and metropolitan general hospitals must, both individually and collectively, respond to the needs of consumers of medical care by providing a decent physical plant, a carefully trained staff, and a system for rendering care to patients with a wide range of problems. Access to appropriate care must be facilitated so that treatment of trauma or acute illness can begin earlier.

This text is designed to respond to the challenge by providing assistance in the training and continuing education of emergency physicians. It is a survey of methods developed and put into use at a large private metropolitan hospital, the Massachusetts General Hospital. The authors are primarily practitioners in the general hospital who also provide care and teaching in the emergency setting.

The book is divided into five sections. The first section entitled "Life Support" is intended to assemble the physiologic and therapeutic considerations that could apply to resuscitative efforts in the following chapters. The second and third sections treat medical and surgical topics, respec-

tively. The fourth section is devoted to the administrative aspects of an emergency facility. The final section illustrates some of the more common techniques performed in the emergency ward. Selected reading lists at the conclusion of chapters are intended to complement the discussions and are not exhaustive surveys of the literature.

Most of the art work has been the effort of Ms. Edith S. Tagrin, head of the Medical Art Department of the Massachusetts General Hospital. Illustrations for Chapters 18, 19, and 28 were done by Mr. Sidney Rosenthal of Arrco Medical Art and Design, Inc.; Ms. Hedwig Murphy furnished some of the illustrations for Chapter 30. Most of the photographic work was done by the Photography Laboratory of the Massachusetts General Hospital under the direction of Mr. Stanley Bennett.

The editors wish to express their gratitude to all who have spent the long hours and sometimes frustrating moments necessary in coordinating this textbook. Ms. Catherine P. Fitzgerald has been patient, persuasive, and highly competent as chief technical editor and general orchestrator of the entire manuscript, with the able assistance of Ms. Susanna Adams. Mrs. Jane McDermott was instrumental in the organization of the book at the conceptual stage and was extremely helpful in accumulating manuscript. To these three women in particular, I would like to give sincere and everlasting thanks that words are inadequate to express.

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SECTION 1

Life Support

CHAPTER 1

Pathophysiologic Principles

HAMILTON R. HAYES, M.D.
BURTON A. BRIGGS, M.D.

In simplest terms, an organism survives by maintaining oxygenation, circulation, and the integrity of its cellular milieu. Each of these elements comprises many interrelated anatomic, physical, and physiologic aspects. To consider the principles involved in detail, they will be separated and discussed as indicated in Table 1.1.

AMBIENT ATMOSPHERE

The pathway leading to oxygenation of peripheral tissues begins with the composition of the inspired air. This becomes important in the clinical setting when the oxygen supply is depleted, as in asphyxiation, or when a toxic gas is added, as in carbon monoxide poisoning; the clinician must remember that room air at sea level contains 21% oxygen and a negligible amount of carbon dioxide. The total and partial pressures of gases are presented in Table 1.2.

PATENCY OF AIRWAY

Possession of thorough knowledge of the anatomy of the respiratory tract and of the skills required to establish and to maintain its patency constitutes one of the cornerstones in the practice of emergency medicine. Establishment of an open airway is the first procedure in most resuscitative exercises. Securing and defending the airway is frequently lifesaving in itself—the definitive resuscitative measure. Conversely, failure to establish an airway will doom any additional measures, however heroic, to defeat.

The airway may become obstructed at several anatomic sites (Fig. 1.1). Foreign bodies such as vomitus or dentures, edema due to anaphylaxis or burns, hematomas, mechanical disruption, and loss of tone of the supporting musculature following depression of the central nervous system all can occlude the passage. Obstruction of the nasopharynx in adults is not critical, but blockage at any point from the oropharynx to the tracheal carina is life-threatening. Patency of the oropharynx is a function of the muscular support of the mandible and of the floor of the mouth. In the obtunded patient, the tongue tends to collapse back and to rest against the posterior wall of the