

普通高等教育“十二五”规划教材
全国高等医药院校规划教材

英文版

ANAESTHESIOLOGY

麻醉学

留学生与双语教学用

主编 王国林 郭曲练

Chief Editor WANG Guolin GUO Qulian

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北 京

内 容 简 介

全书共分13章,涵盖了临床麻醉、重症及疼痛诊疗相关内容,包括术前评估、麻醉监测、气道管理、局麻药与区域阻滞、全身麻醉、酸碱平衡、呼吸衰竭、休克、心肺复苏、营养支持和疼痛诊疗等。可供医学留学生、七年制或八年制医学生、医学本科生英语或双语教学使用。

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Associate Editor 副主编

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General Foreword

总序言

随着中国政治、经济、文化的快速发展,中国软实力和国际影响力的不断提升,《留学中国计划》的逐步实施,越来越多的外国人认识到留学中国的未来价值,来华留学生规模不断扩大。2013 年有来自 200 个国家和地区的 346 499 名外国留学生在我国 746 所高等院校和科研机构学习或进修,我国已经成为亚洲最大的留学目的地国家。

近年,来华学习医学的留学生人数增长尤为迅猛,目前来华学习医学的留学生人数已位居来华留学生人数的首位,2013 年占比高达 21.76%,为 29 048 名。

为了维护我国高等教育的国际声誉,教育部高度重视来华医学留学生教育教学质量,不断加强对医学留学生教育教学的规范和管理,多种措施付诸实现。2007 年教育部即制定了《来华留学生医学本科教育(英语授课)质量控制标准暂行规定》,要求招生院校严格落实执行。2013 年 7 月,教育部国际合作与交流司下达了《关于对招收本科临床医学专业(英语授课)来华留学生的高等学校进行专项检查的通知》,委托中国高等教育学会外国留学生教育管理分会组成专家组对招生院校进行专项检查。2013 年 8 月,全国性的“来华留学生(医学)教学专业委员会”成立大会暨第一次学术研讨会在天津医科大学成功召开。2014 年上半年,教育部国际合作与交流司又组织专家组对部分医学院校实施了飞行检查。2014 年 6 月,“来华留学医学教育 2014 学术研讨会暨首届医学院校国际教育学院院长论坛”在安徽医科大学举办。

来华留学生的教学质量是来华留学教育事业可持续发展的核心保障,来华留学生教育的教材建设是保障和提升教学质量非常重要的手段。适合来华医学留学生使用的教材的需求越来越迫切,临床医学专业的教材长期匮乏和不足,教材编写、教材内容、教材形式、教材版权等都需要进行整合和改进完善。

在教育部国际合作与交流司的指导和高等教育学会外国留学生教育管理分会的支持下,众多医学院校的领导和专家经过多次讨论、磋商,决定成立“来华医学留学生教育教材建设专家指导委员会”,委托天津医科大学和清华大学出版社共同承担全国性临床医学专业英文版立体化教材编写和出版的具体组织工作。

天津医科大学有近 17 年的英语授课培养外国留学生的历史,在来华医学留学生教育的实践方面开始较早,是教育部指定的第一批计划招生全英文临床医学专业的 30 余所院校之一,也是教育部首批批准的“来华留学教育示范基地”,设有教育部来华留学英语教学师资培训中心(医学),至今已举办 6 期培训班,为全国 52 所医科院校培训英语授课教师 364 人,所编教材在全国 30 余所西医院校教学中被借鉴或使用,在全国医学高等院校来华留学生教育教学

领域里具有代表性和很大的影响力。

清华大学出版社在高等教育的综合出版领域里，排名我国第二位，是以出版全方位、多学科、立体化的高等教育教材为主的大社；上级主管单位为教育部，主办单位是清华大学，高质量、创新型、探究型的特色教材是其出版的重点任务，也是其肩负的社会职责所在，其所具有的强烈的社会责任感、主动性和积极性值得肯定。

据悉，该套教材近 50 种，主要供临床医学留学生、七年制或八年制医学生、医学本科生英语或双语教学使用。部分教材由我国长期从事医学留学生教育的教授、学者编写，其余大部分教材由清华大学出版社从多家国外出版社引进，改编出版，以适应我国临床医学专业留学生课堂教学和临床实习所需。

该套教材的陆续出版，是我国对高校来华留学生教育教材系列化、专门化的首次探索。希冀其会对全面提升来华医学留学生教育质量水平，对规范来华医学留学生教育的教材建设，甚至对其他学科的留学生教材建设，起到积极的示范效应和引领性作用。

这是一个良好的开端，希望该套教材在今后教学中经过不断探索、不断总结，得到修订，日臻完善。

中国高等教育学会外国留学生教育管理分会
副会长兼秘书长

2014 年 10 月

Preface

前 言

In recent years, anesthesiology as the grade-2 subject and grade-1 clinical department has been independently learned by many students including foreign students. Now, it is urgent that an English textbook of anesthesiology is needed for undergraduate program for international students. This textbook is written according to the depth of Chinese undergraduate textbook of anesthesiology and the requirement of textbook of 1- and 2-year international anesthesia residents, which is suitable for undergraduate program for international students.

This book covers the related contents of clinical anesthesia, intensive care and pain, which is divided into 13 chapters including preoperative assessment, anesthesia monitoring, airway management, local anesthetics and regional anesthesia, general anesthesia, acid-base balance, respiratory failure, shock, cardiopulmonary resuscitation, nutrition support, and diagnosis and treatment of pain, etc. This book is written by 15 anesthesia experts and scholars from teaching hospital of different areas in China, which is the final version after the first draft, twice cross review and finalization. This book highlights the combination of fundamental information, related progress and latest knowledge, which can help students to facilitate the understanding of discipline development.

We hope that every teacher can give advices in the process of using this book, which can make it republication more perfect.

Editors
Oct 30, 2014

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Chapter 1

one

Introduction

The term *anesthesia* was first used in the first century AD to describe the narcotic-like effects of the plant mandragora. The term subsequently was defined as “a defect of sensation” and “privation of the senses.” Oliver Wendell Holmes in 1846 was the first to propose the use of the term to denote the state that incorporates amnesia, analgesia, and narcosis to make painless surgery possible. Generally, *anesthesia* is characterized by sensory deprivation and reversible inhibition of the function of central and/or peripheral nervous system caused by drugs and techniques.

In the United States, use of the term *anesthesiology* to denote the practice or study of anesthesia was first proposed in the second decade of the twentieth century to emphasize the growing scientific basis of the specialty. Although anesthesia now rests on scientific foundations comparable to those of other specialties, the practice of anesthesia remains mostly a mixture of science and art. Moreover, the field of anesthesiology has been far beyond the scope of a word in the aspects of anesthesia (Table 1-1). The development of modern anesthesiology can be divided into three connected stages with different characteristics.

Table 1-1 Definition of the practice of anesthesiology within the practice of medicine

1. Assessment and preparation of patients for surgery and anesthesia.
2. Prevention, diagnosis, and treatment of pain during and following surgical, obstetric, therapeutic, and diagnostic procedures.
3. Acute care of patients during the perioperative period.
4. Diagnosis and treatment of critical illness.
5. Diagnosis and treatment of acute, chronic, and cancer-related pain.
6. Cardiac, pulmonary, and trauma resuscitation.
7. Evaluation of respiratory function and application of treatments in respiratory therapy.
8. Instruction, evaluation of the performance, and supervision of both medical and paramedical personnel involved in perioperative care.
9. Administration in health care facilities, organizations, and medical schools necessary to implement these responsibilities.
10. Conduct of clinical, translational, and basic science research.

Data from the American Board of Anesthesiology Booklet of Information, February 2012.

Anesthesia Since 1840s, the initial stage of the development of modern anesthesiology has been nearly 100 years. At this stage, the main task of anesthetic workers was to solve pain caused by the operation, focus on the development of narcotic drugs and methods of anesthesia,

innovation and clinical application. As many theoretic and clinical problems were solved in the development process, the theory of anesthesiology was accumulated and enriched. It also laid the foundation for the development of disciplines.

Clinical anesthesiology This is an essential stage that anesthesia was rapidly transformed into anesthesiology. Anesthesiology was endowed with distinctively clinical and theoretical characteristics: assessment and preparation of patients for surgery and anesthesia; implementation and management of anesthesia; anesthetic management for special patients; anesthetic management for critically ill patients; prevention and treatment of anesthetic accidents and complications. At this stage, anesthesiology not only trended to improve and perfect its features, but also played a significant role in promoting the development of surgery and became an important branch of surgery in clinical medicine.

Anesthesia and Critical Care Medicine Since the mid-twentieth century, anesthesiology has entered a rapid developing stage. Anesthesiology has absorbed relevant theory and technology from basic medicine, clinical medicine, biomedical engineering and several edge disciplines in the long term practice to generate and change its own theory and technical system, thus becoming an important and independent discipline in clinical medicine.

Recently, work domain of anesthesiology has been expanded from operation room to outpatient and ward. The scope of anesthesiology covers clinical anesthesiology, critical care medicine (CCM) and pain management. Emphases of clinical anesthesiology have been transferred to monitoring, maintaining and improving vital function in patients. Establishment and management of postanesthesia care unit (PACU) and intensive care unit (ICU) not only provided a strong guarantee for the safety of critically ill patients and patients undergoing major surgery, but also became a necessary symbol of hospital modernization. Pain management has expanded a novel way in which the theory and technology of anesthesiology were applied to patients with pain. Today anesthesiology has become a wide range of discipline that investigates clinical anesthesia, critical care medicine, resuscitation, and the mechanisms, diagnosis and treatment of pain. Furthermore, the ability to manage systems for the efficient operation of a medical center also makes the field of anesthesiology extremely rewarding. It has often been said that the hospital does well if the anesthesia department does well, and vice versa. The two are so interlinked that one cannot succeed without the support of the other. Anesthesiology has become one of the most rapid developing and dynamic disciplines.



1 History of anesthesiology

1.1 The development of ancient anesthesiology

In the Stone Age, humans began to use stone needle, spicules for analgesia and treatment. In China, a wide variety of drugs such as black henbane, marijuana, aconitum, monkshood, pepper were used for anesthetic and analgesic function in *shennong bencaojing*. In the han

dynasty, Hua Tuo performed laparotomy with the assistance of *mafeisan*.

Ancient Egyptians used the combination of opium poppy (containing morphine) and hyoscyamus (containing scopolamine), which is a similar combination (morphine and scopolamine) as nowadays preoperative medication. Regional anesthesia in ancient times were consisted of compression of nerve trunks (nerve ischemia) or the application of cold (cryoanalgesia). The American Indians may have practiced local anesthesia as their surgeons chewed coca leaves and applied them to operative wounds, particularly prior to trephining for headache.

1.2 The initiation and development of modern anesthesiology

1.2.1 Inhalational anesthesia

In 1540, Diethyl ether (known at the time as “sulfuric ether” because it was produced by a simple chemical reaction between ethyl alcohol and sulfuric acid) was originally prepared by Valerius Cordus. Ether was used for frivolous purposes (“ether frolics”), but not as an anesthetic agent in humans until 1842, when Crawford W. Long and William E. Clark independently used it on patients for surgery and dental extraction, respectively. However, they did not publicize their discovery. Four years later, in Boston, on October 16, 1846, William T.G. Morton conducted the first publicized demonstration of general anesthesia for surgical operation using ether, when was recorded as the beginning of modern anesthesiology. In 1847, chloroform was introduced into clinical practice by the Scot Sir James Simpson, who administered it to his patients to relieve the pain of labor. In 1844, Gardner Colton and Horace Wells were credited with having first used nitrous oxide as an anesthetic for dental extractions in humans.

After ether, chloroform, nitric oxide were brought into clinical, the development of inhalation anesthesia is relatively slow. Chloroform could cause arrhythmia, respiratory depression and liver toxicity, so it was abandoned. Even after the introduction of other inhalation anesthetics (ethyl chloride, ethylene, divinyl ether, cyclopropane, trichloroethylene, and uroxene), ether remained the standard inhalational anesthetic until the early 1960s. In 1920, Guedel published papers about ether. The same year, Magill introduced the application of endotracheal intubation in inhalation anesthesia to solve the management problems of respiratory tract. In 1927, Ralph Waters invented to use sodium lime to absorb carbon dioxide. In 1956, halothane is available, but the side effects of halothane include inhibition of respiratory cycle, liver poisoning and increased sensitivity of myocardium to the adrenaline after extensive use, which causes arrhythmia. In 1959, methoxyflurane was used, but its metabolites have renal toxicity. Enflurane, isoflurane and sevoflurane were available in 1972, 1981, 1990 respectively. The development of contemporary anesthesia can be embellished by introducing the improvement in anesthetic apparatus and monitoring systems toward greater safety or, on the pharmacologic side, the continued research for the basis of narcosis at the molecular level. In this connection, a useful clinical yardstick was the concept of minimum alveolar concentration (MAC), which correlates closely with lipid solubility of anesthetics. Also, measurements of MAC permitted comparison of studies on the physiologic effects of anesthetics in terms of their relative potencies. Parenthetically, there is the

seemingly heretical suggestion that nitrous oxide should once and for all be abandoned due to the ever-present liability of hypoxemia, its adverse effect on essential bone marrow metabolic enzymes, and its well-known nonpharmacologic properties in relation to air-containing body cavities.

1.2.2 Intravenous anesthesia

Intravenous anesthesia appeared after the injection syringe and syringe needle were manufactured. Since the second half of the nineteenth century, pioneers tried to perform intravenous anesthesia with chloral hydrate, chloroform, ethyl ether, morphine, scopolamine, and so on. Later barbiturates appeared, in 1934, Lundy and Waters used thiopental sodium to replace for the inhalation anesthesia induction with ether. Methohexital, another type of barbituric drugs, was available in clinical practice in 1957. Sodium thiopental is still one of the choices of intravenous anesthetics, and then benzodiazepines appeared, such as diazepam in 1959, lorazepam in 1971, midazolam in 1976 etc. Currently midazolam is widely used in pre-anesthesia medication, general anesthesia induction, sedation or part of compound anesthesia. Some other intravenous anesthetics, such as sodium hydroxybutyrate, ketamine, etomidate, and propofol, remain available depends on different levels of medical center. The clinical application of propofol is considered to be a great advancement of intravenous anesthesia, for its rapid onset, rapid emergency, short duration, good controllability and wide range of application, especially suitable for ambulatory surgery or some kinds operations.

Opioids Morphine, isolated from opium in 1805 by Sertürner, was also tried as an intravenous anesthetic. The high morbidity and mortality which was associated with high dose of opioids in early reports caused many anesthetists to avoid opioids and favor pure inhalational anesthesia. In 1969, Lowenstein rekindled performed "pure" opioid anesthesia by reintroducing the concept of large doses of opioids as complete anesthetics, which are rarely used now. Morphine was the first agent so employed, but fentanyl, sufentanil and alfentanil have been preferred by a large margin as sole agents. As several new opioid analgesics had minor effects on heart like volatile anesthetics, they have been widely used in clinical practice. Efficiency of sufentanil in anesthesia is strong; duration of alfentanil is short with a better controllability. Remifentanil, an opioid subjects to rapid degradation by nonspecific plasma and tissue esterases, permits profound levels of opioid analgesia without worries about prolonged postoperative ventilation, so it has been widely used in clinical settings.

Neuromuscular blocking agents The introduction of curare by Harold Griffith and Enid Johnson in 1942 was a milestone in anesthesia. Curare greatly facilitated tracheal intubation and muscle relaxation during surgery. For the first time, operations could be performed without relatively deep large doses of anesthetic to produce muscle relaxation. After that, the new muscle relaxants are developed. Succinylcholine, the only depolarizing muscle relaxant today, was synthesized by Bovet in 1949 and released in 1951; it has become a standard agent for facilitating tracheal intubation during rapid sequence induction. Until recently, succinylcholine remained unchallenged in its rapid onset of profound muscle relaxation, but its side effects (such as intraocular pressure and gastric internal pressure elevation, hyperkalemia, muscle pains, and