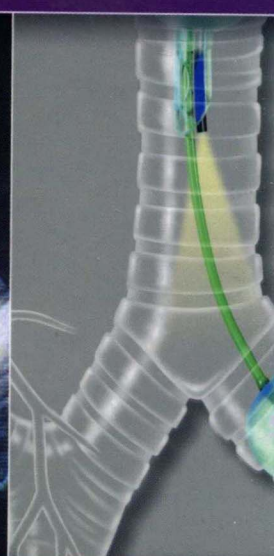
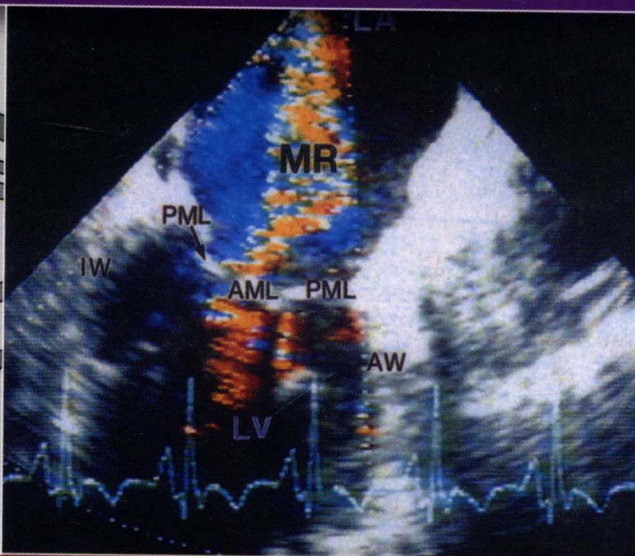
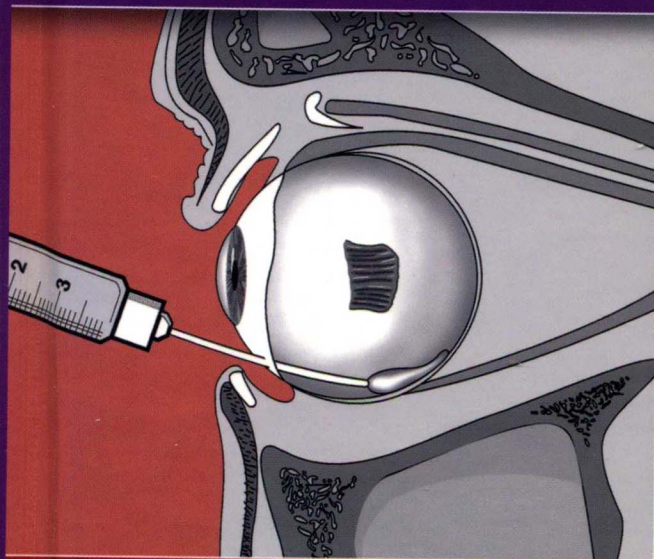
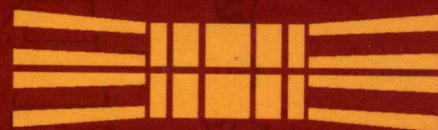


Clinical Anesthesia

Paul G. Barash • Bruce F. Cullen • Robert K. Stoelting



Fifth Edition



LIPPINCOTT WILLIAMS & WILKINS

CLINICAL ANESTHESIA

FIFTH EDITION

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Transformation in the delivery of patient care, combined with changes in education, is the new paradigm for anesthesiology in the 21st century. Minimizing costs while improving efficiency and enhancing patient safety are the goals of contemporary anesthesia practice. To ensure that practitioners have incorporated the most-up-to-date information in their practice, certifying and licensing authorities have mandated continual education and testing both at the trainee and at the practicing anesthesiologist level. These changes are coupled with the need for ongoing innovation as the anesthesiologist continues to be challenged to adapt clinical management to new surgical procedures and technologies. These developments are an extension of the observation we made in the first edition of *Clinical Anesthesia*: "The major achievements of modern surgery would not have taken place without the accompanying vision of the pioneers in anesthesiology."

Anesthesiology is recognized as the specialty that has done the most to ensure patient safety. Despite these advances, the specialty's own leadership, in addition to outside agencies, has mandated further improvement. No longer does the anesthesiologist have the luxury of admitting the patient to the hospital a day or more before the surgical procedure and of performing a leisurely workup and preoperative assessment. In the ambulatory surgery unit, for example, the patient may be available only minutes before the operation, and decisions must be made immediately as to adequacy of the preanesthetic evaluation and treatment plan. In the inpatient setting, care is perceived as being even more fragmented. For example, the health care professional performing the preoperative evaluation may not be the caregiver in the operating room. In the operating room, where costs can reach \$40 to \$50 per minute, "production pressure" has been noted to get "the case going." This occurs in a setting of diminished resources, equipment, drugs, and personnel, with the simultaneous requirement to improve patient safety in the OR. Thus, the anesthesiologist must have information immediately available for the appropriate integration of care in the preincision period. In fact, the American Board of Anesthesiology, in its *Booklet of Information*, emphasizes the importance of this facet of clinical management by stating, "The ability to independently acquire and process information in a timely manner is central to assure individual responsibility for all aspects of anesthesiology care."

Simultaneous with these clinical requirements are significant changes in the educational process for trainees and established practitioners. Responsibility and accountability for one's education have increased. Certifying boards use a framework, such as Maintenance of Certification in Anesthesiology (MOCA), to ensure that the practitioner is current in aspects of patient care. This concept is based on lifelong learning, assessment of professional standing, assessment of clinical practice performance, and a written examination testing cognitive expertise. These changes require a significant shift in the manner in which textbooks present knowledge. With the advent of electronic publishing, clinicians cannot rely solely on a single textbook to supply the "answers" to a clinical conundrum or a board recertification question. As a result, *Clinical Anesthesia* remains

faithful to its original goal: *To develop a textbook that supports efficient and rapid acquisition of knowledge.* However, to meet this objective, the editors have also developed a multifaceted, systematic approach to this target. *Clinical Anesthesia* serves as the foundation and reference source for the other educational tools in the Clinical Anesthesia series: *The Handbook of Clinical Anesthesia*, *Clinical Anesthesia for the PDA*, *Review of Clinical Anesthesia*, and *The Lippincott Interactive Anesthesia Library on CD-ROM (LIAL)*. Each of these provides a bridge to clinical care and education.

To recognize these requirements, in this the first edition of *Clinical Anesthesia* of the 21st century, we have totally redesigned the textbook, from its cover to chapter format and inclusion of new and relevant material. To enhance access to information, as well as align chapters with contemporary educational goals, each chapter starts with a detailed outline and Key Points. To meet the realities of the world we live in, we have added new chapters on disaster preparedness and weapons of mass destruction, genomics, obesity (bariatric surgery), and office-based anesthesia. We have encouraged contributors to develop clinically relevant themes and prioritize various clinical options considered by many the definitive strength of previous editions. In addition, each contributor emphasizes applicable areas of importance to patient safety. On occasion, redundancy between chapters may exist. We have made every effort to reduce repetition or even disagreement between chapters. Different approaches to a clinical problem also represent the realities of consultant-level anesthesia practice, however, so this diversity in approach remains in certain instances.

Finally, we wish to express our gratitude to the individual authors whose hard work, dedication, and timely submissions have expedited the production of the fifth edition. In addition, we acknowledge the contributions of colleagues and readers for their constructive comments. We also thank our secretaries, Gail Norup, Ruby Wilson and Deanna Walker, each of whom gave unselfishly of their time to facilitate the editorial process. We would also like to take this opportunity to recognize the continuing support of Lippincott Williams & Wilkins. It was more than 25 years ago that Lewis Reines, the former CEO of J.B. Lippincott, recognized the need for a major American anesthesiology textbook focused on education and clinical care. Throughout the intervening years, he has been a trusted colleague, an advisor, and, most importantly, a friend. In addition, we have been blessed with executive editors who have made singular contributions to the success of *Clinical Anesthesia*: Susan Gay, Mary Kay Smith, and Craig Percy. The enduring commitment to excellence in medical publishing continues from Lippincott Williams & Wilkins with Brian Brown, Senior Acquisitions Editor, and David Murphy, Production Manager, with the assistance of Grace Caputo, Project Director, Dovetail Content Solutions, and Chris Miller, Project Manager, TechBooks.

Paul G. Barash, MD
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SECTION I ■ INTRODUCTION TO ANESTHESIA PRACTICE

CHAPTER 1 ■ THE HISTORY OF ANESTHESIA

HUGH M. SMITH AND DOUGLAS R. BACON

ANESTHESIA BEFORE ETHER

PHYSICAL AND PSYCHOLOGICAL ANESTHESIA

EARLY ANALGESICS AND SOPORIFICS

INHALED ANESTHETICS

- Almost Discovery: Hickman, Clarke, Long, and Wells
- Public Demonstration of Ether Anesthesia
- Chloroform and Obstetrics

THE SECOND GENERATION OF INHALED ANESTHETICS

FLUORINATED ANESTHETICS

REGIONAL ANESTHESIA

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ANESTHESIA MACHINES AND MECHANICAL

VENTILATION

- Early Anesthesia Delivery Systems
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SAFETY STANDARDS

- Control of the Airway
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- Endobronchial Tubes—The Next Step
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PATIENT MONITORING

- Electrocardiography, Pulse Oximetry, and Capnography

INTRAVENOUS MEDICATIONS IN ANESTHESIA

INDUCTION AGENTS

- Opioids
- Antiemetics
- Muscle Relaxants

BLOOD, FLUIDS, AND HEMODYNAMIC CONTROL

ANESTHESIA ORGANIZATION AND EDUCATION

ORGANIZED ANESTHESIOLOGY

ANESTHESIA PRACTICE TODAY AND TOMORROW

KEY POINTS

- 1 Anesthesiology is a young specialty historically, especially when compared to surgery or internal medicine.
- 2 Discoveries in anesthesiology have taken decades to build upon the observations and experiments of many people, and in some instances we are still searching. For example, the ideal volatile anesthetic has yet to be discovered.
- 3 Regional anesthesia is the direct outgrowth of a chance observation by an intern who would go on to become a successful ophthalmologist.
- 4 Pain medicine began as an outgrowth of regional anesthesia.
- 5 Much of our current anesthesia equipment is the direct result of anesthesiologists being unhappy with and needing better tools to properly anesthetize patients.
- 6 Many safety standards have been established through the work of anesthesiologists who were frustrated by the status quo.
- 7 Organizations of anesthesia professionals have been critical in establishing high standards in education and proficiency, which in turn has defined the specialty.
- 8 Respiratory critical care medicine started as the need by anesthesiologists to use positive pressure ventilation to help polio victims.
- 9 Surgical anesthesia, and physician specialization in its administration, has allowed for increasingly complex operations to be performed on increasingly ill patients.

Surgery without adequate pain control may seem cruel to the modern reader, yet this was the common practice throughout most of history. While anesthesia is considered a relatively new field, surgery predates recorded human history. Human skull trephinations occurred as early as 10,000 BC, with archaeological evidence of post-procedure bone infection and healing, proving these primitive surgeries were performed on living humans. Juice from coca leaves may have been dribbled onto the scalp wound but the recipient of these procedures was almost certainly awake while a hole was bored into his or her skull with a sharp flake of volcanic glass. This was a unique situation in anesthesia; there are no other instances in which both the operator and his patient share the effects of the same drug.

In contemporary practice, we are prone to forget the realities of pre-anesthesia surgery. Fanny Burney, a well-known literary artist from the early nineteenth century, described a mastectomy she endured after receiving a “wine cordial” as her sole anesthetic. As seven male assistants held her down, the surgery commenced: “When the dreadful steel was plunged into the breast-cutting through veins-arteries-flesh-nerves-I needed no injunction not to restrain my cries. I began a scream that lasted unintermittently during the whole time of the incision—& I almost marvel that it rings not in my Ears still! So excruciating was the agony. Oh Heaven!—I then felt the knife racking against the breast bone-scraping it! This performed while I yet remained in utterly speechless torture.”¹ Burney’s description reminds us that it is difficult to overstate the impact of