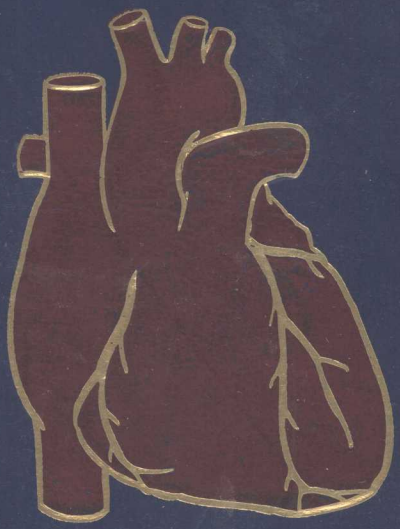
SECOND EDITION

MAYO CLINIC CARDIOLOGY REVIEW



EDITED BY
JOSEPH G. MURPHY, MD

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MAYO CLINIC CARDIOLOGY REVIEW

SECOND EDITION

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M.D., F.R.C.P.I., F.A.C.C., F.E.S.C.

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Dedication

This book is dedicated to my parents, my wife Marian, without whose support and encouragement this textbook would not have been possible, and my children Owen, Sinéad and Aidan, without whose help the book may have been completed somewhat sooner.

Foreword to the First Edition

I am delighted to have this opportunity to introduce the *Mayo Clinic Cardiology Review*. The tremendous amount of work and dedication required to accomplish this summary of the current state of the art reflects a long-standing tradition of the medical profession and one that Mayo has always taken seriously, namely, the sharing of knowledge and experience with others. The authors have concisely presented material that should not only be of value in preparing for the board examination but also serve as a source of reference for many who desire specific practical information in both the clinical realities of practice and the basic science that is fundamental to our current and future success in helping patients with cardiovascular diseases.

While the pressures in medicine mount with efforts to deal with the escalating cost of medical care, it is refreshing to review a text that remains focused on the individual patient. My personal bias is that this should continue to be the focus of our profession.

This year marks the 50th anniversary of cardiac catheterization at the Mayo Clinic. The advances in our knowledge and ability to help patients with cardiovascular disease have been astounding over the past 5 decades. The future promises to be equally exciting.

Robert L. Frye, M.D.
Chair, Department of Internal Medicine
Mayo Clinic and Mayo Foundation
Professor of Medicine
Mayo Medical School
Rochester, Minnesota

Foreword to the Second Edition

It is a pleasure to be asked to write this Foreword for the second edition of the *Mayo Clinic Cardiology Review*.

Fellows and clinicians in cardiology are faced with a rapidly expanding body of information and a shrinking amount of free time that can be devoted to reading and the acquisition of new knowledge. This book provides a contemporary and succinct distillation of the current status of clinical cardiovascular disease. In addition, it presents a wonderfully integrated clinical approach based on the extensive experience at Mayo Clinic.

The genesis of this book is the syllabus for the Mayo Cardiovascular Review Course. The book is written specifically for cardiology fellows, busy clinicians in cardiology or internal medicine practice, candidates for cardiology boards or recertification, and candidates for examination in general internal medicine both in North America and abroad. It is designed to be read in about 6 months, and the 1348 pages of text are accompanied by 111 pages of superb color photographs. The principles of cardiovascular disease and its treatment are comprehensively but precisely presented and are supplemented by more than 600 multiple-choice questions with explanatory answers, teaching points, and examination points.

The emphasis of this book is on the patient, and the objectives extend way beyond the passing of an examination. In this respect, appropriate emphasis on the cellular pathophysiologic basis of diseases is provided by chapters on essential molecular biology, cellular electrophysiology, atherosclerosis and endothelial function, lipid metabolism, and the coagulation system. Advances in basic science and the era of molecular cardiology have radically altered our basic concepts of physiology and pathophysiology, and it is incumbent on all of us, irrespective of the length of time we have been in practice, to renew our understanding of the basic concepts of cardiovascular disease. This book meets this objective admirably.

As we struggle with cost containment and other aspects of a changing health care environment, it is refreshing and stimulating to see how far cardiology has progressed during the past 30 years. We are now on the threshold of the scientific revolution as this century comes to an end and the Human Genome Project approaches completion. This book, which reflects the commitment and the contributions of Mayo Clinic to education, will continue to provide an insightful perspective of the constantly changing practice of cardiovascular diseases in the years to come.

Bernard J. Gersh, M.B., Ch.B., D. Phil.
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Preface

This textbook is designed to present the field of cardiology in a reader-friendly format in a reasonable length text that can be read in about 6 months. Many small cardiology textbooks are bare-bones compilations of facts that do not explain the fundamental concepts of cardiovascular disease, and many large cardiology textbooks are voluminous and describe cardiology in detail from basic cellular concepts to clinical practice. The *Mayo Clinic Cardiology Review* is designed to be a bridge between these approaches. We seek to present a solid framework of ideas with sufficient depth to make the matter interesting yet concise, aimed specifically toward busy fellows in training or practicing clinicians wanting to update their knowledge. Attractive color photographs have been added to supplement, but not replace, the basic text. Teaching points, clinical pearls, and multiple-choice questions have been added to make the textbook come alive and challenge the reader.

The concept for this textbook originated from the first syllabus for the Mayo Cardiovascular Review Course, a function the textbook continues to fulfill. The impetus to produce this textbook owes much to the encouragement of Rick A. Nishimura, M.D., the director of the Mayo Cardiovascular Review Course.

The second edition of the textbook has been expanded at the suggestion of cardiology fellows and now includes 14 new chapters on cardiac pharmacology and atlas chapters of electrophysiologic tracings, angiographic images, radiographs of congenital heart defects, and hemodynamic tracings.

The text is intended primarily for cardiology fellows studying for cardiology board certification and practicing cardiologists studying for board recertification. It will also be useful for physicians studying for memberships and fellowships of the Royal Colleges of Physicians, internists and general physicians with a special interest in cardiology, and coronary care and critical care nurses. The book follows the format of the 45 lectures for the Mayo Cardiovascular Review Course but has an additional 41 chapters. More than 600 new multiple-choice questions and explanatory answers have been added to the text.

I thank all my colleagues in the Division of Cardiovascular Diseases who have generously contributed to this work. I also thank William D. Edwards, M.D., and Robert Schwartz, M.D., for permission to use slides from the Mayo Clinic cardiology pathologic image database. LeAnn Stee and O. E. Millhouse, Ph.D., at Mayo Clinic, contributed enormously through their expert substantive editing. Ruth W. Weinberg at Lippincott Williams & Wilkins patiently guided this project through countless tribulations. I thank both the Mayo and the Lippincott Williams & Wilkins production teams: at Mayo—Roberta Schwartz (production editor), Sharon Wadleigh (editorial assistant), Jeffrey A. Satre (art director), and Barbara McLeod (Continuing Medical Education); at Lippincott Williams & Wilkins—Tim Reynolds (manufacturing manager), Dennis Teston (associate director of production), Robert Pancotti (production editor), Keith Donnellan (developmental editor), Melissa Fox (marketing manager), and Diana Andrews (creative director).

The editorial staff and I have made strenuous efforts to avoid any errors in this text, but as editor-in-chief I accept responsibility for any errors that may have eluded us. I would appreciate comments from our readers about how we might improve this textbook or, specifically, about any errors that you find. Our intentions are to update this textbook every 2 years and to produce multiple foreign versions, in addition to the current Spanish and Chinese versions of the first edition.

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Table of Contents

Chapter 1

The Cardiology Boards

Joseph G. Murphy, M.D.
Naeem Tahirkheli, M.D.

The function of the American Board of Internal Medicine (ABIM) is to enhance the quality of health care by maintaining standards for certifying internists and subspecialists.

The ABIM certification and recertification subspecialty examination in cardiovascular diseases is held annually in November.

Studying Cardiology

In the study of cardiology, it is important to fully understand normal cardiac physiology before learning the pathophysiology of cardiac diseases. Learning is greatly facilitated by incorporating new information into a preexisting framework of knowledge rather than memorizing the extraneous "facts of cardiology."

Several methods can make the study of cardiology more interactive and interesting and, in the end, more productive. A useful study method is to devise examination type multiple choice questions and then formulate in your mind the framework and logic behind the answer. This method will help to identify holes in your knowledge which can be filled in by consulting textbooks, journals, and colleagues. The advantage of this method is that you develop a "questioning attitude" that makes your reading of material an active, searching process rather than a passive, absorptive one.

Another useful study technique is to write all you know from memory about a specific topic in 30 minutes (time yourself). Although this is an old-fashioned way of learning, you will identify areas of ignorance and hone your powers of planning answers and organizing the material.

Another interactive way of learning is to select a question and to explain the answer to a friend, figuratively or literally. This will hone your skills at thinking through an answer in a logical way.

The Cardiology Boards

This examination consists of several hundred questions answered over a 2-day period. Topics covered on the examination are listed in Table 1. The examination is administered in several modules, with 60 questions per test book to be completed in 2 hours each. The examinations contain multiple-choice questions that test clinical judgment, decision making, and factual cardiovascular knowledge. In addition to multiple-choice questions, there are testing sessions in electrocardiographic (ECG) tracings and cardiac motion imaging studies (echocardiograms, ventriculograms, coronary arteriograms, and angiograms) presented in a still image print format. Each session is 2 hours.

Answers for all questions must be recorded on separate answer sheets. Credit is given only for answers recorded on the answer sheet within the time allowed for the examination session. After time has expired for a session, no extra time will be permitted for transferring answers to answer sheets.

Table 1.—Topics Tested on the Cardiology Board Examination*

Basic sciences
Anatomy
Pathology
Physiology
Pharmacology
Cardiac arrhythmias
Coronary artery disease
Primary myocardial disease and congestive heart failure
Pericardial disease
Valvular disease
Diseases of the aorta and peripheral vessels and lipid disorders
Hypertensive and pulmonary disease
Preventive and rehabilitative cardiology

*The examination includes questions on general internal medicine, critical care medicine, and cardiovascular surgery that pertain to the practice of cardiology.

To become certified in cardiovascular disease, a passing score must be achieved on two components: the ECG section and the multiple-choice questions and motion studies. Most questions are based on the presentation of clinical vignettes in outpatient, emergency room, and coronary care settings. The presentations are meant to simulate real-life situations and may be very detailed. A list of normal laboratory values is provided as needed. Refer to this list to interpret values given in an examination. These values could differ from those to which you are accustomed.

Also included on the examination are questions on basic cardiac and vascular physiology and pharmacology. These questions are usually directly applicable to clinical management of patients, such as the mode of action of antiarrhythmic agents, cholesterol metabolism, and vascular wall biology. Disease diagnosis, pathophysiology, and patient management—rather than isolated facts about cardiology—are stressed. The indications for and potential complications associated with cardiac procedures are emphasized rather than the technical aspects of the procedures.

The clinical applications of lessons learned from the major cardiology trials are important. Correct management of emergency situations is frequently tested and, in many cases, is considered a core competence.

In general, a moderately conservative approach to invasive investigations and treatments is appropriate. The guidelines of the American College of Cardiology/American Heart Association for specific cardiology investigations and treatments should be known in detail.

Candidates are expected to be able to interpret complex ECGs and pacemaker rhythm strips, hemodynamic recordings, coronary angiograms, ventriculograms, chest radiographs, and echocardiograms (including Doppler examinations). Basic electrophysiologic recordings, including His bundle electrograms, may be tested. Basic computed tomographic scans, positron emission tomographic scans, nuclear scans, and classic endomyocardial biopsy specimens may also be shown as part of the clinical vignette. Several weeks before the examination, candidates receive an information booklet that provides a detailed description of all question types and any new changes the Board has made in the examination format. It is extremely important to study the ECG answer sheet supplied with the booklet, because the ABIM may change the ECG answer codes in minor ways from year to year.

Example of a Board-Type Question

As mentioned above, the examination consists of only single-best-answer type questions, excluding K-type questions (e.g., A and C are correct or B and D are correct). Single-best-answer questions consist of a question stem (statement), which frequently is a patient case history that may incorporate laboratory data, diagnostic imaging, or pathologic slides, and a specific question and list of possible options. Each of the options is lettered (A, B, C, etc.). You are to choose the one best answer and blacken completely the appropriate lettered circle on the answer sheet, which is numbered to correspond to the items in the test book. Options other than the single best (correct) answer may be partially correct, but you must choose the one answer that is better than the others. An example follows:

A 75-year-old black man has a 6-month history of increasing dyspnea on effort. He denies orthopnea and paroxysmal nocturnal dyspnea. He had an episode of dizziness while lifting his 5-year-old grandchild at a family reunion last fall. He also has recently noted chest-tightness pain when he walks up a hill near his house. He does not report any palpitations. Several years ago his local physician noted a systolic murmur, but this was not investigated further at the time.

His medical history includes a shrapnel wound to his left leg in World War II, cholecystectomy 10 years ago for cholelithiasis complicated by postoperative septicemia, and recent cataract surgery on the left eye. He has had non-insulin-dependent diabetes mellitus for 5 years and