CARDIOPULMONARY PHARMACOLOGY

A HANDBOOK FOR CARDIOPULMONARY PRACTITIONERS AND OTHER ALLIED HEALTH PERSONNEL

SECOND EDITION

CYNTHIA L. HOWDER

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A Handbook for Cardiopulmonary Practitioners and Other Allied Health Personnel

CYNTHIA L. HOWDER, B.S.ED., R.R.T., C.P.F.T.

Respiratory Care Instructor
Vincennes University
Vincennes, Indiana

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Accurate indications, adverse reactions and dosage schedules for drugs are provided in this book, but it is possible that they may change. The reader is urged to review the package information data of the manufacturers of the medications mentioned.

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This book is affectionately dedicated to all my students,
past and present, who have taught me well.

PREFACE

An extremely large number of drugs are used in the practice of cardiopulmonary medicine. They cannot be administered intelligently or safely without a sound knowledge base and understanding of their mechanisms of action, physiologic effects, side effects, toxicity, and kinetics. The primary purpose of ***Cardiopulmonary Pharmacology*** is to lay the foundation from which the student and practitioner can then build a safe and effective practice of administering drugs.

In Section I, the first seven chapters introduce the learner to drug therapy: principles and administration, phases of pharmacologic action and effect, drug interactions and modifications, evaluation, dosages and calculations, and drug preparation. Chapter 2, *Divisions of and Actions within the Autonomic Nervous System,* has been extensively revised with many new illustrations and tables. A new chapter has been added to this section: *Special Aspects of Neonatal, Pediatric, and Geriatric Drug Therapy*. These special population groups present a unique challenge to the practitioner because of their comparative physiologic variances to the normal adult population for which drugs are prescribed.

In Section II, the major portion of this handbook, Chapters 8 through 19 present the individual pharmacologic agents with criteria for use, administration, mechanisms of action and physiologic effects, contraindications, and adverse effects. A brief preparatory review of basic physiology and anatomy is included in many chapters to help the learner fully understand how a particular drug or drug class affects the body. Some chapters have been rearranged for clarity and consistency. For example, all of the bronchodilators have been placed in one chapter instead of three. A new topic has been added in Section II, *The Therapeutic Gases* (Chapter 8). This chapter details those gases that are uniquely administered through inhalation for their beneficial therapeutic properties.

To enhance the learner's awareness, each chapter has a list of learning outcomes, emphasizing the primary points and goals of the chapter.

Accompanying this handbook is a computer-assisted instruction (CAI) diskette that contains a self-assessment quiz for each chapter. A final comprehensive examination is also included. This should help the learner not only in mastering the subject content but also in being able to do so at his/her own pace.

I believe that students, instructors, and practitioners will find that this handbook and the accompanying computer program are practical and useful and provide an up-to-date reference for accurate cardiopulmonary drug information.

Cynthia L. Howder, B.S.Ed., R.R.T., C.P.F.T.

CONTENTS

I INTRODUCTION TO DRUG THERAPY

Chapters 1 through 7 present the pharmacologic principles upon which the safe and effective administration of cardiopulmonary drugs is based. A thorough, solid understanding of these basic principles is necessary before preceding to Section II—The Individual Pharmacologic Agents.

1 General Principles of Pharmacology

Comprehending drugs and their actions and effects is the basis of pharmacology. All drugs alter or enhance the body's own natural system through biochemical and physiological effects. The dose of a drug and the selectivity of a drug's effect are of special importance and are major considerations in therapeutics. Pharmacology is unique not only because it plays a significant part in medicine but also because it deals substantially with the mechanisms of action of biologically active substances.

The role of the practitioner in drug therapy mandates a sound foundation in pathophysiology and pharmacology. The practitioner must fully recognize the principles governing how drugs act upon the body and the various factors that alter a drug's action and effect and the consequences of any alteration. In addition, the practitioner should understand the legal and ethical issues that impact drug therapy.

Learning Outcomes

Upon completion of this chapter, the learner will be able to:

1. Define the following terms: drug, pharmacology.
2. Specify the five types of drug sources and give an example of each.
3. List and define the various types of drug names.
4. Name the official publication for drug standards.
5. Identify the major sources of drug information.
6. Describe the various legislative acts that pertain to the sale and manufacture of drugs.
7. List and describe the four legal categories of drugs.
8. Identify the seven major components that should be included in a medication order.

9. Explain the major parts of the written prescription and define the following terms: superscription, inscription, subscription, and signature.
10. Associate a standard medical abbreviation used in drug orders with its meaning.
11. Discuss the process and procedures involved in the research and clinical testing of drugs.

KEY TERMS

(The following key terms are highlighted in **bold** when they first occur in the text of this chapter.)

Drug—A chemical substance that exerts a biological effect. A drug may modify one or more of the body's functions and is used to diagnose, treat, or prevent a disease. The terms *medication* and *pharmacologic agent* are synonyms for the term *drug*.

Pharmacology—The study of drugs. Comprehensively, pharmacology is the study of drugs and their:

- origin
- chemical and physical properties
- sites of action within the body and physiologic effects
- influence within the body (mechanism of action)
- absorption, distribution, metabolism, and excretion from the body
- safe and effective dosage regimens and routes of administration
- adverse reactions and toxic effects

DRUG SOURCES

Medicines have been known to man since the days of antiquity. Naturally derived sources of **drugs** used for medicinal purposes originated in the pre-Christian era, when remedies for common illnesses were treated with hot and cold applications, counterirritants, and medicinal herbs. The oldest known written record of drug mixtures dates from 2100 B.C. and is a legacy left by the ancient Sumerians. Significant discoveries were made by the ancient Egyptians, who used belladonna and narcotics such as mandrake and opium. Knowledge about these drugs was relatively limited and gained primarily from empirical observation. Over the centuries, the number of available drugs has increased tremendously and the knowledge of these drugs has become correspondingly more scientific. Currently, drugs originate from five major sources:

Animal sources—Examples include thyroxine (a purified compound obtained from the thyroid gland of an animal), used for the treatment of hypothyroidism, and insulin (an antidiabetic hormone), obtained from the pancreata of hogs, sheep, and cattle. Many vaccines also originate from animal sources.

Vegetable or plant sources—Examples include digitalis, which originates from the dried leaves of the purple foxglove plant, used in the treatment of congestive heart failure and cardiac arrhythmias. Another antiarrhythmic, quinidine sulfate, is the sulfate of an alkaloid obtained from cinchona bark. Atropine and scopolamine are obtained from the plant *Atropa belladonna*. Also, morphine sulfate, cocaine, nicotine, and caffeine all originate from parts of plants.

Mineral sources—These drugs are usually formed from acids, bases, and salts found in food. Calcium, potassium chloride, copper sulfate, and magnesium sulfate originate from mineral sources.

Synthetic sources—The most common sources of drugs today. This group is composed of compounds formed from the natural elements. Examples include meperidine (Demerol), an analgesic; diphenoxylate (Lomotil), an antidiarrheal medication; and the synthetic steroids and sulfonamides.

Genetic engineering—This relatively new and exciting source of drugs has opened a new concept to **pharmacology.** The most recent advances include the cloning and production of human insulin and tissue plasminogen activator (TPA). TPA is the newest thrombolytic agent used to treat myocardial infarction. Initially, TPA was isolated from blood and various tissues. However, the amounts that could be purified were not sufficient for any extensive use. TPA is now produced through genetically engineered cells in culture.

DRUG NOMENCLATURE

Individual drugs may have many names. The formal name given to a drug is its *chemical* name, which consists of the drug's structural formula. A *code* name is given to a drug by a manufacturer while it is still in the development or research phase. If the drug appears therapeutically useful and the manufacturer wishes to market the drug, a *United States Adopted Name* (USAN) is selected by the USAN Council. The name assigned to the drug by the USAN Council is the drug's *nonproprietary* name, which is often referred to as the generic name. If the drug becomes fully approved for use and is admitted to *The United States Pharmacopeia* (see below), the USAN becomes the *official* name. Often, the nonproprietary and official names of a drug are the same; however, older drugs may differ in these names. The manufacturer, or legal owner, will also issue a *trade name,* or *proprietary* name, to the drug. A drug may be marketed by more than one manufacturer; therefore, one drug may have several proprietary names.

The nonproprietary, or generic, name of the drug should be referred to whenever possible because it leads to less confusion when a drug has several proprietary names. For purposes of identification, the generic name will be used throughout this text; if the proprietary name is mentioned, it will be in parentheses following the generic name.

Example: albuterol, salbutamol in Europe (Ventolin, Proventil, Respolin)