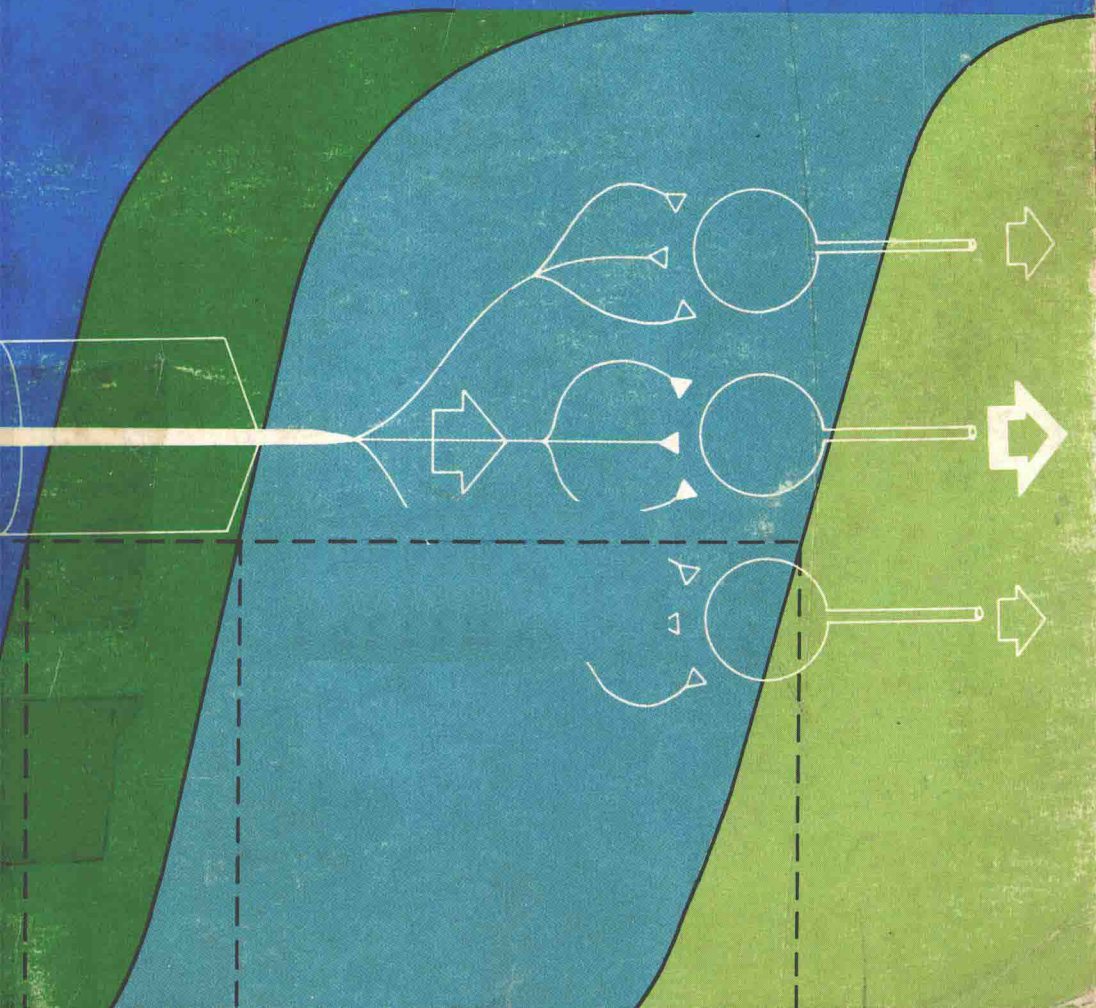
Pharmacology

for the

Dental Hygienist

For students and practitioners

FRED F. COWAN



Pharmacology *for the* Dental Hygienist

For Students and Practitioners

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O love that wilt not let me go, I rest my weary soul in thee;
I give thee back the life I owe, that in thine ocean depths its flow may richer, fuller be.

GEORGE MATHESON, 1842-1906

To the glory of God
and to my loving family,
Phyllis, Caroline, and Kirk

PREFACE

My primary reason for writing this text is to provide students and practitioners of dental hygiene with their own accurate, up-to-date, unembellished study guide to information regarding the drugs of specific interest and concern to them. Secondly, I want to establish a higher level of understanding between the dental hygiene profession and pharmacology by demonstrating the specific relationships between our two disciplines. Thirdly, I believe that there is a current need for such a text. This is not to say that the *Pharmacology for the Dental Hygienist* by Kutscher and his associates, published in 1967, is completely out-of-date. There will always be a need for the enormous amount of such clinical detail regarding drug use in dentistry.

The present textbook is more oriented toward the basic science aspects of pharmacology with just the appropriate amount of clinical dental hygiene application to keep the student making necessary correlations. It is hoped that the text supports the principles and the specifics of the American Dental Hygiene Association's curriculum essentials as they have been modified over recent years.

It is, of course, difficult to know where to begin in acknowledging individuals for assistance in the preparation of this book. Before I do so I must explain that, in reality, I look upon myself as an arranger of pharmacological information; I did not compose the original music nor write the original lyrics; what I have done is pick and choose from a large, ever-growing body of knowledge that I thought most appropriate at the time. I know there are areas of pharmacology that should be included in future editions, and I am expecting every reader to offer suggestions for what should be added and what should be deleted. As an arranger, then, each

thought found herein probably can be accredited to someone else, for my own present understanding of pharmacology is the summation of what all my teachers, colleagues, and students have taught me.

I am specifically grateful to my colleague and fellow arranger, Samuel E. Taylor, Ph.D., who has contributed the material on the adrenergic stimulants and blocking agents, as well as the following complete chapters: Characteristics of Drug Action, Vitamins, Drugs in the Treatment of Cardiovascular Disorders, and Drugs in the Treatment of Endocrinological Disorders. In addition, he has given continuous encouragement and valuable advice on many other sections. Surely, he is my friend.

Writing words on paper is only a small part of the preparation of a textbook, even one as narrow in scope as this; however, having the manuscript typed in a presentable, accurate form takes manipulative skills as well as dedication to the smallest detail. I am grateful to Colleen M. Gooding who has typed this textbook not just once but countless times. Surely, she is an artist.

Lastly, I can state honestly that I am even grateful to Martin C. Dallago, my editor at Lea & Febiger, who originally convinced me to undertake this task and who has since waited so patiently for so long. Surely, he is a saint.

Portland, Oregon — Fred F. Cowan

CONTENTS

PART I

ORIENTATION AND GENERAL PRINCIPLES

1

THE ROLE OF PHARMACOLOGY IN DENTAL HYGIENE

Pharmacology is the science that deals with all facets of drugs, especially the action of drugs on living tissue. Since a drug is usually defined as any chemical substance that affects living tissue, pharmacology is a broad discipline. More commonly a drug is considered as any chemical substance, with the exception of food, that is used as an aid in the diagnosis, treatment, or prevention of disease or to control or improve any physiological or pathological condition.

Although a course in pharmacology is included in most dental hygiene educational programs, it has been difficult to find what the role of pharmacology is or should be in dental hygiene. In many instances the pharmacology courses in dental hygiene education appear to be general, selected surveys of a variety of drug groups with or without special emphasis on the drugs particularly used in dentistry. It would seem if pharmacology is important enough to include in the dental hygiene curriculum there should be some attempt to agree upon what it is doing there and to orient it strongly toward that pharmacology necessary for the competent practice of dental hygiene.

It will no doubt come as a surprise to many pharmacologists, but today's dental hygienists do utilize a small number of drugs as adjuncts to the procedures they perform. These selected agents are administered under the supervision of a dentist, and the kinds of drugs that the dental hygienist may give to the patient are spelled out in the practice acts of each state. Even at this time, because of the rapid evolution of the dental hygiene profession, there is wide variation from state to state regarding what drugs, if any, may be used by the dental hygienist. Changes will continue to come in

terms of what drugs may be used, how the drugs may be administered, and the degree of actual supervision required by the dentist. Based upon this background several roles of pharmacology in dental hygiene are offered for discussion.

It could be argued quite validly that the dental hygienist must know the pertinent pharmacology of at least those drugs that are utilized as adjuncts to the dental hygiene procedures and are administered by the dental hygienist. On the other hand, what pharmacology would be considered essential if the dental hygienist does not make the final decision whether a particular drug should be used in a particular patient, or even what dose should be administered? In most instances the supervising dentist must make the final decision concerning a drug's use, how much to give, and how it must be taken.

This pharmacologist does not accept the dental hygiene profession as an overeducated group of "go-fors." To be realistic the dental hygienist may most likely be the dental health team member who first recognizes the dental patient's need for a particular drug. The dental hygienist would then verify this need with the dentist who, with the dental hygienist, would make the final decision as to which drug, the dose, and route of administration. In other words, the dental hygienist must be aware of the specific indications for which these drugs are used. Furthermore, the dental hygienist must know what effects the drug may be expected to produce as well as any precautions to be observed in the drug's use.

If this general philosophy is acceptable, then the specific pharmacological information for dental hygienists to learn and know regarding those drugs they will be using as adjuncts to their procedures may be outlined. This approach has the added advantage of allowing to be identified all that other pharmacology dental hygienists should not be required to learn. Therefore, one of pharmacology's roles in dental hygiene is to supply the appropriate and selective information about the specific drugs the dental hygienist will be using as adjuncts to their procedures.

Pharmacology has another role to play in the life of a competent dental hygienist. Even if the dental hygienist finds no need to administer or to recommend any drug to a particular patient, the hygienist would still need an adequate background in pharmacology to handle properly the drug information regarding each dental patient. An important part of patient pretreatment evaluation is the accurate recording of the patient's personal, medical, and dental history which includes a number of inquiries about drugs. Some of these questions would include, but not be limited to the following: Is the patient taking any drugs (both prescription drugs and

over-the-counter drugs) currently or within the past month? If so, what are the names of the drugs? Has the patient experienced allergic or any unusual effects to any drug, in particular any of the drugs the patient may be required to encounter during dental hygiene or dental treatment? Does the patient now have, or has the patient ever had, any one of a number of disorders or diseases which require special drug administration (e.g., chemoprophylaxis) before dental hygiene or dental procedures can be carried out?

Once the dental hygienist has obtained this critical drug information from each patient, then it must be evaluated and translated into how it may or may not alter the planned course of dental or dental hygiene treatment for the patient. It is this translation process that requires a definite understanding of pharmacology.

Another role of pharmacology in dental hygiene is to guide the dental hygienist toward the most reliable sources of drug information. The dental hygienist is a busy professional involved in a special aspect of public health. Like colleagues in medicine, dentistry, and nursing, the dental hygienist will need to know how and where to find accurate, up-to-date information regarding drugs used in dental hygiene, drugs used in dentistry, and drugs dental patients are taking when they seek your services.

As an important and active member of the health team in the dental office, it is only natural, desirable, and to be expected that the dental hygienist have some degree of general understanding of all aspects of the care of dental patients. The dentist uses drugs in the treatment of oral diseases and as adjuncts to the dental procedures performed. Although the dental hygienist will not be administering many of these drugs, it is necessary that the dental hygienist have a general understanding regarding at least the types of situations for which the drugs are indicated in dentistry, what effects they will produce in the patient that will indicate the drug is giving the desired response, as well as what precautions should be observed in employing any drug used in the dental office. By being the second person in the office who knows this information, the dental hygienist can aid immeasurably in the general safety of the patient. Unusual drug-induced effects can be noted and immediately conveyed to the dentist. Moreover, an active and effective role in the handling of the dental office emergencies can be assumed by the dental hygienist.

As the dental hygiene profession continues to grow and take on new and broader responsibilities, it seems only inevitable that the future will require the dental hygienist to possess a deeper understanding of pharmacology.

2

CHARACTERISTICS OF DRUG ACTION

Pharmacology is a truly integrative science, borrowing heavily from such disciplines as physiology, biochemistry, and other biological sciences, and as such has become one of the most complex and all-encompassing of the basic medical or dental sciences. Some of the specialties of pharmacology are defined in Table 2.1

Although pharmacology may be said to have had its beginnings with early man's observations of the effects of herbs and plant extracts on himself and other animals, pharmacology as a science could not begin until hundreds of years later when chemists began to improve their techniques for the extraction and purification of active principles from plants. This was a necessary precursor to the advancement of pharmacology, since any conclusions about how drugs work must be based on knowledge of exactly what substance and how much of this substance is being administered. Only then can hypotheses be developed that may be tested by reproducible experimentation.

Historically, physiology has contributed the most to the science of pharmacology, and most of the early pharmacologists were originally trained in physiology. Of these men, Rudolf Buchheim is usually credited with establishing the first "modern" laboratory of pharmacology.[1] As modern technology advances, allowing scientists to study the action of drugs at the cellular and molecular levels, biochemical and molecular pharmacology are areas of increasing research interests. Much as been learned in the past decade or so about the biochemical fate of many drugs within the body. However, many intriguing questions remain to be answered: How is the drug's initial contact with a particular cell translated into changes within the intracellular physicochemical

Table 2.1. Specialties of Pharmacology

	Definitions
Biochemical pharmacology	the metabolism and other biochemical aspects of drugs
Clinical pharmacology	the study of the effects of drugs in man
Descriptive pharmacology	the consideration of the qualitative effects of drugs
Molecular pharmacology	a study of drug effects at the molecular level
Pharmacodynamics	the study of the biochemical and physiological effects of drugs and their mechanisms of action
Pharmacogenetics	the interrelationships between drug effects and the genetic makeup of the responding individual
Pharmacognosy	the study of the botanical sources and properties of naturally occurring drugs
Pharmacokinetics	the absorption, distribution, biotransformation, and excretion of drugs
Pharmacotherapeutics	the art and science of using drugs in the prevention, diagnosis, and treatment of disease
Pharmacy	the art and science of preparing and dispensing of drugs as medicines
Posology	the study of the general subject of dosage
Toxicology	the study of the adverse effects of drugs; the science of poisons

environment which eventually lead to the characteristic drug effect? How do variations in an individual's genetic composition affect his response to a given drug? Can more specific drugs be developed for the treatment of cancer and for suppression of the immune and inflammatory responses?

Of more immediate concern to the dentist and the dental hygienist is the application of present and future pharmacological knowledge to the safer and more effective use of drugs in their patients. A thorough understanding of the general principles of drug action to be discussed in this chapter is the foundation upon which this goal may be accomplished. Such an understanding not only is important for the proper administration and monitoring of drugs by the practitioner, but also is imperative for any mature understanding of the possible interactions between drugs administered by the practitioner and other drugs the patient may be taking, either self-administered or under medical supervision.

The first medical uses of drugs by man were based strictly on empiricism, that is, the use of a drug in particular situation based

only upon the dictates of past experience without any sound knowledge of what the drug was doing. Some drugs are still used empirically in both medicine and dentistry because they "work"; they alleviate illness, or at least its manifestations, but what the drug is actually doing to cause these improvements (its mechanism of action) is not known. However, with our present understanding of pharmacology, as meager as it may be, the use of drugs should be based on a rational approach whenever possible. The rational use of drugs includes an understanding of how the drug acts, what effects it has on normal physiological and biochemical processes of the body (both desirable and undesirable), and then using this knowledge to produce safely the desired effect. Paramount to rational therapeutics is the concept of the therapeutic end point. A drug should never be administered to a patient unless the practitioner has a clear understanding of the appropriate type and intensity of therapeutic effect the drug is to produce, as well as how to determine when this point has been reached.

DRUG RECEPTORS

Probably everyone has at one time or another taken an aspirin to relieve the pain of mild headache. Within a brief time after taking the aspirin, the headache pain usually disappears. Few people, however, stop to wonder how the aspirin brings this about. Similarly, most people have comfortably undergone potentially painful dental treatment while under local anesthesia. By injecting a solution containing a local anesthetic into the patient's oral tissues the dentist can perform traumatic procedures with the patient feeling little, if any, pain. How does the local anesthetic produce this effect? If one drank the local anesthetic solution, it would not relieve headache pain; nor would injection of an aspirin solution into the oral tissues produce local anesthesia. What is it then that makes aspirin, with its characteristic headache-relieving properties, an analgesic, and the local anesthetic, with its characteristic ability to produce profound absence of local pain, a local anesthetic?

The answer to this question lies in the chemical sturcture of the drug itself, as well as in the physicochemical composition of the body's biological systems. All drugs have their own individualized chemical structures, just as each person has his own unique set of fingerprints. Knowledge of the drug's chemical structure alone, however, is not enough to predict the type of characteristic pharmacological response a drug will produce. Only when aspirin and a local anesthetic are introduced into a patient under the proper conditions does a difference become apparent. These two drugs