

# PHARMACOLOGY FOR THE ELDERLY

The Nurse's Guide to Quality Care



Marjorie R. Crow

# PHARMACOLOGY FOR THE ELDERLY

The Nurse's Guide to Quality Care

Marjorie R. Crow, RN, MSN

*Instructor, Des Moines Area Community College  
Manager, Nursing and Educational Services for Today,  
Provider #159, Iowa Board of Nursing*

Foreword by Katy McNally, RN  
*Des Moines Area Community College*



TEACHERS  
COLLEGE  
PRESS



Y078055

Teachers College, Columbia University  
New York and London 1984

This book is lovingly dedicated to  
my husband, Ronald,  
who has always promoted my personal growth  
and supported my ideals.

Published by Teachers College Press, 1234 Amsterdam Avenue, New York, N.Y. 10027

Copyright © 1984 by Teachers College, Columbia University

All rights reserved. Except where indicated in the text, no part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopy, or any information storage and retrieval system, without permission from the publisher.

Library of Congress Cataloging in Publication Data

Crow, Marjorie R. Edwards.

Pharmacology for the elderly.

Includes bibliographical references and index.

1. Geriatric pharmacology. 2. Geriatric nursing.

I. Title. [DNLM: 1. Aging—Drug effects—Nursing texts.

2. Drug therapy—In old age—Nursing texts. 3. Pharmacology, Clinical—In old age—Nursing texts. WT 100

C953p]

RC953.7.C76 1984

615.1'0880565

83-18183

ISBN 0-8077-2752-0

Manufactured in the United States of America

89 88 87 86 85 84 1 2 3 4 5 6

¥72.38元

# Foreword

Our reliance on drug therapy in managing a variety of illnesses associated with aging, along with the increase in the elderly population, has greatly affected the role of the nurse as a patient advocate and patient educator.

It is necessary for nurses to update their knowledge of drug therapy if they are to appropriately fulfill these two roles. To meet this need, we undertook extensive research to find appropriate information and a concise format for presenting it. From these materials we developed a course, entitled "Drugs and the Elderly," which has provided classes for many nurses participating in health continuing education at the Des Moines Area Community College, Ankeny, Iowa. This course is one in a series of courses leading to a "Gerontological Nursing Specialist Certificate." We now present the materials developed for our course in the form of this textbook. Marjorie and I hope that this book will be a valuable resource for instructors, students, graduate nurses, and all who are involved in health maintenance and nursing care for the elderly.

The ever-changing and expanding knowledge base is simplified by the use of graphs, charts, tables, and examples. Their use provides opportunity for insight and understanding into the effects of drug therapy in relation to the aging process.

In my role as a health occupations programmer and coordinator, it is particularly satisfying to identify the needs of nurses and to aid in the design of continuing education programs to meet those needs.

I know the nurses of central Iowa have appreciated Marjorie's help. I like that! I know that Des Moines Area Community College has played an important part in enhancing the quality of care for elderly patients and clients, and I like that!

It is our hope that this book will prove valuable to each of you in planning and implementing patient care that will improve the quality of life for the elderly in your area.

Katy McNally, RN  
Health Program Coordinator  
Des Moines Area Community College  
Ankeny, Iowa

# Preface

The relationship between the aging process and drug therapy for the elderly patient is an area of nursing that needs more attention. In the March/April 1983 issue of *Nursing Life* magazine, Joseph L. Fink reports the results of a 1979 hospital-based study on drug administration errors. The study identified 7 types of errors and reported that 1 of every 6 medications administered to a hospitalized patient is administered in error (p. 28). A study by Petersen, Whittington, and Payne (1979, p. 127) suggests that those who administer drugs to the elderly residing in long-term care facilities do so in error on an average of 30 percent of the time. In addition, semi-dependent and independent elderly people who administer their own medications often make errors because of lack of knowledge.

It is important, then, for all nurses—the student nurse, graduate nurse, staff nurse, nurse specialist, director of nursing, and nurse educator—to become more knowledgeable about drugs and more conscientious about their administration to elderly patients. We need to improve the accuracy of our administration of drugs to older patients, and we must also make teaching a primary goal, protecting our patients by helping them to understand how to take their medication properly and how the drugs they are taking may affect them.

Aside from the much greater likelihood of error in drug administration for elderly patients, these patients present a variety of health problems. Some of these problems are a result of normal aging; others are due to disease processes. Even when drugs are properly administered, problems arise due to adverse drug reactions or drug interactions, or to a combination of any of these factors. Assessments must be made and care planned so as to meet each individual patient's special needs.

Besides exploring the basic principles of aging, this text provides opportunity for practical experience in such areas as using case studies, completing patient evaluation exercises, learning the toxic blood levels for selected drugs, and exploring drug utilization and how it is modified in the elderly patient. A table of drug interactions is presented, along with other information that is specific to the elderly patient and his or her drug therapy. The appendices contain lists of state coordinators for poison control and state units on aging, along with the opportunity to learn basic nursing phrases in other languages (French and Spanish) as they relate to drug administration. A glossary and an index are provided for your reference.

Every attempt is made in this book to present up-to-date information in a manner that will meet the needs of today's nurse and his or her elderly patient. However, due to rapidly changing technology, all nurses involved in drug administra-



tion to the elderly must constantly update their knowledge by reading the results of the latest research in the field.

Good luck in your personal growth and experiences as you now focus your attention upon the elderly patient and his or her drug therapy.

## Acknowledgments

The author wishes especially to acknowledge the help of those listed below, whose support and assistance has made this book possible.

Family, friends, reviewers, students, and librarians for suggestions, assistance, and encouragement.

Mark I. Fow, Ph.D., U.S. Department of Health, Education, and Welfare, for providing the information in the list of state coordinators for poison control (appendix 3).

Apothecary Products, Inc., for providing the Medi-Set picture and permitting its use.

Mary (Buswell) Mallison, editor of the *American Journal of Nursing*, for providing research materials and encouragement.

Michelle S. Holtman, language instructor, Nevada Community Schools, Nevada, Iowa, for Spanish translations and proofreading.

Linda Jean Crow and Robert E. Crow for French translations.

Michael J. Rhodes, R.Ph., for editing for accuracy the table on drug interactions (table 4.1).

Paul Aardsma, Iowa Commission on Aging, for providing information on the location of state units on aging given in appendix 4.

Katy McNally, Health Program Coordinator, Des Moines Area Community College, Ankeny, Iowa, for writing the foreword.

Christie Lerch, copy editor, for assisting with revision and organization of this book.

Becky Heintz, graphic design student, Iowa State University, for illustrating the poem "A Search in the Park," written by the author. She made the painting during her senior year in high school.

# **PHARMACOLOGY FOR THE ELDERLY**

**The Nurse's Guide to Quality Care**

Aging is a natural phenomenon, that no one will deny. Let us, as health professionals, not be like the politicians in Will Campbell's "Unnamed Poem" in his novel *Glad River* (chap. 20). According to Campbell, the young politicians planned in seclusion for the old men, who hoped their planning was fair. The young politicians wanted a "whittlin' room" for the old men, who only wanted to sit and whittle in the town square.

As we approach the problems of aging, let us involve our patients in planning for and implementing their own health care. Otherwise our efforts may produce no effect, like those of the young politicians who found themselves with a big, empty room filled with brand-new spittoons and ignored benches, a room that became a tourist attraction, since, denied their only wish, "the old men don't whittle no more." Let us begin now by looking at "The Aging Process."



# Contents

Foreword	vii
Preface	ix
Acknowledgments	x
1. The Aging Process	1
2. Level of Functioning and Drug Administration	13
3. Techniques of Drug Administration	23
4. Drug Utilization and Interactions	27
5. Commonly Used Classes of Drugs	39
6. Adverse Reactions and Body Responses	47
7. Nursing Assessment and Intervention	58
8. Resources for the Independent Patient	77
9. Vitamins, Minerals, and Other Nutrients	83
Post-Test	95
Appendices	95
1. Worksheets	99
Age Review Graph	99
Patient Teaching Guide	100
Recording Worksheet	102
Plan of Care	103
2. Adverse Reactions	104
3. State Coordinators for Poison Control	111
4. State Units on Aging	116
5. Using Foreign Languages in Patient Teaching and Drug Administration	121
Case Studies: Teaching the Non-English-speaking Patient	121
English-to-Spanish Translations	123
English-to-French Translations	128
Glossary	135
References	141
Index	145

# 1

## The Aging Process

*Purpose of chapter:* To help you to understand the physiological changes that occur as a result of normal aging, and to enable you to distinguish between these changes and those that occur as a result of drug usage.

Upon completing this chapter, you should be able to

- Realize that any of the symptoms associated with normal aging could also be a result of an adverse reaction to a prescribed medication.
- Understand the need for a normal, or “baseline” assessment of your patient’s physical and mental health.
- Recall the percentage of decrease in cardiac output per year that occurs normally with aging.
- Explain why administration of *digoxin* poses a special risk of toxicity.
- Realize why bringing about a *sudden* reduction in blood pressure through the use of antihypertensive drugs is not desirable.
- Name some ways to check for sensory nerve involvement due to adverse drug reactions.
- Explain how hypoxia may increase because of aging.
- List physiological and other reasons for increased malnutrition with aging.
- Understand how decreased drug elimination may occur due to aging.
- List some causes for mental and emotional changes in the elderly patient.

It has been estimated that by the year 2000, one-half of those who are over 65 years of age will be at least age 75 or older. It is further predicted that of those who are in the over-75 age group, nearly one-half (42 percent) will experience substantial physical or mental limitations (Lesnoff-Caravaglia, 1980, p. 92). With that in mind, let us take a closer look at some of the specific changes that occur with aging. Understanding the changes that may occur and how they, in turn, may affect drug reactions and interactions will allow for more effective patient care through assessment, planning, intervention, evaluation, teaching, and patient involvement.

### MENTAL CHANGES

The aging brain starts to lose neurons at about 25 or 30 years of age, and by age 60 or 70 nearly 30 to 40 percent of the original number may be lost. This decrease in the total number of functional neurons plays a role in decreased oxygen consump-

tion by the aging brain (Lesnoff-Caravaglia, p. 49; Petersen, Whittington, and Payne, 1979, p. 54).

This decrease in oxygenation, together with the decrease in the total number of functional neurons, plays an important role in the degree of orientation or confusion experienced by an elderly patient. Confusion may be noticeable when new tasks or information are presented, yet the patient may remain well oriented in familiar situations and settings, since "crystallized" intelligence (mathematical ability, vocabulary, mechanical ability, etc.) remains at a high level and may grow all throughout one's life span (Watson, 1982, p. 24).

Administration of drugs that adversely affect the central nervous system makes it more difficult to assess a patient's normal level of mental functioning. Greater assessment problems will occur if the patient is also undergoing abnormal aging due to genetic disorders, disease processes, or trauma.

## PHYSICAL CHANGES

Like the mental changes, the physical changes that occur with aging do not occur at a uniform rate in the various organs and systems. Nor do they occur at the same rate for every individual; therefore, it is imperative to establish a *normal baseline*, or estimate of physical health, through nursing assessment for each individual patient. This will help the nurse to determine which physical problems are the result of aging in this particular patient and which might possibly be the result of drug administration.

### Skeletal Changes

#### OSTEOPOROSIS

Bones become more brittle and break more easily due to osteoporosis, the metabolic bone disorder that occurs to some degree in aging. This condition can also occur, however, as a result of treatment with certain medications (hypocholesterolemic/antilipemic agents, vitamin D, anticoagulants, and adrenocorticosteroids) and also because of dietary deficiencies, inactivity, or disease processes. It is very important, then, to consider your patient's medications in making your overall assessment of a patient with osteoporosis.

#### JOINT DISORDERS

With normal aging, joints may become stiff and painful. Joint as well as muscle disorders occur as side effects of many medications (antilipemics, antineoplastics, barbiturates, and others) and also as a result of inadequate tissue perfusion. In certain situations involving inactivity, contractures can develop in a matter of two to three days (Rossman, 1971, p. 462). Keep in mind that the patient who is experiencing muscle and joint stiffness or pain will be more resistant to movement or physical activity.

## Circulatory Changes

As the body ages, starting at approximately age 20 or 30 cardiac output decreases at an average rate of 1 percent a year, while peripheral vascular resistance increases at approximately the same rate (Tichy and Chong, 1981, p. 60; Petersen, Whittington, and Payne, 1979, pp. 53-54; Rossman, 1971, p. 20; Kanungo, 1980, p. 4). The possibility of dysfunction of the valves of the heart increases with age, and any existing prolapse or stenosis may worsen, resulting in inadequate emptying of the heart chambers. When this happens, thrombi may form. If an accompanying disorder such as an arrhythmia is corrected by medication, increasing the cardiac output, the thrombi may be ejected into the circulation, causing multiple infarctions; the result may be cerebral ischemia or strokes. Especially in cardiac conditions that are long-standing, such as in the patient with atrial fibrillation, a drug such as *quinidine*, which would effectively correct the arrhythmia, may be contraindicated, since thrombi that have accumulated in the myocardium may be forced into the circulation through the more effective cardiac output (Folkow and Neil, 1971, pp. 234-35; Govoni and Hayes, 1978, p. 639).

Certain heart medications, especially *digoxin*, put the elderly patient at increased risk of drug toxicity. As the normal heart ages, the number of myocardial drug binding sites decreases, permitting an increase of the drug level in the circulation (Tichy and Chong, 1981, p. 60). Elderly patients who are receiving heart medications may be in danger of experiencing drug toxicity unless their dosage is decreased. Rossman (1971) recommends that the elderly patient receive the pediatric dosage (0.0625 mg) of digoxin, which is available in both tablet and elixir form (p. 376). Since this practice is not yet common, it is little wonder that in a study reported by Petersen et al. of drug-induced illnesses in the elderly that were severe enough to require hospitalization, digoxin was found to be the second leading offender (1979, p. 67).

Since only a small percentage of the total elderly population receive digoxin, these results may seem surprising. However, the range between the therapeutic and the toxic blood level for this drug is extremely narrow. The therapeutic blood level starts as low as 0.5 nanograms per milliliter (0.5 ng/ml) of blood, while the toxic level starts at only 2.2 ng/ml. Patients who are particularly sensitive to digoxin may exhibit signs of toxicity at a lower level than 0.5 ng/ml. Since the level of digoxin in the blood can rise in response to minute quantities of the drug in the circulation, it is easy to understand the high number of hospitalizations attributed to digoxin in the study reported by Petersen et al.

The incidence of hypertension increases with normal aging. As a nurse whose responsibility it becomes to administer antihypertensives, you should avoid dosage levels that might produce too rapid a reduction in pressure. Such reductions have been followed by severe disorders such as permanent blindness, myocardial and cerebral infarctions, and death (*Nurse's Drug Alert*, Sept. 1979, p. 121).

## Summary

The picture of the physical changes in our aging patient begins to take shape. We see a decrease in oxygen consumption in the brain, due to a decrease in the number

of functional neurons. Over 20 percent of the loss of functional neurons occurs in the cerebral cortex with the remainder occurring in the lower brain which governs activities such as movement, circulation, and respiration. The resulting decrease in physical activity permits poor muscle tone, not only for those muscles associated with lifting and walking but also for the abdominal muscles associated with efficient respiration. Combine this with a decrease in cardiac output and an increase in peripheral vascular resistance, and it becomes clear why the elderly patient may experience a decrease in cellular perfusion that will, in turn, result in mental changes such as increased confusion and physical changes such as hypertension. Further, we see a decrease in the number of myocardial drug binding sites, permitting an increase in the circulating drug level that may require dosage adjustment.

## **Special Senses**

Important changes frequently occur with aging in the senses through which we perceive the world. Again, these changes may also occur from drug usage. It is important to know which condition causes the changes in order to adequately intervene.

### **KINESTHETIC SENSES**

The kinesthetic senses, which govern muscle coordination, are receptors located in muscles, tendons, and joints. The elderly patient may experience deterioration of the kinesthetic senses. Body position and movement may be affected when this occurs.

To check your elderly patient for changes in the level of function, have him or her write a word on the left side of a sheet of paper; then immediately have the patient, with eyes closed, write the same word on the right side of the paper. Compare this with a normal or baseline sample that he or she had written earlier or to a sample written by a younger patient. You may see a wider spacing of the letters on the right side of the paper. This wider spacing results from a loss of muscle coordination, which is governed by the kinesthetic senses. Depending upon the severity of loss or change in muscle coordination, it may become important to determine whether the change is simply a result of normal aging or whether it has occurred as an adverse drug reaction or interaction.

Almost any medication has the potential to cause muscle weakness as an adverse side effect. (For more specific examples of muscle dysfunction due to drug usage, see chapter 6).

### **SENSE OF SMELL**

If you are concerned that your patient may have loss of sensation involving the olfactory nerve, you can do some simple experiments with the sense of taste to confirm or rule out this possibility as a real problem. Provide your patients two sticks of candy or other flavorful food. If diabetes is a problem, unsweetened gum or items sweetened with sugar substitute might be acceptable, unless the patient is on a sodium-restricted diet. The two sticks (or other items) should be different flavors. Ask your patient to do the following:

1. Pinch nostrils and breathe through mouth.
2. With nostrils pinched, taste one stick.
3. While tasting, release nostrils.
4. Determine when the item was more flavorful.
5. Repeat steps 1 through 4 with a second stick.
6. Now taste one stick while smelling the other.
7. Determine which item was actually "tasted."
8. Reverse sticks and repeat steps 6 and 7.

This experiment should give you some valuable insight into your elderly patient's sense of smell. It can also provide clues to problem areas such as insensitivity to strong odors or lack of interest in food. If your patient reports that the *taste* of the item selected is that of the item being *smelled*, then his or her olfactory nerve is probably unaffected.

Nasal congestion or discharge may be caused by drugs such as antitussives, expectorants, narcotics, antipsychotic agents, and antihistamines. The olfactory sensory neurons, since they are situated in the nasal mucosa, may be affected by either nasal congestion or nasal discharge.

### SENSE OF TASTE

If you are concerned about your patient's sense of taste, first knowing the status of his or her sense of smell would be of value. Once this is known, you might then proceed to check the patient's ability to identify the following tastes, since certain disorders (diabetes, cancer, and zinc deficiency), ingested drugs (such as anticonvulsants and diuretics), and normal aging can all interfere with taste perception. Test for

1. Sweetness: on the tip of the tongue
2. Sourness: on the sides of the tongue
3. Bitterness: on the back of the tongue
4. Saltiness: on the tip of the tongue

Knowing your patient's ability or inability to identify odors and flavors is important because these abilities also decrease with age (Yen, 1982, p. 56). (For further information on interference with taste perception as a result of drug usage, see chapter 6).

### HEARING

If hearing loss is a concern, you can use a tuning fork to test the patient's hearing acuity. Hold the tuning fork by its base above the patient's cranium, about midline and in line with the auditory canals. Extending the two prongs upward, squeeze them together, then release. While they vibrate, permit the base to touch your patient's head. If he or she then hears the sound as being louder in one ear than the other, either a conductive hearing loss or a sensorineural hearing loss may exist (Malikiewicz, 1982, p. 60; Alfano, 1982, pp. 56-57).

Your findings, if abnormal, may need to be brought to the attention of the patient and should also be brought to the attention of the attending physician. An inability to hear adequately can be frustrating for the patient as well as for those with whom he or she comes into contact. You should further assess your patient's medications to determine if any adverse reaction or drug interaction may be causing the problem. If this is the situation, early intervention may prevent permanent loss of hearing. Ethacrynic acid (Edecrin), antineoplastics, and sulfonamides are examples of drugs that may cause deafness.

## SIGHT

If your elderly patient is experiencing difficulty in seeing, you should observe for deterioration of the optic nerve. With optic nerve damage, the pupils may become miotic and somewhat fixed, responding less readily to light and not accommodating well (Tichy and Chong, 1981, p. 60). It is imperative here also to rule out this problem as being an adverse reaction to a drug, in order to administer the proper therapy.

Along with other visual disorders, blurring of vision may be caused by a variety of drugs, including levodopa, diuretics, antidiabetics, and lithium. This blurring and the resulting decreased ability to read clearly may in turn cause other drug-related problems, especially for the independent elderly person who is responsible for administering his or her own medications, since instructions on taking medications, or labels, may be misread.

## Muscular Changes

A decrease in the level of muscular activity often occurs with aging, due in part to a decrease in strength and in part to an increase in muscle irritability. With the decreased activity comes also a decrease in range of motion (ROM), loss of muscle tone, and muscle atrophy.

These problems may be accentuated by drugs (such as adrenocorticosteroids, narcotics, antiemetics, and others) that have adverse side effects involving the musculoskeletal system. On the other hand, muscle strength and tone may be maintained through a regular exercise program. A ten-year study of participants aged 51 to 74 who took part in an exercise program showed no deterioration in physical condition, and improvement in certain physical and motor tests, resting electrocardiogram (ECG) values, and pulmonary function (Danon, 1981, p. 193). The value of exercise to older patients is an important factor to remember when doing patient teaching.

## Respiratory Functioning

With normal aging, respiratory changes occur that make coughing and deep breathing more difficult. By age 90, vital capacity has decreased, on the average, to approximately 60 percent of normal, with maximal breathing capacity at approximately 40 percent of normal. There is a decrease in the elasticity of lung tissue, along with a decrease in muscle tone (Kanungo, 1980, p. 4).



If these changes are accompanied by disease processes, genetic abnormalities, the effect of environmental pollutants, trauma, or undesirable drug reactions, serious respiratory dysfunction can easily result.

Antineoplastics and oil-based laxatives may cause pneumonia or pulmonary toxicity; narcotics and antipsychotic agents may cause a decreased cough reflex; and various other drugs adversely affect respiratory function.

## Gastrointestinal Changes

As a result of normal aging, the elderly patient, whose body is already experiencing *inadequate cellular perfusion*, may suffer further from poor nutrition brought on by changes in gastrointestinal functioning, due to

- Decreased secretions (oral and digestive enzymes)
- Increased premalignant oral mucosa lesions
- Decreased peristalsis, with resulting constipation or paralytic ileus
- Stomach cancer
- Gastric ulcers
- Malnutrition in the elderly patient may also result from the following factors:
  - Social factors (doesn't like to eat alone)
  - Financial factors (lives on a limited income)
  - Emotional factors (depression)
  - Physical factors (loose dentures, etc.)
  - Drug reactions (anorexia, nausea, vomiting)
  - Twenty-percent reduction in metabolic rate by age 90 (Kanungo, 1980, p. 4)

Body cells will be further deprived of oxygen if malnutrition occurs as a result of any of the above factors. This, in turn, would then increase the degree of confusion and lassitude, if any exists, and could mean that a previously independent or semidependent patient now needs a different level of care, at least temporarily, while plans are made to correct the malnutrition and prevent its recurrence.

For other gastrointestinal disorders associated with adverse drug reactions, see appendix 2.

## Hormonal and Reproductive Changes

One significant change that results from the aging process is a decrease in the size of the pituitary gland by as much as 20 percent (Tichy and Chong, 1981, p. 127), which in turn causes a decrease in the functioning of other glands and lower production of these hormones:

- TSH (thyroid stimulating hormone)
- ACTH (adrenocorticotrophic hormone)
- STH (somatotropin, or growth hormone)
- FSH (follicle stimulating hormone)
- LH (luteinizing hormone)

- LTH (luteotropic hormone)
- MSH (melanocyte stimulating hormone)
- ADH (antidiuretic hormone)
- Oxytocin

With a decrease in thyroid function, your patient can experience mental depression, malaise, withdrawal, or other personality disorders that may respond to hormone replacement. Be alert to whether or not these disorders could also be the result of drug reactions.

## Urinary System Changes

Significant changes occur in the functioning of the urinary system between the ages of 20 and 90 years of age. The kidneys become smaller, thereby decreasing the total number of functional glomeruli. To further complicate this situation, renal plasma flow decreases by 50 percent, as a result of decreased cardiac output (Tichy and Chong, 1981, p. 62; Petersen, Whittington, and Payne, 1979, pp. 52-54; Kanungo, 1980, p. 4; Rossman, 1971, p. 370). It becomes easy to see that those drugs normally metabolized to water-soluble compounds for renal excretion may not be adequately excreted unless the dosage is reduced in older patients.

A decrease in fluid intake, together with a decrease in urinary output and sphincter tone, may account for an increase in susceptibility to urinary tract infections in the aging patient. With urinary tract infections, changes occur in the urinary pH, causing it to become more alkaline (Strand and Elmer, 1976, p. 66; Widmann, 1976, p. 231); therefore, drugs (such as quinidine) that are normally excreted in an acid urine will be less well excreted unless the urinary pH is altered. In a situation such as this, your patient may experience drug toxicity or undesirable drug interactions that would not otherwise occur. Drugs such as sulfonamides and streptomycin are more effective in an alkaline urine and may require a reduction in dosage with an increase in urinary pH (Hopkins, 1979, p. 98).

Perhaps the best indicator for kidney function is the serum creatinine level. When the serum creatinine level doubles, kidney function has decreased to one-half the normal level. With an elevated serum creatinine level, you then need to be aware that your patient will not be excreting potassium and other drugs adequately and that toxic levels may build up. Frequent laboratory determinations will need to be made and dosage adjusted accordingly (Harvey, 1974, pp. 58-59; Widmann, 1976, p. 119).

## Summary

The picture of aging that we have drawn so far begins to show a patient who experiences the following:

- A decrease in nerve functioning
- A decrease in muscle tone
- A decrease in fluid intake
- A decrease in gastrointestinal functioning
- A decrease in cardiac output