Drug Disposition in Geriatric Patients

Each day in the United States another 10,000 people reach the age of 65. Today there are 40 million seniors in the United States and by 2030, that number is projected to rise to 72 million. In addition, there are 15 million seniors with long-term disabilities in the United States. Patients older than 65 years of age are considered *geriatric patients*. They represent a significant population when providing pharmaceutical care. Although the elderly account for 12.7% of the U.S. population, they consume approximately 34% of total prescriptions, and 28% of hospitalizations among seniors are due to adverse drug reactions (ADRs). The estimated annual cost of medication-related problems in acute-care facilities alone is $20 billion.\(^1\)

Care of this patient population requires increased attention because of the special needs associated with the physiological and pathological changes that occur with aging. Aging is associated with a decline in certain physiologic functions and a reduction in the efficiency of many organ systems. These age-related declines, which are a result of changes in cellular activity and a decrease in the number of normally functioning cells, are independent of any disease process. The result is a decrease in the body’s ability to maintain homeostasis (i.e., stability in biological processes). The decline in homeostatic capacity increases the impact of stress and disease on biological functions in the elderly.

Age-related physiologic changes may impact the pharmacokinetic and pharmacodynamic parameters of medications and could result in drug toxicity or unusual pharmacologic responses that do not normally occur in younger adults. These age-related changes may also affect adherence to medication therapy. Age-related
changes and their potential impact on medication therapy are described in Table 25-1.²

**Geriatric Drug Dosing**

Geriatric patients may require smaller drug doses than younger adults due to age-related decline in biological functions. Changes in organ function associated with aging, such as declining hepatic or renal function, can reduce the elimination of some medications (e.g., anti-infectives), requiring reductions in doses or lengthening of the dosage interval.

Recommended drug dosages for geriatric patients have been established for many medications and are reported in the package labeling and other drug information references. Doses are usually reported as micrograms (mcg), milligrams (mg), or grams (g) per dose but may be expressed in other ways such as a percentage of the dose used in younger adults or mg/kg/dose, mg/kg/day, mg/m² (body surface area [BSA]).

To calculate BSA there are several equations. The following is commonly used:

\[ \text{BSA (m}^2) = \sqrt{\frac{\text{Height (inches) \times Weight (pounds)}}{3,131}} \]

or

\[ \text{BSA (m}^2) = \sqrt{\frac{\text{Height (cm) \times Weight (kg)}}{3,600}} \]

There are also nomograms to calculate BSA available in the published literature. However, recommended doses may not be appropriate for elderly patients when age-related changes are not taken into consideration.

More commonly, medication dosage adjustments in the elderly are based on renal function because renal function declines with age. Therefore, renal impairment is seen in many of these patients. Dosage adjustments are made based on estimated creatinine clearance calculated using methods such as the Cockcroft-Gault equation. Chapter 29: Medication Dosing in Patients with Renal Dysfunction contains more detailed information regarding dosing of medications based on renal function.

Dosages may also be based on serum drug concentrations. Examples of medications that can be initially dosed, monitored, and adjusted using pharmacokinetic data and the patient’s response include aminoglycosides, vancomycin, and digoxin.

Dosage adjustments may be needed when switching from one dosage form or route of administration to another because of differences in physiochemical and pharmacokinetic properties (e.g., salt form and bioavailability). Medications that require dosage adjustments from one dosage form to another include, but are not limited to, the following: levothyroxine, phenytoin, verapamil, diltiazem, and propranolol. For example, the intravenous dose of levothyroxine is 50% of the oral dose.

**Medication Administration in Geriatric Patients**

In general, geriatric patients tolerate all dosage forms and routes of administration similar to younger adults. However, the choice of medication formulation, dosage form, and route and method of administration are dependent on patient-specific factors (e.g., age-related changes in physiologic functions and concurrent disease states) and the availability of appropriate drug preparations. Seriously ill patients may be unable to take medications by mouth, requiring alternative routes of administration, such as parenteral and rectal routes. Debilitation of the swallow reflex may necessitate the use of liquid dosage forms, sometimes via a nasogastric tube.

Some medications are not available as oral liquid formulations and must be modified for use. Crushed tablets and the contents of emptied capsules may be mixed with beverages, soft foods, enteral formulas, or extemporaneously prepared in syrups and other liquid vehicles. However, problems can occur when some products are altered. Sustained-release, entericoated, microencapsulated, and sublingual products should not be crushed because the bioavailability of the medication will be altered. Foods, enteral formulas, and liquid vehicles can interact with medications and alter bioavailability and other physiochemical properties. Some patients susceptible to fluid overload, such as those with renal failure, may require oral liquid and parenteral medications to be prepared in more concentrated form when appropriate concentrations are not available commercially. Therefore, great care must be taken to ensure that appropriate concentrations and diluents are used. It is always best to consult the specific manufacturer for guidance on the altering or crushing of tablets or capsules.