Excerpt from Food-Medication Interactions 13th edition by Zaneta M. Pronsky, MS, RD, LDN, FADA

INTRODUCTION

The study of the absorption, distribution, metabolism and excretion ***of drugs*** is referred to as ***pharmacokinetics***.
The study of the absorption, distribution, metabolism and excretion ***of nutrients*** is ***nutrient kinetics***.

Absorption: Process by which a drug/nutrient proceeds from the site of administration to the systemic circulation.

Distribution: Movement of the drug/nutrient from one location to another.

Metabolism: Process by which the drug/nutrient is chemically changed by the action of enzymes (usually in the liver). The metabolite may become more active, less active or as active as the parent compound.

Excretion: Process by which the drug/nutrient or metabolites are removed from the body primarily by the kidneys.

EFFECT OF FOOD/NUTRIENTS ON MEDICATION KINETICS

EFFECT OF FOOD/NUTRIENTS ON MEDICATION ABSORPTION

The presence of food in the stomach may decrease the rate and/or extent of drug absorption.

* The absorption of the antiosteoporosis drug alendronate (Fosamax) is decreased 60% with coffee or juice. It is NOT absorbed at all when ingested with a meal. Absorption is optimal if taken 2 hours before food.

* A high fiber diet may decrease the absorption of tricyclic antidepressants such as amitriptyline (Elavil).

Chelation occurs between certain drugs and divalent/trivalent cations Ca, Mg, Al, Fe, Zn, thus decreasing drug absorption.

* Ciprofloxacin (Cipro) forms an insoluble complex with Ca in some dairy products; Ca, Fe, Mg or Zn in supplements; or Ca, Al and/or Mg antacids, decreasing drug absorption.

The presence of food in the stomach may enhance the absorption of some drugs.

* The absorption of cefuroxime axetil (Ceftin) is significantly higher when given with food than when fasting.

EFFECT OF FOOD/NUTRIENTS ON MEDICATION DISTRIBUTION

A significant decrease in serum albumin may increase the free fraction of highly protein bound drugs.

* Hypoalbuminemia (< 3g/dL) provides fewer binding sites for highly protein bound drugs such as phenytoin (Dilantin- 90% bound) and warfarin (Coumadin- 99% bound). Therefore a higher free fraction of drug is available, resulting in increased drug effects. For warfarin this could induce bleeding, while higher phenytoin levels could cause toxicity.

EFFECT OF FOOD/NUTRIENTS ON MEDICATION METABOLISM

Food may alter the hepatic metabolism of some drugs.

* Concurrent ingestion of food and propranolol (Inderal) reduces first pass metabolism of the drug. This results in higher serum drug levels.

* Grapefruit inhibits metabolism of antihyperlipidemic HMG CoA Reductase inhibitors, e.g. atorvastatin (Lipitor), by cytochrome P450 3A4 isoenzymes in the intestinal wall, raising drug blood levels.

EFFECT OF FOOD/NUTRIENTS ON MEDICATION EXCRETION

Foods and nutrients may alter the renal excretion of some drugs.

* Lithium (Eskalith) and sodium compete for tubular reabsorption in the kidney. High sodium intake causes more lithium to be excreted. Low sodium intake will cause the kidney to retain lithium, raising blood levels.

Effects of Medications on Nutrient Kinetics

EFFECT OF MEDICATION ON NUTRIENT ABSORPTION

Drug complexes with nutrients preventing the absorption of drug, nutrient or both.

* Antibiotics tetracycline and ciprofloxacin (Cipro) chelate with divalent or trivalent cations, Ca, Mg, Fe, Zn.

* Antihyperlipidemic, bile acid sequestrant cholestyramine (Questran) adsorbs fat soluble vitamins A, D, E, K.

Drug alters gastric acidity.

* Prolonged use of antiulcer drugs such as cimetidine (Tagamet) may decrease absorption of vitamin $B_{12,}$ thiamin, Fe.

Drug damages mucosal surface.

* Medication induced mucosal damage by antineoplastic drugs may cause decreased nutrient absorption.

EFFECT OF MEDICATION ON NUTRIENT METABOLISM

Drug increases the metabolism of nutrients resulting in higher requirements and danger of deficiency.

* Anticonvulsants phenobarbital and phenytoin (Dilantin) increase the metabolism of folic acid, vitamins D and K.

Drug causes vitamin antagonism.

* Antituberculosis drug isoniazid (INH) inhibits the conversion of pyridoxine (vitamin B_6) to the active form. This may cause vitamin B_6 deficiency and peripheral neuropathy unless a B_6 supplement is also prescribed.

EFFECT OF MEDICATION ON NUTRIENT EXCRETION

Drug increases the urinary loss of nutrients.

* Loop diuretics, such as furosemide (Lasix), increase excretion of Na, K, Cl, Mg, Ca.

Drug decreases the urinary excretion of nutrients.

* Thiazide diuretics increase excretion of most electrolytes, but decrease excretion of Ca due to renal reabsorption.

MODIFICATION OF MEDICATION ACTION

ENHANCEMENT OF MEDICATION ACTION

Foods or additives have effects similar to those of a drug, enhancing the effects or toxicity of the drug.

* High caffeine intake may increase the adverse effects of theophylline (nervousness, tremor, insomnia).

* Tyramine, dopamine or other vasoconstrictors in food enhance the toxic effects of MAO inhibitors, such as tranylcypromine sulfate (Parnate). This effect may cause a hypertensive crisis, which can be fatal.

ANTAGONISM OF MEDICATION ACTION

Nutrient or food ingredient may oppose the desired action of the drug.

* Vitamin K aids the production of clotting factors in direct opposition to the action of warfarin (Coumadin).

* Caffeine is a stimulant which counteracts the antianxiety effects of tranquilizers.

Diet counteracts the effect of the drug.

* High fat diet counteracts the effect of antihyperlipidemic drugs such as lovastatin (Mevacor) or gemfibrozil (Lopid).

Effects of Medication on Food Intake and Nutritional Status

ORAL AND TASTE/SMELL EFFECTS

Drug may impair salivary flow causing dry mouth and increased caries, stomatitis, glossitis.

* Tricyclic antidepressants such as amitriptyline (Elavil) cause dry mouth and sour or metallic taste.

Drug may be secreted into the saliva.

* The antibiotic clarithromycin (Biaxin) enters the saliva causing a bitter taste.

Drug may suppress natural oral bacteria resulting in oral candidiasis.

* Antibiotics, such as tetracycline, may result in oral yeast overgrowth i.e. candidiasis.

Drug may cause dysgeusia (taste change)

* Antibiotic metronidazole (Flagyl) causes metallic taste in the mouth.

Drug may damage rapidly proliferating cells.

* The cytotoxic effects of antineoplastics such as cisplatin or methotrexate cause stomatitis, glossitis, esophagitis.

GASTROINTESTINAL EFFECTS

Drug may irritate the stomach mucosa causing distress, nausea, vomiting, bleeding, ulceration.

* Nonsteroidal anti-inflammatory drugs (NSAID) such as acetylsalicylic acid (aspirin), ibuprofen (Advil, Motrin) and naproxen (Aleve, Anaprox) cause stomach irritation, sometimes leading to sudden, serious gastric bleeding.

Drug may affect intestinal peristalsis.

* Anticholinergic drugs (antipsychotics, antidepressants, antihistamines) slow peristalsis causing constipation.

Drug may destroy intestinal bacteria.

* Antibiotics (e.g. ciprofloxacin (Cipro) cause overgrowth of Clostridium difficile and result in pseudomembranous colitis.

APPETITE CHANGES

Drug may suppress appetite.

* SSRI antidepressant drugs such as fluoxetine (Prozac) may cause anorexia and weight loss.

Drug may increase appetite.

* Tricyclic antidepressants and most antipsychotic drugs, such as amitriptyline (Elavil), olanzapine (Zyprexa) and clozapine (Clozaril), stimulate appetite and weight gain.