Drug and Food Interactions

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OUTLINES

- Drug-Food interaction
- Pharmacokinetic interactions
- Food-Drug interaction
- Mechanisms of Food-Drug interaction
- Risk factors
- Corticosteroid effects on calcium

Introduction

- Drug: Any chemical substance, natural or manmade (usually excluding nutrients, water, or oxygen), that by its chemical nature alters biological structure or functioning when administered and absorbed.
- Foods: Products derived from plants or animals that can be taken into the body to give in energy for the maintenance of life & the growth & repair of tissues.

Drug-Food Interaction

- A drug-food interaction occurs when your food or one of its components and medicine interfere with one another. Interactions can happen with both prescription and over-the-counter medicines.
- Not all medicines are affected by food. Some medicines cannot be taken with certain types of food. The food can cause a reaction that changes the effect of the medicine.
- On the other hand, some medicines are easier to handle when taken with food.
- The Drug whose activity is affected by such an interaction is called as an "Object drug”
- The agent which precipitates such an interaction is referred to as the "Precipitant"

What influences the effect of Drug-Food interactions?

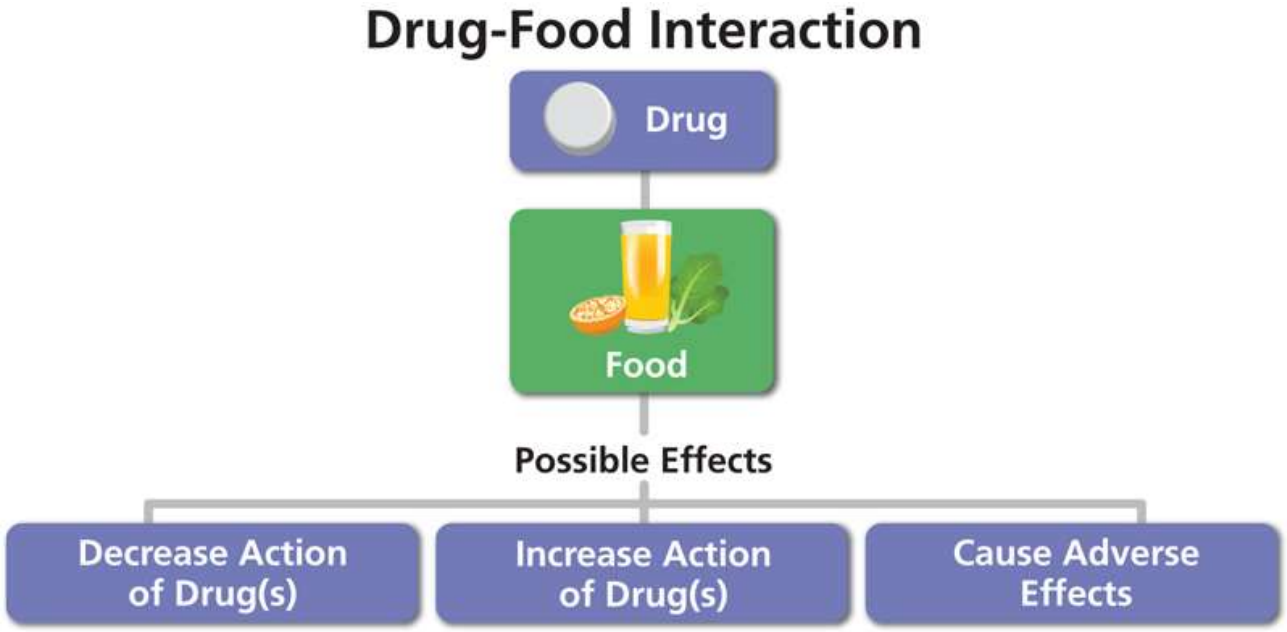
- ✓ Dosage of the drug
- ✓ Person's age
- ✓ Size and state of health
- ✓ The time foods and the medications are taken
- Avoidance of drug interactions does not necessarily mean avoiding drugs or foods. In the case of tetracycline and dairy products, these should simply be taken at different times; rather than eliminating one or the other from the diet.

Pharmacokinetic Interactions

These interactions are those in which ADME properties of the object drug is altered by the precipitant and hence such interactions are also called as ADME interactions.

These are classified as:

1. Absorption interactions
2. Distribution interactions
3. Metabolism interactions
4. Excretion interactions



Absorption interactions

- Are those where the absorption of the object drug is altered.

- The net effect of such an interaction is:

➢Faster or slower drug absorption.

➢More, or, less complete drug absorption.

Absorption interactions

- Food may affect drug absorption in the GI tract by altering gastric pH, secretion, gastrointestinal motility and transit time. This may result in a change in the rate of absorption or extent of drug absorption or both.
- For example, rate and extent of azithromycin absorption is decreased when it is taken with food, resulting in a 43% reduction in bioavailability.
- A reduced rate of absorption may sometimes be useful in reducing the side effects of a drug, as in the cases of ibuprofen, without reducing bioavailability.

Distribution interactions

Distribution interactions: These occur when the drug's intended distribution pattern is changed.

1. The major mechanism for distribution interaction is alteration in protein-drug binding

- Cranberry juice can increase the distribution of warfarin, by reducing its plasma protein binding. This can lead to higher levels of warfarin in the blood and tissues and increase the risk of bleeding. Therefore, people who take warfarin should avoid drinking cranberry juice or eating cranberry products.

Distribution interactions

2. Body composition

- Obese or elderly → higher ratio of adipose tissue. So, fat soluble drugs may accumulate in the body, increase risk of toxicity.

Metabolism interactions

- Interactions with metabolism: These occur when the drug of interest has an altered metabolism.
- Mechanisms of metabolism interactions include:

1. Enzyme induction: Increased rate of metabolism.
2. Enzyme inhibition: Decreased rate of metabolism.

It is the most significant interaction in comparison to other interactions and can be fatal.

Metabolism interactions

- Grapefruit juice mainly inhibits the intestinal metabolism (CYP3A4) of numerous drugs (calcium channel blockers, anti-anxiety agents) enhancing their effects and increasing risk of toxicity.

- Cruciferous vegetables contain Indolic compounds which are inducers of CYP1A2, that stimulate the rate of human drug metabolism.

Excretion interactions

- Excretion interactions: These occur when a drug's excretion pattern is changed.
- Major mechanisms of excretion interactions are:

➢Alteration of urine PH

➢Alteration in renal blood flow

Excretion interactions

1. Foods may alter the urinary pH, which can affect the activity of certain drugs. The half-lives of some medications can be significantly changed by alterations in urinary pH. Therefore, the half-life of acidic drugs will be extended in acidic urine because the drug is in its unionized form.

   However, the half-life of an acidic drug in alkaline urine is reduced because the drug is in its ionized form. Foods such as milk, vegetables and citrus fruits can alkalinize the urine. Meats, fish, cheese and eggs can acidify the urine.

Excretion interactions

2. Foods may alter the renal excretion of some medications. Lithium 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.

Food-Drug interaction

- A nutrient-drug interaction is the effect of a medication on food or a nutrient in food.
- Medications interact with foods and nutrients in several ways.
- Medications can decrease appetite or change the way a nutrient is absorbed, metabolized, or excreted.
- For individual taking medication for a long time, nutrient-drug interactions may lead to **nutritional deficiencies.**

Mechanisms of Food-Drug interaction

- May medications interact with nutrients through:

01 Food intake changes

02 Slow down nutrient production

03 Decreasing nutrient absorption

04 Increasing nutrient metabolism

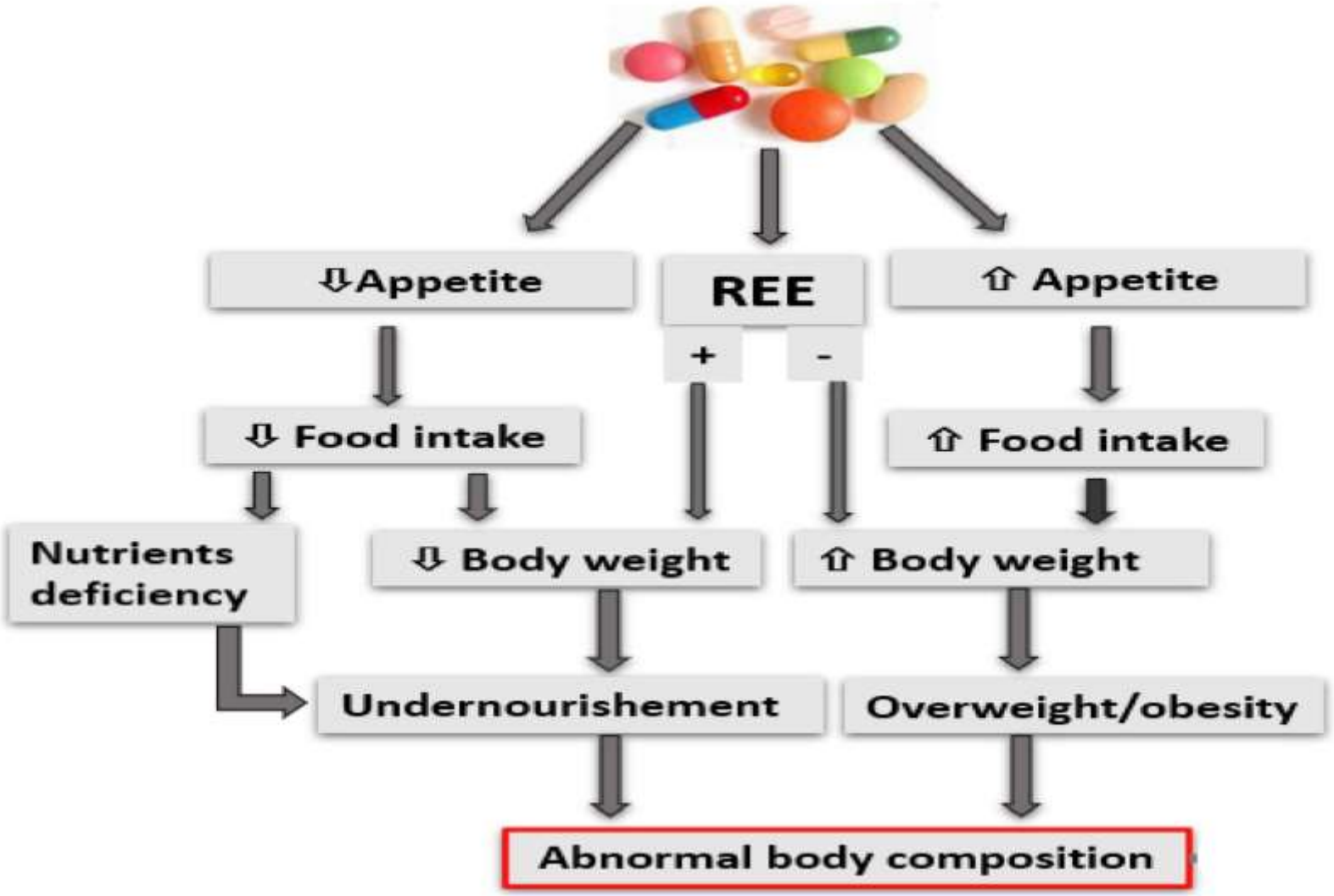
05 Increasing nutrient excretion

1. Food intake changes

- Some medications affect nutritional health by causing poor food intake, such as:
  - anorexic agents (e.g., amphetamine) which reduces appetite, resulting in lower food intake, leading to weight loss.
  - Several cancer medications and treatments may cause nausea, vomiting, sore, or dry mouth resulting in poor food intake.

- Some medications increase food intake, such as:
  - Corticosteroids, by stimulating appetite, leading to an increase in body weight, namely due to fat mass increase and/or overhydration.

1. Food intake changes



2. Slow down nutrient production

Antibiotics kill harmful bacteria

↓

They can also kill helpful bacteria

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Including bacteria that produce vitamin K in the intestine

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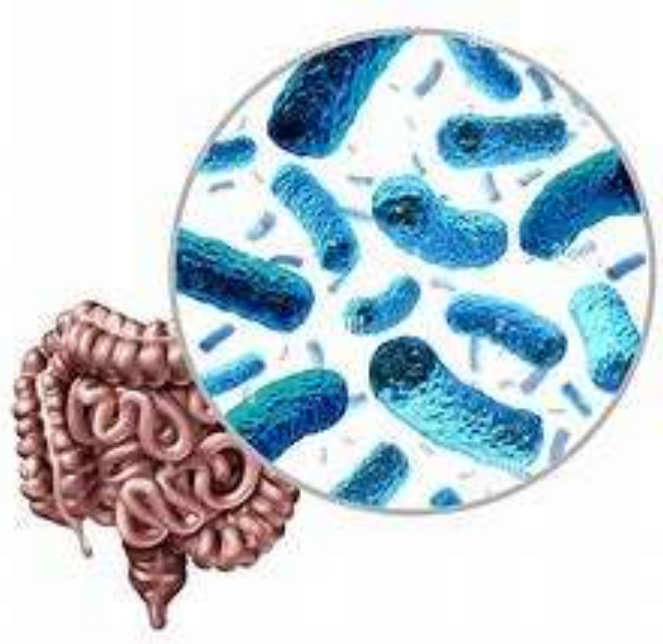
Decreased production of vitamin K



3. Decreasing nutrient absorption

- Malabsorption both primary and secondary produced by drugs can lead to deficiencies of vitamins A, D, E, K, folate and vitamin B12.
- Mechanisms of decreasing nutrient absorption:-

01

Chelation

Can occur between medications and mineral reducing the amount of mineral available.

02

Adsorption

Some antihyperlipidemic bile acid sequestrants cause fat-soluble vitamin malabsorption.

03

Transit time

Some drugs (e.g., laxatives) speed up transit time so not enough digestion can occur.

04

Damage intestinal mucosa

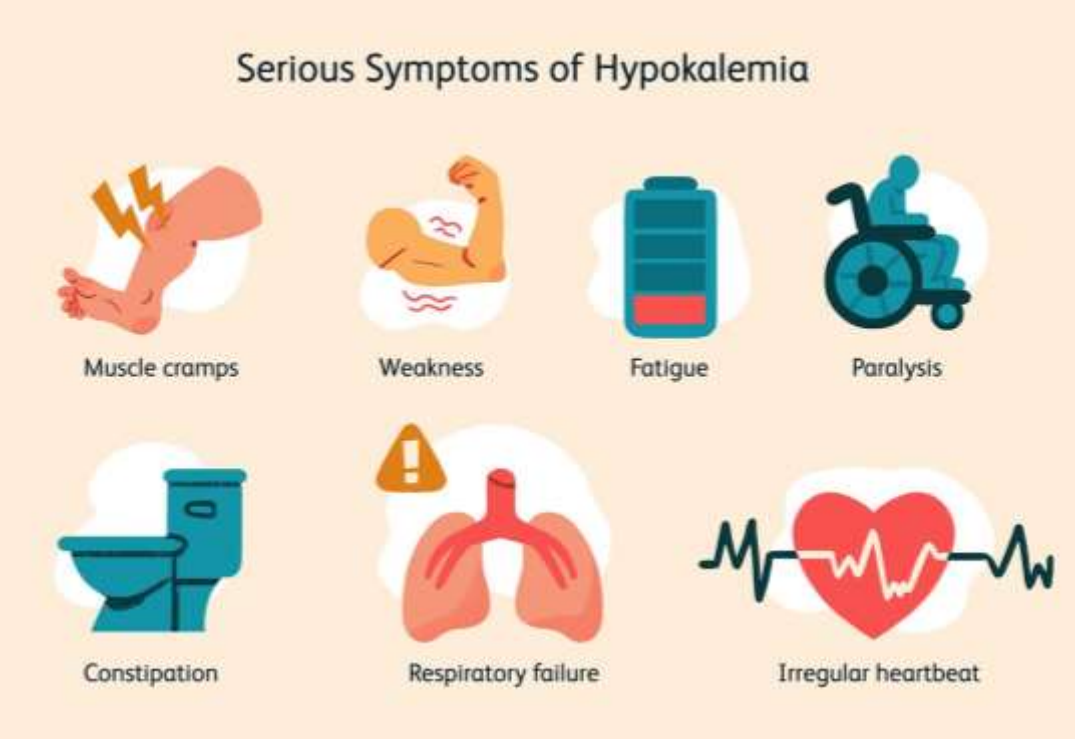
These drugs have the greatest effect on nutrient absorption.

4. Increasing nutrient metabolism

- Medications can interfere with the body's ability to metabolize nutrients.
- Some anticonvulsants alter the activity of liver enzymes, such as barbiturates and carbamazepine are strong stimulants for hepatic microsomal enzymes, causing increase metabolism of folate (B9), vitamin D and vitamin K.

5. Increasing nutrient excretion

- Medications can increase the loss of a nutrient.
- Diuretics remove excess fluid from the body. Some diuretics (e.g., loop and thiazide diuretics) may also increase loss of potassium along with fluids resulting in hypokalemia.
- Potassium is very important in proper functioning of the heart and other muscles.



Risk factors

- Some people may be at greater risk of drug-nutrient interactions than others.
- Those can include the following:

1. People with poor diet or malnourished
2. Growing infants and children
3. Pregnant women
4. Elderly
5. People with serious health problems
6. Patients taking 2 or more medications at the same time
7. Patients taking medications for a long period of time
8. Patients who drink alcohol and smoke
9. Patients not following direction

Corticosteroid effects on calcium

- Long-term treatments with corticosteroids are responsible for a particular kind of osteoporosis which develops more rapidly than other varieties of the disease.
- Corticosteroid treatment causes a negative calcium balance, due to:
  - a rapid impairment of calcium transport in the intestine, leading to a decrease in the availability of calcium
  - a decrease in the renal reabsorption of calcium (and phosphate) which results in an increase in the urinary losses of these minerals

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