The Relationship Between Nutrition and Pharmacology

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The influence of food and dietary patterns on drug absorption and bioavailability is complex. Drugs and nutrients may interact and produce different effects other than originally intended. This can affect the drug efficacy on one hand or the nutritional status of the individual on the other. Because of this relationship between foods and drugs, the nutritionist has a role in pharmacological counselling. This article describes how the drugs affect the utilization of food and nutrients and conversely how the food and nutrients modify the effects of drugs, and reveals the special relationship between pharmacology and nutrition.

Key Words: Nutrition, pharmacology, drugs.

INTRODUCTION

All drugs are toxic if used in excess and will invariably cause undesirable side effects. They may also interfere with absorption, metabolism and excretion of nutrients. Individuals most at risk are those who lack reserve nutritional stores, under-nourished, chronically ill, those who use large amounts of drugs, those in period of rapid growth, the elderly, and those on multiple drug therapy [1,2,3].

The effects of drugs on nutrients are often due to both the intended therapeutic effect, as well as the incidental side effects of the drugs. Foods can also affect the absorption rates of drugs, resulting in a decrease in the amount of total drug absorbed and available for utilization. The nutritionist has a complex task of determining diet composition in relation to the potential nutrient-drug interactions. It is therefore, important for a nutritionist to understand these interactions when planning nutritional therapy and education for the patients/clients who are also on various medications. This article examines some of the important contributory factors leading to drug-nutrient interactions.

Drug induced hypophagia and hyperphagia

Drugs may affect food ingestion by reducing taste acuity, decreasing appetite and causing nausea which results in hypophagia or decreased food intake. A number of drugs have the effect of increasing appetite and consequently increase food intake (hyperphagia) [1].

Drugs that depress the appetite (anorexigenic agents) include amphetamines, insulin and alcohol [4]. Amphetamines acts as stimulants to the central nervous system, while insulin induces a rapid drop in blood sugar with the resultant effect of nausea, weakness and aversion to foods [5]. Alcohol induces gastrointestinal irritation leading to loss of appetite hence reduced food intake and subsequent malnutrition.

Excessive alcohol consumption over an extended period of time can lead to serious nutritional deficiencies, gastritis, hepatitis (alcoholic), cirrhosis and psychosis [1,2,3,]. It affects the stomach, intestines, liver, and pancreas, causing them to act less efficiently in digestion, absorption and metabolism of nutrients. Nutrient deficiencies in alcohol abuse include the B vitamins (especially thiamin and folic acid), vitamin A, C and D, zinc, magnesium, potassium, calcium and proteins. Excessive drinking over a long period whether or not accompanied by adequate nutrition will bring about deficiency of all the aforementioned nutrients.

Antipsychotic drugs (eg chlorpromazine) often cause a marked increase in food intake to the extent of causing overweight in patients [6]. When used by the elderly they have been shown to decrease food intake due to their slowed activity, somnolence and disinterest in food.

Loss of taste (dysgeusia) may be caused by a number of drugs as for example non-steroidal anti-inflammatory drugs (NSAIDs), diuretics and methotrexate. The taste loss in this case is due to drug induced zinc deficiency [6].

Effects of drugs on nutrient absorption and metabolism

Absorption of drugs and nutrients occur by very different mechanisms. Absorption of most drugs is influenced by their lipid/water partition coefficient, gastric pH, molecular size and physicochemical form of the drug [7]. The major site of drug-nutrient interactions is the stomach and upper intestinal region. Cholestyramine, an ion exchange resin, binds bile salts and impairs the absorption of fat soluble vitamins such as vitamin K. Cholesterol absorption is impaired, hence its use in atherosclerosis.

Flatulence, abdominal pains and symptoms of specific nutrient deficiencies may also occur. Folic acid deficiency anaemia associated with use of phenytoin is a good example. Nausea and vomiting is a common side effect of many drugs eg nitrofurantion. A number of drugs can promote the nutritional status by increasing nutrient absorption. For example, cimetidine, a gastric antisecretory agent used in the treatment of peptic ulcers, reduces gastric acid output

and improves the absorption of protein and carbohydrates [2, 3]. Absorption of ferrous salts is enhanced by ascorbic acid.

The interaction of food and drugs when administered concurrently induces a change in the drug bioavailability since drugs are generally absorbed more slowly when taken with food [2, 3].

The effect of milk on tetracyclines absorption is a good example of food-drug interaction. Tetracycline absorption is impaired when taken with milk, antacids, or iron supplements [8]. It combines with divalent and trivalent cations (Ca^{++}, Fe^{++}, Al^{+++}, Mg^{++}) to form new insoluble compounds that are poorly absorbed. Milk and antacids should therefore be taken at different times from the drug. An interval of 1-2 hours is acceptable.

Meals high in fat and fibre slow the gastric emptying process. Beverages such as cola drinks are acidic and may affect acid labile drugs such as ampicillins, erythromycin [2]. Griseofulvin an antifungal drug is best absorbed after a high fat meal.

The drug-nutrient interaction occur mainly during absorption. However, drugs occasionally interfere with the way nutrients are metabolized *[9]*. This alteration in metabolic process can be due to drug induced vitamin antagonism or to the activation of enzymes through which vitamins are metabolized and degraded. For example, Isoniazid, an antitubercular drug interferes with nutrient metabolism by forming a complex with vitamin B_6 and is subsequently excreted making the vitamin unavailable for use [11]. Adrenocortical hormones cause breakdown of glycogen and protein. This causes tissue wasting with mobility of fat to certain body areas creating the "buffalo hump" and "moon face" commonly seen in long time corticosteroid users [2, 5]. The ingestion of aged cheese, beer and certain wines has caused hypertensive crisis in patients who were being treated with monoamine oxidase (MAO) inhibitors. This has been attributed to presence of tyramine which is normally metabolised by MAO enzyme [12].

Drug-induced patho-physiological gastrointestinal changes and malabsorption

Mucosal alterations caused by drugs usually involve the destruction of the microvilli, interference with intestinal wall and inhibition of local enzymes activity [7]. Effects depend on physical and chemical properties of the drug as well as the dosage, general nutritional status of an individual and the presence of concurrent disease. Undesirable gastrointestinal changes following use of cytotoxic drugs may lead to reduced food intake in these patients. This effect is also caused by many antibiotics given orally [6].

One of the drug groups that affect the lumen is the cathartics [7]. These drugs may reduce the intestinal transit time by causing nutrients to pass through the small intestine too rapidly for absorption to occur. Antacids change the pH of the stomach, causing a decrease in iron absorption, since an acidic environment is necessary to change iron from ferric to the absorbable ferrous form. Anticholinergic agents, such as hyoscine, reduce motility and tone of gastrointestinal tract thus altering absorption rate of food and other drugs.

Drug nutrient interaction in excretion

Drugs affect nutrient excretion by altering the renal tubular reabsorption or GIT reabsorption following biliary excretion. A drug may displace a vitamin from its binding site on plasma protein and cause it to be excreted more rapidly. A case in point is aspirin and folic acid. Foods may affect drug excretion by changing the pH of urine. Another undesirable effect associated with certain drugs is the retention of sodium and fluid [4]. Several drugs may also interfere with lactation leading to decreased milk output in breastfeeding mothers. Drugs administered to the mother may be excreted in milk and therefore be ingested by the baby together with milk.

CONCLUSION

The nutritionist in her diet prescription must take into account several factors to assure maximum effectiveness of the drug as well as optimum food intake and utilization. The nutritionist must take a complete dietary history including drug history. Information obtained should include drug name, dosage, frequencies, reason for the drug prescription and duration of treatment. This information should also be obtained for over the counter drugs, mineral/vitamins supplements, home remedies and herbs. It is imperative that the nutritionist monitor all patients on their drug intakes. For example, patients on weight reducing diets must be monitored for drug formulations containing large amounts of sugar such as cough suppressants and expectorants. This must be taken into account in the calculation of the patients daily caloric intake. Close monitoring is also necessary for the intake of medicines containing sodium or other restricted nutrients.

As we move on to the next millennium, there is a great potential for new relationships and collaborative efforts between the fields of pharmacy and nutrition. This is a great challenge for both professions, a challenge to learn from each other, working with each other and recognizing that the synergism between them will lead to improved healthcare.

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