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A Review on Effect of Food on Medication

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ABSTRACT

Medications, both prescription and over-the-counter, are used every day to treat acute and chronic illness. Research and technology constantly improve the drugs we have available and introduce new ones. Medications can help people live healthy lives for a prolonged period. Although medicines are prescribed often, it is important to realize that they must still be used with caution. The effect of drug on a person may be different than expected due to food, beverages, dietary supplements the person is consuming (drug-nutrient/food interaction) or another disease the person has (drug-disease interaction). A drug interaction is a situation in which a substance affects the activity of a drug, i.e. the effects are increased or decreased, or they produce a new effect that neither produces on its own. These interactions may occur out of accidental misuse or due to lack of knowledge about the active ingredients involved in the relevant substances. Regarding food-drug interactions physicians and pharmacists recognize that some foods and drugs, when taken simultaneously, can alter the body's ability to utilize a particular food or drug, or cause serious side effects. It is imperative for pharmacists to keep up-to-date on potential drug-food interactions of medications, especially today's new drugs, so that they may counsel properly and advise patients regarding foods or beverages to avoid when taking certain medications. This fact sheet describes common food/drug and drug/nutrient interactions. We hope this will help to see the potential for interactions to avoid them.

Keywords: Medication, Pharmacist, Prescription, Interaction, Disease.

1. INTRODUCTION

Medicines can treat and cure many health problems. However, they must be taken properly to ensure that they are safe and effective. Medications should be extremely specific in their effects, have the same predictable effect for all patients, never be affected by concomitant food or other medications, exhibit linear potency, be totally non-toxic in any dosage and require only a single dose to affect a permanent cure. However, this ideal drug is still to be discovered.[1]

Many medicines have powerful ingredients that interact with the human body in different ways. Diet and lifestyle can sometimes have a significant impact on drugs. A drug interaction is a situation in which a substance affects the activity of a drug, i.e. the effects are increased or decreased, or they produce a new effect that neither produces on its own. Typically, interactions between drugs come to mind (drug-drug interaction). However, interactions may also exist between drugs and foods (drug-food interactions), as well as drugs and herbs (drug-herb interactions).

The interactions are many which affect drug absorption and the factors associated like pharmaceutical factors and patient related factors. Pharmaceutical factors includes chemical factors, physicochemical properties of drug substances like drug solubility & dissolution rate, particles size & effective surface area, polymorphism & amorphism, solvates & hydrate, salt form of drug, ionization state, drug pka, lipophilicity & GI pH along with formulation factors like disintegration time, manufacturing variables like method of granulation and compression force, nature & type of dosage form, pharmaceutical ingredients, product age & storage conditions.

Patient related factors include physiological factors like membrane physiology involving nature of cell membrane and transport processes, gastrointestinal motility involving gastric emptying rate, intestinal motility, drug stability in GIT, pH of GIT, surface area of GIT.

These may occur out of accidental misuse or due to lack of knowledge about the active ingredients involved in the relevant substances. Interactions between food and drugs may inadvertently reduce or increase the drug effect. Some commonly used herbs, fruits as well as alcohol may cause failure of the therapy up a point of to serious alterations of the patient's health. The majority of clinically relevant food-drug interactions are caused by food induced changes in the bioavailability of the drug.[2]

Risk for food/drug and drug/nutrient interactions can be affected by many factors such as age, gender, medical history, body composition, nutritional status and a number of medications used.[3]

The most important interactions are those associated with a high risk of treatment failure arising from a significantly reduced bioavailability in the fed state. Such interactions are frequently caused by chelation with components in food. In addition, the physiological response to food intake, in particular, gastric acid secretion, may reduce or increase the bioavailability of certain drugs.[4]

The study of drug-drug, food-drug, and herb-drug interactions and of genetic factors affecting pharmacokinetics and pharmacodynamics is expected to improve drug safety and will enable individualized drug therapy. Drugs can show their efficacy only if administered in appropriate quantity with appropriate combination of drugs and foods and at appropriate time.[2]

2. FACTORS AFFECTING THE EXTENT OF INTERACTION BETWEEN FOODS AND DRUGS

The impact of drug-food interactions depend on a variety of intervening factors like dosage of the drug, person's age, size and state of health. Apart from these, the time foods and the medications are taken also play an important role. Avoidance of drug interactions does not necessarily mean avoiding drugs or foods.[5]

3. DRUG FOOD INTERACTION

A food drug interaction occurs when the effect of drug is altered by the presence of food in the body. Sometimes when medications are taken with food or meals, they can have less of an effect than if they were taken on an empty stomach. Additionally, vitamin and herbal supplements taken with prescribed medication can result in side effects.

Some examples of how foods and medications can interact include:

1. Food can speed up or slow down the action of a drug.
2. Some medications may cause vitamins and minerals to not work properly in the body.
3. Stimulation or suppression of the appetite.
4. Medications may alter how nutrients are used in the body.
5. Herbs may interact with many medicines.[6]

However on extensive literature survey, it is found out that the effect of drug food interaction does not significantly affect distribution of food.[7]

Drug food interactions can happen with both prescription and over-the-counter medicines, including antacids, vitamins and iron pills. Foods containing active substances that interact against certain medications can produce unexpected or adverse effects. Nutrients include food, beverages and dietary supplements. Consumption of these substances may alter the effects of drugs the patient takes. The presence of food in the digestive tract may reduce absorption of a drug. Often, such interactions can be avoided by taking the drug one hour before or two hours after eating. Alcohol is a drug that interacts with almost every medication, especially antidepressants and other drugs that affect the brain and nervous system. For example, taking alcohol with metronidazole can cause flushing, headache, palpitations, nausea and vomiting.[4]

Consequences of drug-food interactions may include delayed, decreased or enhanced absorption of the drug by altering gastric pH, secretion, gastrointestinal motility and transit time. Along with that the metabolism and excretion of certain drug is also affected by altering the urinary pH. Therefore, the half-life of acidic drugs will be extended in acidic urine because the drug is in its unionized form.[13] 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.[5]

4. POTENTIAL MECHANISMS OF FOOD EFFECTS ON BIOAVAILABILITY

Food effect bioavailabiity studies are usually conducted for new drugs and drug products during the Investigation new drug period to assess the effects of food on the rate and extent of

absorption of a drug when the drug product is administered shortly after a meal (fed conditions), as compared to administration under fasting conditions.

Food can change the bioavailabiity of a drug and food effects on bioavailabiity can have clinically significant consequences. Food can alter bioavailabiity by various means, including

1. Delay gastric emptying
2. Stimulate bile flow
3. Change gastrointestinal (GI) pH
4. Increase splanchnic blood flow
5. Change luminal metabolism of a drug substance
6. Physically or chemically interact with a dosage form or a drug substance

Food effects on bioavailabiity are generally greatest when the drug product is administered shortly after a meal is ingested. The nutrient and caloric contents of the meal, the meal volume, and the meal temperature can cause physiological changes in the GI tract in a way that affects drug product transit time, luminal dissolution, drug permeability, and systemic availability. In general, meals that are high in total calories and fat content are more likely to affect the GI physiology and thereby result in a larger effect on the bioavailabiity of a drug substance or drug product.[8]

5. PHYSICAL SIGNS DUE TO ADVERSE FOOD DRUG INTERACTIONS [12]

Because older adults often take more medications than younger adults, the number of side effects increases with age. However, side effects frequently go unnoticed or are not always caught in older people for the following reasons:

1. Drug reactions sometimes act like signs or symptoms of disease (e.g., dementia).
2. Symptoms of a drug reaction are thought to be caused by an existing illness or the start of a new health problem.
3. Physical reactions to medication, such as being tired, falling, or weight loss, may be mistakenly labeled as “normal” aging.

There are many physical signs that can happen due to the food drug interaction effect. These include:

- fatigue (being tired)
- constipation or diarrhea
- incontinence (not being able to control your bladder or frequent urination)
- frequent falls
- depression (feeling sad or blue)
- weakness or tremors
- excess drowsiness or dizziness
- agitation or anxiety [6]

This could be explained in a way that some medicines must be taken with or after food. Failing to do this may cause gastrointestinal upset or reduce the effectiveness of the medicine. Whereas some medicines need to be taken just before meals or they will not work. For medicines that require administration on an empty stomach in order to be absorbed properly, residents should choose times of the day that are convenient to them.

Once daily medicines are best taken before breakfast, but other good times include mid-morning, mid-afternoon and last thing at night.

5.1 Medicines taken with or after food[9]

There are six main reasons why medicines may need to be taken with or after food:
Medicines may cause nausea or vomiting
Irritant medicines
Medicines to treat conditions in the mouth and/or throat
Medicines that are better absorbed with food
Antidiabetic medicines
Antacids in patients with meal-time symptoms

5.2 Medicines that may cause nausea or vomiting[9]

These should preferably be taken after a meal to minimise this side effect. Examples include allopurinol, bromocriptine, co-beneldopa (Madopar®).

5.3 Irritant medicines[9]

These may cause gastrointestinal disturbances such as indigestion, inflammation or ulcers. Although it is preferable to take these medicines with a meal, some biscuits, a sandwich or a glass of milk is usually sufficient. Examples include Aspirin, Non-Steroidal Anti-Inflammatory Drugs (e.g. diclofenac, ibuprofen etc), steroids (e.g. prednisolone, hydrocortisone and dexamethasone).

5.4 Medicines to treat conditions in the mouth and/or throat[9]

Mouthwashes, preparations for oral thrush (e.g. liquid nystatin, miconazole gel) and treatments for mouth ulcers must be

used after meals. If given before a meal the process of eating food washes the medicine away too quickly and the medicine may not work.

5.5 Medicines that are better absorbed with food[9]

Some medicines need food in the stomach to be absorbed into the bloodstream. Examples of these include the HIV medicines ritonavir, saquinavir and nelfinavir.

5.6 Antidiabetic medicines[9]

Medicines for diabetes are usually taken around meal times. This helps to reduce the high blood glucose levels which can occur after meals (hyperglycaemia) and avoids the subsequent very low blood glucose levels (hypoglycaemia). Some are taken before meals, some with meals and some afterwards.

5.7 Antacids in patients with meal-time symptoms[9]

Indigestion or heartburn at mealtimes is caused by the stomach producing too much acid when food enters the stomach. Taking antacids immediately after, or in the middle of a meal may relieve these symptoms.

5.8 Medicines taken on an empty stomach[9]

Most of the medicines that must be taken on an empty stomach are not absorbed into the bloodstream very well if there is food in the stomach. Some common examples include flucloxacillin, phenoxymethylpenicillin (penicillin V), Oxytetracycline. These medicines should be taken an hour before food. This will allow them to be absorbed before any food arrives.
Some medicines which actually operate in the gut itself will not work if they are taken after food. Sucralfate, for example, 'coats' ulcers to heal them. It must be taken at least an hour before eating or it simply coats food instead and the treatment does not work.
Mebeverine is used to reduce bowel spasm at meal times. It should be taken 20 minutes before meals, to enable it to start working before food arrives.

Similarly, sodium cromoglicate capsules are taken before meals to minimise the effects of certain types of food allergy. For medicines that require administration on an empty stomach in order to be absorbed properly, residents should choose times of the day that are convenient to them.[9]

6. CONCLUSION

A large number of drugs are introduced day by day. Diet and lifestyle have a significant impact on a drug's ability to work in the body. Food drug interaction imparts a major role in pharmacological science of drug. However it is a difficult and complex problem to accurately determine the effect of food and nutrients on a particular drug, as in the above discussions it is well shown how the presence of food either abolishes or promotes the absorption and effect of drug.

Interaction with food has varied clinical effects on drug therapy. In some cases it has beneficial effects and in some diminishing property. In contrast to the easy access to information on drug-drug interactions, the information about food-drug interaction is not always available conveniently.

These interactions can be avoided by following doctor's instructions carefully to obtain the maximum benefit with the least risk. This requires due care of awareness to the patient regarding such information through the doctor or pharmacist or even through the packaged lables and leaflets covering all aspects of drug information and interactions. Community pharmacist plays a responsible role. This article aims to help the healthcare professionals specially physicians and pharmacists so that they may counsel properly to the patients.

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Table 1: Drug Food Interactions

DRUG	INTERACTION	USE	WHAT TO DO
Acetaminophen[5]	High pectin foods act as adsorbent and protectant.	Analgesic	Take on empty stomach if not contraindicated.
Digoxin[5]	High–fiber, high–pectin foods bind drug	Cardiac failure	Take drug same time with relation to food, Avoid taking with high-fiber foods.
Glipizide[5]	Mechanism unknown.	Antidiabetic	Affects blood glucose; more potent when taken half an hour before meals.
Isoniazide[5]	Food raises gastric pH Preventing dissolution and absorption.		Take on empty stomach if tolerated
Levodopa[5]	Drug competes with amino acids for absorption transport.	Antiparkinsons	Avoid taking drug with high–protein foods.
Quinidine[5]	Possibly protein binding.		May take with food to prevent gastrointestinal upset
Tetracyclines[5]	Binds with calcium ions or iron salts forming insoluble chelates. Dairy products; iron supplements [3]	Antibiotic	Take one hr before or two hr after meals; do not take with milk.
penicillin[5]	Food	Decreases drug absorption	Take on an empty stomach to speed absorption of the drugs. Or after 2 hr after meals[3]
ACE inhibitors[5]	Food	Antihypertensive	Take on an empty stomach to improve the absorption of the drugs.
Alpha blockers [5]		Heart medication	Take with liquid or food to avoid excessive drop in blood pressure.
Beta blockers[5]	food, especially meat	Antihypertensive	Take on an empty stomach; food can cause dizziness and low blood pressure
Ibuprofen(Motrin) [3] Naproxen(naprosyn) [3]	Food or milk Alchohol	Food Decreases GI Irritation Liver risk & stomach damage due to alcohol	Take with food Avoid alcohol
Sironolactone diuretic[3]	Food	Food Decreases GI Irritation	Take with food
Propranolol [5]	Food	Food may reduce first-pass extraction and metabolism	Take with food