PHARMACOLOGY FOR NURSING

Second Stage
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Lecturer: Ammar Khalid

Reference (Text Book)

Lehne , Richard A., Pharmacology for Nursing Care . 10th edition . 2019.

PHARMACOLOGY

- **“Pharmacology”,** this term is derived from two Greek words: *pharmakon*, the Greek word for “drugs or medicine and *logos* , the Greek word for “study or science”. Thus, pharmacology is most simply defined as **“ the Science of Drugs”**

- **Pharmacology** is a science that study properties of drugs and their effects on living organisms” by increase or suppress the body processes (i.e; alter functions of living organisms).

- Drug properties include physiochemical properties, sources, methods of administration, absorption, distribution, biotransformation, excretion, mechanism of action and clinical uses . While effects refer to both therapeutic and harmful effects associated with the use of drug .

- **Clinical Pharmacology**: Is a branch of pharmacology that study the drugs in human body (patients or healthy volunteers), thus concern with all aspects of the interaction between drugs and living system (i.e ; the drug’s effects on the body, and the body’s response to the drug).

- **Therapeutics (pharmacotherapeutics)**
- It concerns with clinical or medical applications of drugs, and the principles of drug actions, rational selection of particular drug to particular patient, dose, route & regimen to provide optimal drug related patient care.

- **therapeutics provide knowledge to understand the following:**
  - How drugs produce their therapeutic and adverse effects,
  - Why a particular drug given to a particular patient,
  - The rationale underlying selection of *dosage, route, and schedule of administration*, for providing drug-related patien care and education.
- So the knowledge of therapeutics, enhance nurses to ***Understand the strategies for promoting the beneficial drug effects and to minimizing the undesired effects.***

- **Chemotherapy:** A branch of pharmacology dealing with drug that selectively inhibit or arrest growth of invading cells as (bacteria, fungi , parasites, invading viruses) or cancer cells.

- **Toxicology:** Is the science that study the ***undesirable toxic effects of chemicals*** (drugs or toxicants) on the biological systems. [Detect, prevent and treat] cases of poisoning For drugs both beneficial and harmful effected by the amount of drug administered (DOSE)
- **Dose:** The quantity of drug which administered each time to give a desired effect.

- **Drug :** Chemical substance of known *source and structure* that medically used to *alter* (i.e increase or Reduce) biochemical or physiological process.
- In general, drugs can be dispensed without prescription as Over the counter medications (OTC)] or prescription only medications *(POM), which must be dispensed to consumers possessing a valid prescription.*

Over The Counter (OTC) :

- Indicates all products that sold *directly to a consumer without a prescription* as drugs, nutrients, dilatory supplement, herbal preparations, ...etc.

- The OTC drugs account for 60% of all given drugs, used for self treatment of mild conditions, as mild pain, motion sickness, allergies, colds, constipation, and heartburn,...etc.

- The OTC medications must be determined by the FDA, and must be clearly labeled for each of active ingredients , uses, warnings, directions, and inactive ingredients to help in selection of drugs with most benefit and least risk. Some drugs that were originally sold only by prescription are now sold over the counter and vas versa.

Therapeutic Applications of drugs:

The use or application of the drugs include;

1- ***Treatment of disease***: treat signs, symptoms, and disease processes.

-To cure disease: that eliminates the disease, and the drug is withdrawn, e.g. as in bacterial and parasitic infection.

- Suppression of symptoms to avoid the effects of disease without attaining cure e.g. control symptoms as pain, cough,...etc.

2- Diagnosis of the disease (investigation)

3- ***Prevention of pregnancy as prophylaxis***

4- ***Control the disease***

SOURCES OF DRUGS:

Natural drugs, Semi-synthetic drugs and Synthetic drugs

1-Natural drugs:

a- Plants: e.g; -Alkaloids as (*Atropine, Morphine, pilocarpine……etc.)*

-Glycoside as *Digoxin* .

b- Animals or Humans: e.g; *(Insulin, Vaccines , Heparin…etc).*

c- Inorganic substances (minerals) ; the minerals or their salts are used to cure many diseases ; e.g., Al, Ca, Fe, … , and Mineral Oils ; as liquid paraffin is used as purgative.

d- Microorganism ; e.g antibiotics taken from microorganisms to treat infections caused by other microorganisms.

2- Semi-synthetic drugs: They have modified molecular structure of naturally occurring substances to make the drug more effective. (e.g., many antibiotics –penicillin substrates, and first-, second-, third-, and fourth generation e.g; cephalosporins, *Benztropine, ampicillin* , …etc.

3-Synthetic drugs : These are drugs which are completely synthesized in the laboratories as *Aspirin paracetamol, sulfonamides*…….etc.

or **Genetically engineered drugs** – e.g., Human insulin, human growth hormone; a process of altering DNA, usually of bacteria, to produce a chemical to be used as a drug

DRUG NAMES

Throughout the process of its development, a drug will acquire at least three different names; **Chemical name, Generic name, and Brand name.**

1- Chemical name:

It is constituting a description of a drug's chemical composition and molecular structure, which can be long and complex. Because of their complexity, chemical names are inappropriate for everyday use e.g.; chemical term (N-*acetyl-para-aminophenol*).

2- Generic name:

Each drug has only one generic name, which also known as the ***nonproprietary*** name. Generic names are much shorter and less complex than chemical names. It is approved by the ***Medical or Pharmaceutical Associations*** *in the* ***original country*** of manufacture and is adopted by all countries. In many cases, the final syllables of the generic name indicate a drug's pharmacologic class. For example, the syllables –***cillin*** refers to penicillin class of antibiotics e.g; *cloxacillin.* Similarly, the syllables –***statin*** used for effective class of drugs for lowering cholesterol e.g; *Simvastatin* . The antiviral drug name ends with –***vir*** suffix e.g; *acyclovir.*

3- Brand name:

Brand names, also known as ***trade*** names, are the names under which a drug is marketed. These names are created by the (patent owner) drug ***companies*** with the intention that they be easy for nurses, physicians, pharmacists, and consumers to recall and pronounce. A single drug may have a large number of brand names, because it can be marketed in *different formulations* and by ***multiple companies***. Therefore, brand names must be approved by the FDA to ensure that no two brand names are too similar.

Examples of different drug names

Chemical name	Generic name	Brand name
N-acetyl-p-aminophenol	Paracetamol, acetaminophen	Paracetol
2- acetoxybenzoic acid	Acetyl salicylic acid	Aspirin
(RS)-2-(4-(2-methylpropyl) phenyl) propionic acid	Ibuprofen	Brufen

- **Which Name to Use?**

  When large numbers of drug names are unfamiliar or common with many brand names, it creates the *potential for confusion*. For this reason, many professionals advocate for *the universal use of **generic names***.

- **Classifications of Drugs** **:** Drugs are classified according to:

1- **Effects on particular body systems**. E.g.,. drugs affect CVS , GIT , CNS,…
2-Therapeutic uses; where drugs assigned according to their therapeutic usefulness in treating particular diseases . E.g., *antidepressants, antihypertensives, anticoagulant, antihyperlipidemics, antidysrhythmias, antianginal, and Antiemetic*.
3- **Mechanism of action;** e.g., Calcium channel blockers, vasodilators , and Diuretics.

PROTOTYPE DRUG:

- Its a well-understood drug model with which other drugs in its representative class are compared.
- When classifying drugs, it is common practice to select a single drug from a class and compare all other drugs with this representative drug. Examples:

-Atropine ; prototype of anticholinergic drugs ,

-Morphine ; prototype of opioid analgesics;

-Aspirin ; prototype of NSAIDs.

By learning the characteristics of the prototype drug, you well predict the actions and adverse effects of other drugs in the same class.

PROPERTIES OF AN IDEAL DRUG

The newly developing drug want to be the best drug as possible in its safety and effectiveness, and being close to that of ideal drug (In reality, *there is no perfect drug*), Which have the following properties:

- **Effectiveness:**

The effective drug is one that elicits the responses for which it is given. If a drug is doesn't do what it is intended to do, there is no justification for giving it. Current U.S. law requires that *all new drugs be proved* effective prior to release for marketing.

- **Safety:**

As most drugs have the ability to cause injury when given in high doses and for long time, so safe drugs must not have such criteria and not produce harmful effects. e.g; some *anticancer drugs* (e.g. *cyclophosphamide, methotrexate*), at usual therapeutic doses, always associated with risk of serious infection. *Opioid analgesics* (e.g., *morphine, meperidine*), at high therapeutic doses, can cause potentially fatal respiratory depression. While Aspirin and other related drugs can cause life-threatening gastric ulceration, perforation, and bleeding of GIT.

- **Selectivity**:

The selective drug is that produces ***only the response for which it is given.*** However, the selectivity *is a relative parameter can be lost with high doses and almost drugs cause side effects.* e.g; 1st generation antihistaminic cause drowsiness; while second generation drugs are more selective to peripheral sites. **Atropine** as anti cholinergic drug has non selective action with many side effects as urinary retention, CNS effect , tachycardia, blurred vision. While **Ipratropium, tolterodine** are more selective atropine substitutes.

- **Reversible action:**

In most cases, the drug actions need to be subsides within an certain time. e.g; *General anesthetics*, if its irreversible the patients never woke up, oral contraceptives would find wide acceptance if they caused permanent sterility.

- **Predictability:**

Before drug administration, it's usually helpful to predict the response of patient to given medication. But unfortunately, because each patient is unique, the accuracy of predictions cannot be guaranteed. Accordingly, individualization of drug therapy is advised to maximize the chances of eliciting desired responses.

- **Ease of Administration:**

The ideal drug should be *administered easily* through *convenient route* should with *low number of daily doses*. e.g; Insulin is ***not considering as ideal drug*** when need to be ***injected for multiple times*** a day. Similarly, drugs given by ***multiple IV injections*** *not consider ideal specially for nurses* who must set up and monitor the administration of drug.

- **Have no drug Interactions:**

When a patient is taking two or more drugs, those drugs can interact. These interactions may either ***increase or reduce*** **drug responses**. e.g.; *Respiratory depression* caused by *diazepam [Valium]*, can be *intensify* when taken with alcohol. While the *antibacterial effects* of *tetracycline reduced* by taking the drug with *iron or calcium supplements*. The ideal drug would *not interact with other agents*. Unfortunately, ***few medicines are devoid of significant interactions***

- **Low Cost:**

The cost of drugs can be an important economic load, especially when a medication need to be taken chronically. Like for people with hypertension, arthritis, or diabetes may take medications every day for life.

- **<u>Chemical Stability:</u>**

The effectiveness of drugs may reduce during storage, or when being in solution due to chemical instability.

The ideal drug would keep its activity indefinitely. **But No Drug Is Ideal**

- All drugs have the potential to produce *side effects*.
- Drug responses may be *difficult to predict* .
- Drug effect may altered by *interactions*.
- Drugs may be *expensive, unstable, and hard to administer*.

Drug intensity

The magnitude of drug response relative to drug concentration available at the site of action

FACTORS THAT DETERMINE THE INTENSITY OF DRUG RESPONSES

- **Administration of drug:**

The *drug* ***dosage, route,*** **and** ***timing*** of administration are ***important determinants of drug responses*** by determining the concentration of a drug at its sites of action. Drugs are not always taken as prescribed (poor adherence), so may cause toxicity if the dosage is too high or treatment failure if the dosage is too low. Errors produced by any of medical staff in administration *routes, dosage and time* may cause *more harm than benefits*. Therefore, ***you should give patients complete instructions about their medication and how to take it.***

- **Pharmacokinetics**

The movement of drug within the body will determine how much of an administered dose gets to its sites of action. There are four major pharmacokinetic processes.

(1) drug absorption

(2) drug distribution

(3) drug metabolism

(4) drug excretion.

Collectively, these processes can be thought of as the *impact of the body on drugs.*

- **Pharmacodynamics**

It determines the nature and intensity of drug response. The initial step that lead to a response is the binding of a drug to its target site, followed by a sequence of events that finally results in a response.

- **SOURCES OF INDIVIDUAL VARIATION**

Because individuals differ from one another, ***no two patients will respond identically to the same drug regimen***. Each patient has a characteristic pattern in response to a drug.

Sources of individual variation include:

- *physiologic variables* e.g., ***age, gender , weight***
- *pathologic variables* (Health state) and functionality of major organs of drug elimination.
- *Genetic variables*; deficiency of enzymes may alter the metabolism of drugs and can predispose patients to unique drug effect.

Accordingly, to achieve the therapeutic objective, we must fit drug therapy to the individual by understanding all above factors that influence the intensity of drug response.

- The patient functional state also affects the response therefore nurses have to identify each of the following conditions prior to drug administration:

Tolerance:

A decrease of response to a particular dose of drug with repeated administration, so that you have increase the dose to get a response similar to that of initial dose.

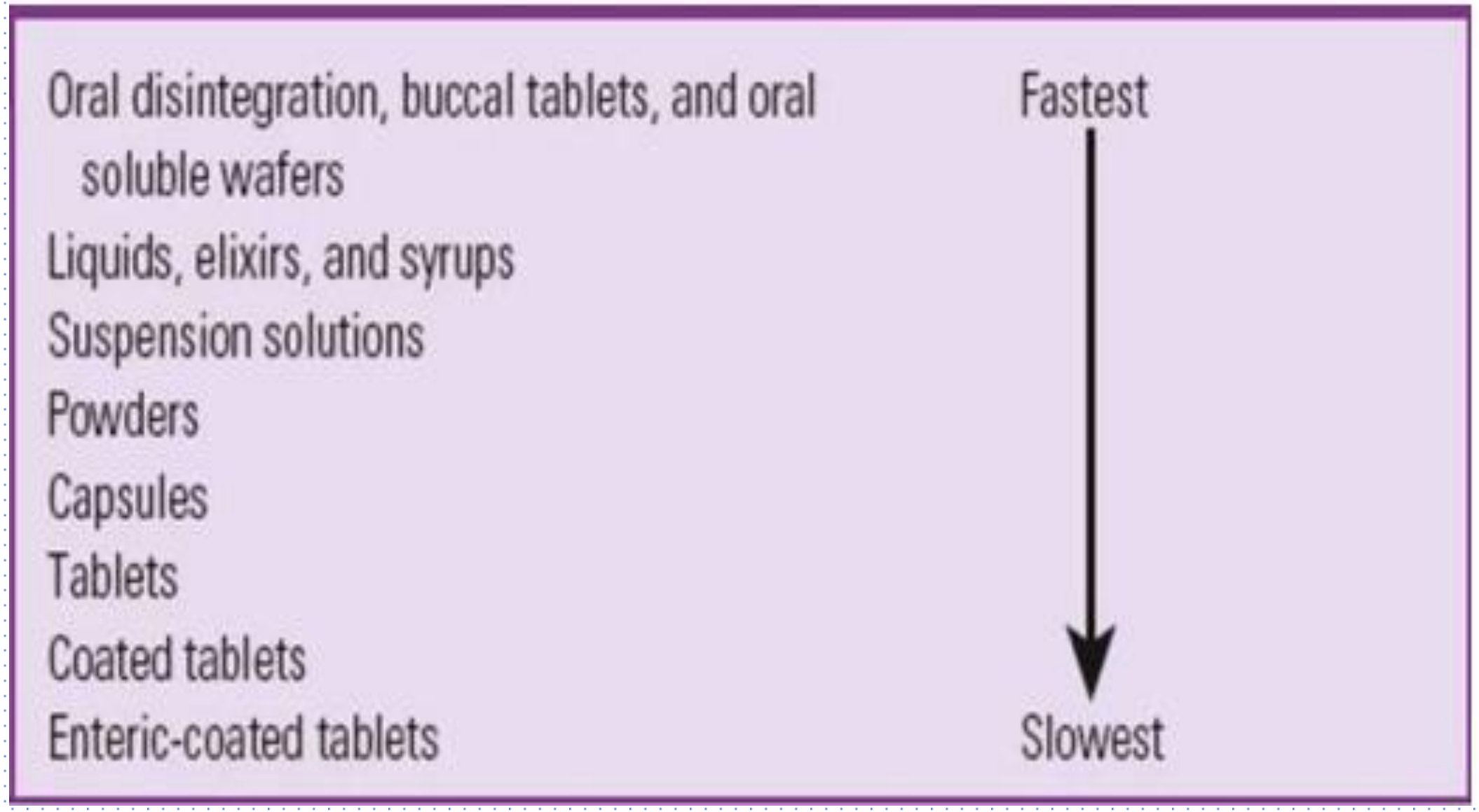
Tachyphylaxis:

Rapidly developing tolerance. The more use of drug → more need for drug to get same response.

Dependence: A physiologic or psychological need for a drug

• Drug dosage forms:

Dosage form determines → Absorption→ Rapidity of response; therefore nurses must consider the time of therapeutic response according to the onset of drug action.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