

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ
(وَفَوْقَ كُلِّ ذِي عِلْمٍ عَلِيمٌ)



Pharmacology | Lecture #

Introduction to pharmacology pt.2



Written by : **Leen Aljarah**
Leen Abukhalaf

Reviewed by : **Tuqa Al-soud**

Definitions

Drug: It is any chemical that affect living processes. It **modifies** an already existing function, and **does not create** a new function.

Definitions

Pharmacology:

Nowadays, the new technology, DNA sequencing and genes study is helping us identifying new targets for the drugs. So we have two ways in studying pharmacology, the old one and the new one.

The science of drugs.

It is the knowledge of history, source, physical and chemical properties, absorption, distribution, excretion, biotransformation, actions and therapeutic uses of drugs. (or toxic effects on microbes and cancer cells).

Conventional way

So, in the past, they discovered specific plants, like in Chinese culture, where they used the bark of the willow tree to ease the pain. Later on, scientists discovered that this bark contains salicylic acid, which eventually led to the development of aspirin.

Another classic example is penicillin, discovered by Alexander Fleming in 1928. He observed that penicillin could kill bacteria long time before its mechanism of action was fully understood.

So basically, we started by observing the drug and its physiological effect, such as easing the pain. Later on, through many studies, we discovered its mechanism of action.

The modern way

Nowadays, we know exactly what goes on in our cells. We can identify receptors and transcription factors.

The second way in drug discovery is to start with the drug target. For example, in the lab, when we studied vascular disorders (inefficient blood vessels) caused by diabetes and hypertension, we focus on a molecule called angiotensin which is related to those diseases, then we discovered the enzyme arginase (our target) in the urea cycle which affects angiotensin. First, we identified the target, which is the enzyme (arginase), and then we proceed to design inhibitors or drugs that can act on it.

What do I do next?

Since I (the pharmacologist) am not a Pharmacist, I cannot create drugs myself. Instead, we collaborate with Pharmacists . we(the pharmacologists) identify a target enzyme(arginase for example)and ask pharmacists to design an inhibitor for it. They use computational methods and modeling programs to generate many compounds. These options are then narrowed down using automated computer programs to 100 or 20.

Once the most promising options are selected, they are sent to me as a pharmacologist. I study their effects on the enzyme to see whether they successfully inhibit its activity. After this evaluation, we may end up with three to five effective inhibitors.

Next, I study these inhibitors at the cellular level, then in animal models, and finally in human studies.



A drug discovery is a collaboration between different departments like medical chemistry and computational departments

Definitions

Medical (or Clinical) Pharmacology:

Is the science that deals with the use of drugs for diagnosis, prevention and treatment of human disease.

Definitions

is the study of drugs as
chemical entities that they
have to formulate for us
(The Pharmacologists) to
study their effect on the
human body

Pharmacy:

Is that branch of the health sciences dealing with the preparation, dispensing, and proper utilization of drugs.

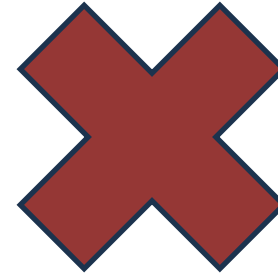
Definitions

Toxicology:

Some people consider it a part of pharmacology and others say that they are two complimentary departments.

**Is that aspect of pharmacology which deals with adverse effects of drugs and the toxic effects produced by household, environmental and industrial chemicals.
(poisons are also drugs, why?)**

Definitions



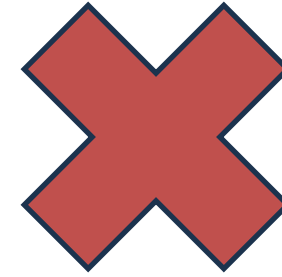
Clinical Toxicology:

Is the study of the toxic or adverse effects of toxins on the human body, including the diagnosis and treatment of human poisoning.

Analytical toxicology:

Is a branch of analytical chemistry concerned with the measurement of toxic chemicals in biological and environmental materials.

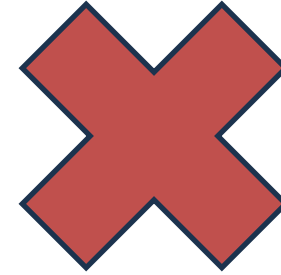
Definitions



Forensic Toxicology:

Deals with the medico-legal aspects of toxicity. It is concerned with proving the relationship of the health condition of the patient (including death) with a particular poison.

Definitions



Environmental toxicology:

- Deals with the movement of toxins into the environment and contamination of food chain.
- Industrial toxicology is a specific area of environmental toxicology that deals with the work environment which is part of industrial hygiene.

Definitions

- **Two general principles that every student should always remember:**
 1. **All substances can under certain conditions be toxic.** Explained in the next slide
 2. **All dietary supplements and all substances promoted as health-enhancing should meet the same standards of efficacy and safety as drugs.**

All substances can be toxic under certain conditions, and one of these conditions is overdose.

The threshold for overdose can vary from one patient to another.

For example, some patients may safely take two pills of a drug like paracetamol for it to be effective, while others may achieve the same effect with only one pill.

This variation occurs because each person's body responds differently to drugs due to several factors, such as gender, genetics, and age.

Terms

The guide

- **Prescription:** the written direction for the preparation and the administration of the drug.
- **The therapeutic effect:** is the primary effect intended that is the reason the drug is prescribed such as morphine sulfate is analgesia.
- **Side effect:** secondary effect of the drug is one that unintended, side effects are usually predictable and may be either harmless

Example of prescription

Scientific Name	Paracetamol
Dose	500 mg
Frequency	Twice a day
Route of Administration	Orally (PO) or Intravenously (IV)
Special Instructions	In full stomach
Prescriber's Signature	✓

The effect

We have two kinds of effects for any drug: the therapeutic effect, which is the good one, and the side effect, which can be harmful or harmless. For example, ibuprofen : its therapeutic effect is being a strong painkiller, but a side effect can be stomach irritation.

Another example is antihistamine that causes sedation(sleepiness) which is harmless side effect But sometimes, we can actually use this side effect for good, like during surgeries, to help patients rest.

The cool thing is, side effects are often predictable. Why? Because we know how the drug works—its mechanism of action—so we can anticipate the possible side effects before they even happen.

Conti.....

- **Drug toxicity:** deleterious effect of the drug on an organism or tissue, result from overdose or external use.
- **Drug interaction:** occur when administration of one drug before or after alter effect of one or both drug.

When you take two drugs at the same time some drugs affect the function of each other (there has to be an effect to call it an interaction)
After distribution of the drug it reaches the receptor where it interacts -> this is where kinetics and dynamics bridges

Conti.....

- **Drug misuse:** Is the improper use of common medications in way that lead to acute and chronic toxicity for example laxative, antacid and vitamins.

Laxative is s drug to treat constipation. Some people misuses it as they use it for weight loss by preventing minerals absorption

- **Drug abuse:** is an inappropriate intake of substance either continually or periodically.

For eg: using morphine after the patient completes their course.

Usually the word misuse means using the drug in a wrong way ,
While abuse is usually used with opioids (المخدرات)

Definitions

Pharmacotherapeutics:

Is the use of drugs in the prevention and treatment of disease (or the medical uses of drugs).

معالجة الجسم باستخدام الدواء
مثل خفض ارتفاع ضغط
الدم/مستوى السكر

Chemotherapeutics:

Is the use of drugs to stop the growth or kill microorganisms or cancer cells.



Can be a virus
or bacteria not
only cells

Definitions

Pharmacogenomics: We study an individual

The relation between the individual's genetic makeup to his/her response to specific drugs (entire genome).

For eg : If a patient has a mutation that prevents the clearance of toxins, they can't be given a highly toxic drug

Pharmacogenetics: We study the community

Interindividual variation in drug response that is due to genetic influences (specific gene). For eg: we study the percentage of people carrying a specific mutation in a specific gene

Definitions

Idiosyncratic drug response:

Unpredictable

Unusual response, infrequently observed in most patients. Usually caused by genetic differences in metabolism of drug, or by immunologic mechanisms including allergic reactions.

Definitions

Tolerance:

Is a decrease in the responsiveness to the drug with continued drug administration.

Mostly observed in opioids (that's why it's given in small controlled doses)

Tachyphylaxis:

Similar to tolerance but more rapid.

Areas of Pharmacology

Pharmacodynamics:

Is what the drug does to the body, which includes the biochemical and physiological effects of the drug, including the mechanism of action, interaction with receptors as well as the adverse effects.

Areas of Pharmacology

Pharmacokinetics:

- **Is what the body does to the drug.**
- **Deals with absorption, distribution, biotransformation and excretion of drugs:**
 1. **Absorption: Is the movement of drug molecules from the site of administration into the circulation.**

Areas of Pharmacology

- 2. Distribution:** Is the movement of drug molecules from the circulation to tissues and between different parts of the body.
- 3. Biotransformation:** Is conversion of the drug from one chemical structure into another by the action of metabolic enzymes (metabolism).
- 4. Excretion:** Is the movement of drug molecules out of the body.

Pharmacokinetics & Pharmacodynamics

Tablet
Taken orally

Dosage form

↓
Gets in the
stomach

تفكك

Disintegration



ذوبان

Dissolution

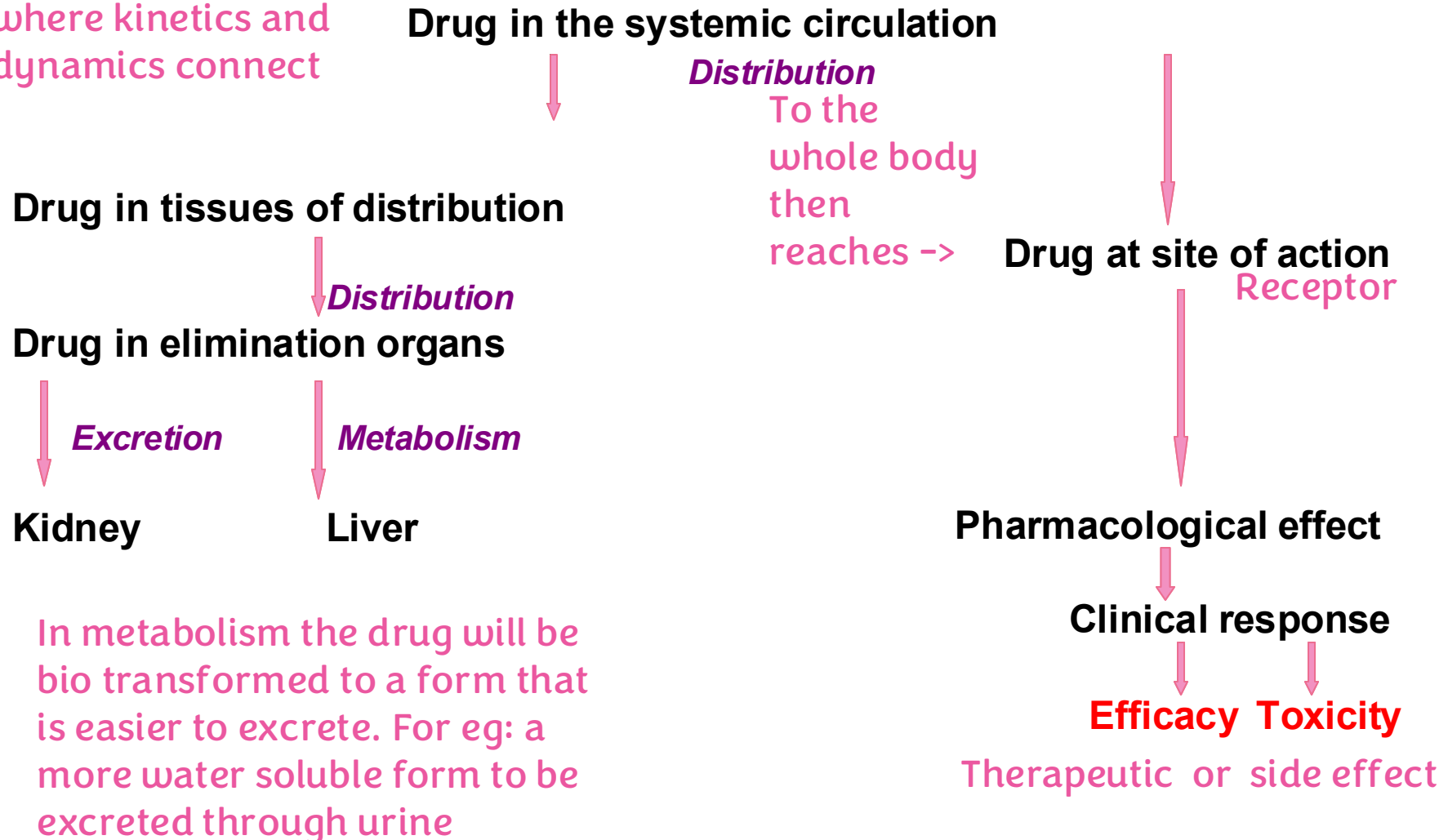
absorption

↓
In the
intestines

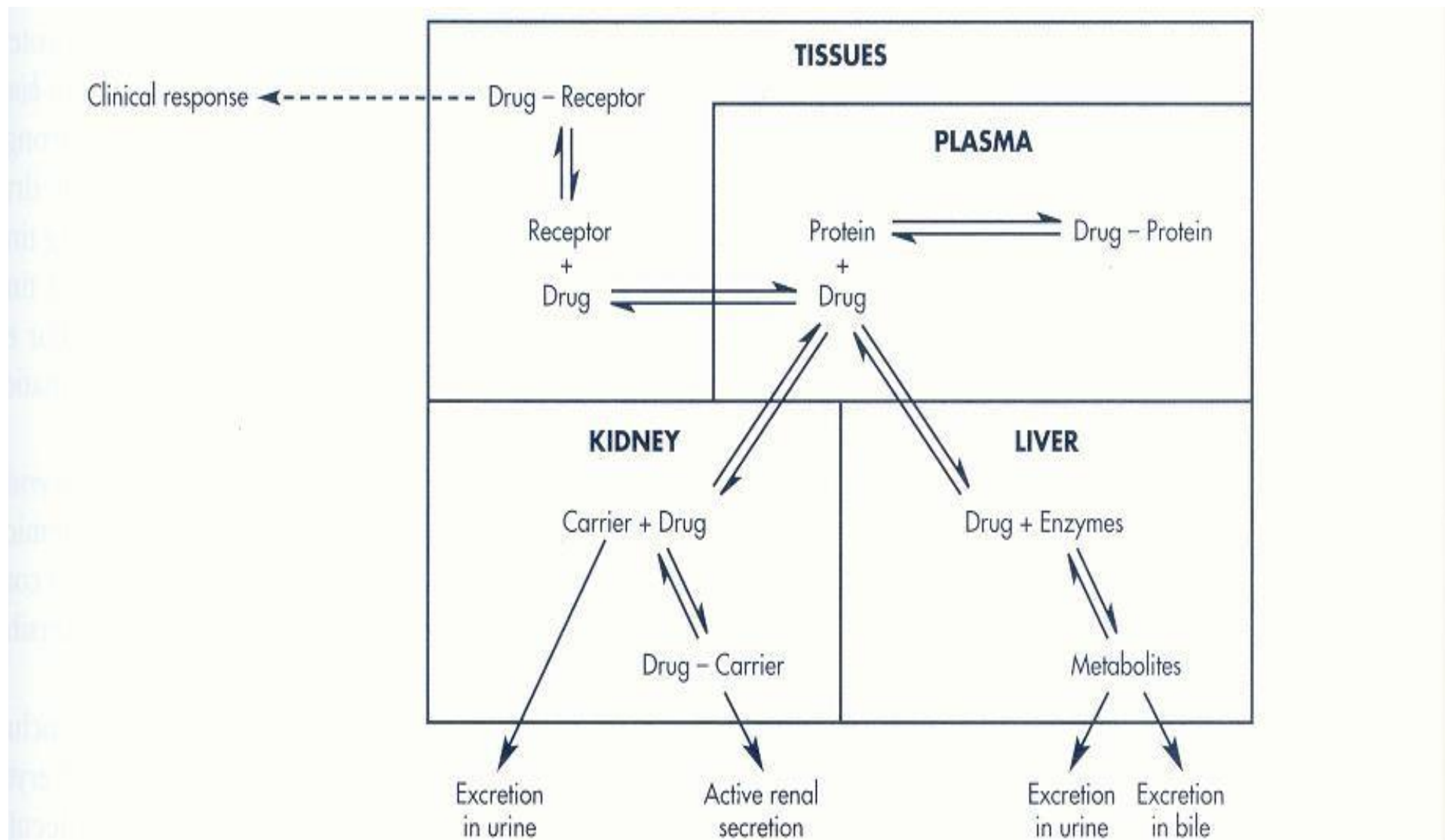
Drug in the systemic circulation

Pharmacokinetics & Pharmacodynamics

Distribution is the step where kinetics and dynamics connect



Drug Disposition



Pharmacoepidemiology

- The study of the utilization and effects of drugs in large numbers of patients.
- It applies epidemiological techniques to study drug use in a large population.
Epidemiology is the study of the factors that determine the occurrence and distribution of diseases in populations.

Drug Sources

1. Natural Sources:

For eg: Lipitor (a lipid lowering drug) is made from statins which is a plant source

- **Plants:** include alkaloids , which are substances containing nitrogen groups and give an alkaline reaction in aqueous solution. Including morphine, cocaine, atropine, and quinine.
- **Microbes:** include antibiotics which are isolated from microorganisms, such as *Penicillium* and *Streptomyces* species.
 From fungi

Drug Sources

- **Animal tissues:** The most important are hormones used for replacement therapy (Insulin, growth hormone, thyroid hormones). These days, peptide hormones may be synthesized by recombinant DNA technology.
- **Minerals:** include few useful therapeutic agents, including the lithium compounds used to treat bipolar mental illness.

For eg: iron supplements , calcium supplements

Drug Sources

2. Synthetic Drugs: Unnatural

- **Synthesized new compounds:** include aspirin, barbiturates, and local anesthetics which were among the first drugs to be synthesized in the laboratory. Aspirin is modified from salicylic acid
- **Modified naturally occurring drugs:** include Semisynthetic derivatives of naturally occurring compounds, such as the morphine derivative oxycodone.

Drug Sources

- **In some cases, new drug uses were discovered by accident when drugs were used for another purpose, or by actively screening a huge number of related molecules for a specific pharmacologic activity.**

Drug Sources

- Medicinal chemists now use **molecular modeling software** to utilize **structure-activity relationship**, which is the relationship between the drug molecule, its target receptor, and the resulting pharmacologic activity.

رسالة من الفريق العلمي:

﴿وَلَا تَيْأَسُوا مِنْ رَوْحِ اللَّهِ إِنَّهُ لَا يَيْأَسُ مِنْ رَوْحِ اللَّهِ
إِلَّا الْقَوْمُ الْكَافِرُونَ﴾

قالوا: أفضل العبادة انتظار الفرج:

أن يكون كل ما حولك يُوحى أن ليس هناك حلّ،
ولكنك مؤمن أن الأمر بيد الله!
وأن كل ما حولك مجرد أسباب تجري على الناس،
لا على الله!

لا تياسوا، لم يقلها يعقوب عليه السلام في رخاء،
قالها حين فقد بنيامين، بعد فقد يوسف عليه السلام،
فما هي إلا أيام حتى كان يشم ريح يوسف،
وما هي إلا أيام بعدها، حتى كان يضمّه إلى صدره،
ثق بالله دوماً!

For any feedback, scan the code or click on it.



Corrections from previous versions:

Versions	Slide # and Place of Error	Before Correction	After Correction
V0 → V1	Slide no: 18	Morphine causes stomach irritation	Ibuprofen causes stomach irritation
V1 → V2			