Our life is tightly associated with the use of drugs. However, do you actually know how they get removed in our body?

When we swallow a drug, the drug will start getting absorbed into our plasma and circulating blood will distribute the drug to our cells. Then, our body will slowly metabolise the drug to make it more readily excreted in the urine and finally eliminate it [1].

But in this elimination process, things can get really tricky. For example, everybody will actually have a different drug elimination rate and it can get affected by various factor such as dose, half-life etc. [1]. Also, drug has two type of elimination kinetic too [2].

**FIRST-ORDER KINETIC**

Around 95% of drugs undergo first-order elimination. The characteristic of this elimination is a constant percentage of drugs is eliminated from our body at each half-life regardless the dose [2, 3]. A half-life is the time taken for the concentration of a drug to get halved [2].

This means that the amount of drug that is eliminated is variable. For example, if your body have a really high initial drug concentration, your body eliminate high amount of drug and it gets lower after period of time. Hence, first-order kinetic has an elimination rate that is proportional to drug concentration and it is described as an exponential decay [1, 3].

Imagine you got a glass of 1L water and you are requested to drink 50% of the water each 10 minutes. Hence, you will drink 500mL water at the first 10 minutes (half-life), 250mL after 20 minutes and 125mL after 30 minutes. Hence, the volume of consumed water is actually decreasing over time.

**ZERO-ORDER KINETIC**

So the remain 5% of drugs are like rebels. They act completely opposite to the first-order kinetic. Hence, the characteristic of this mechanism is that they have a constant elimination rate regardless of the drug concentration in plasma. This is because the number of enzyme participate in drug elimination is limit. Hence, they can only eliminate equal amount of drugs [4].

Imagine you have a glass of 1L water and you drink 200mL of water each 10 minutes. That what this mechanism does.

**QUICK INFORMATION**

First-order Elimination:

It’s like you drink half portion of water each time
WHAT HAPPENS WHEN DRUG IS USED IN OVERDOSE?

Overdose happens when the enzyme in the elimination process is fully occupied by the drug molecules and the elimination rate has reached its maximum little. So, now there is a certain amount (NOT PERCENTAGE) is now being eliminated over a certain time [5].

Notice that I mentioned that 95% of drugs undergo first-order elimination above and this mechanism has a variable elimination rate depends at certain time. Hence, when the elimination rate stays constant in overdose condition. It mean first-order elimination is now behaving like zero-order elimination [5, 6].

Hence, excessive drugs will start accumulating in our body because they’re unable to get eliminated. When the concentration of drug in plasma is too high, it turnouts to be toxic to our body [6].

EXTRA INFORMATION

Optimum dose is needed to have a desired effect (yellow area). If it is too low, it doesn’t have effect. But if we are overdosed, the drug will have a toxic effect [1].

Zero-order Elimination:

It’s like you pour out equal amount of water each time

Credit: Salamatik

LOADING DOSE – LIFE-SAVING TECHNIQUE

When you have swallow an optimum dose of drug, it actually takes time for absorption and distribution before the drug concentration reaches stable therapeutic range. It usually takes like 3-4 half-lives to reach the range [7].

However every drugs has different half-life, some is short like hours, while some could be days or weeks. Hence, when there is a patient who is in life-threatening condition, a loading dose which is a higher dose compared to normal dose is administrated. What it does is it pushes the starting drug concentration to the peak drug concentration [7].

After a loading dose is used, the patient is then given normal dose to keep the drug concentration within therapeutic range. Also, if the dosing intervals is same as the drug half-life, the loading dose should be twice of the amount of the normal dose. This is because concentration will drops by half after one half-life and adding another normal dose will still push them to peak concentration [8].

Calculation of loading dose

Loading dose=$C_pV_d$, which two variables are [8]:

- $C_p$ = desired peak drug concentration
- $V_d$ = volume of drug distribution in body
REFERENCE


Image

