What is the Half-Life of a Drug?

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The elimination half-life of a drug is a pharmacokinetic parameter that is defined as the time it takes for the concentration of the drug in the plasma or the total amount in the body to be reduced by 50%. In other words, after one half-life, the concentration of the drug in the body will be half of the starting dose.

With each additional half-life, proportionally less of the drug is eliminated. However, the time required for the drug to reach half of the original concentration remains constant.

In general, the effect of the drug is considered to have a negligible therapeutic effect after 4 half-lives, that is, when only 6.25% of the original dose remains in the body.

Illustrative Example

Taking a 100 mg dose of an intravenous drug with a half-life of 15 minutes as an example, the following is true:

- 15 minutes after the drug administration, 50 mg of the drug remains in the body.
- 30 minutes after the drug administration, 25 mg of the drug remains in the body.
- 45 minutes after the drug administration, 12.5 mg of the drug remains in the body.
- 1 hour after the drug administration, 6.25 mg of the drug remains in the body.
- 2 hours after the drug administration, 0.39 mg of the drug remains in the body.

Clearance and Volume of Distribution

There are two factors that affect the elimination half-life of a drug: clearance and volume of distribution. The clearance of the drug (CL) refers to the rate

at which the body eliminates the drug from the body. The volume of distribution (Vd) refers to the distribution of the drug around the body. The relationship between these factors is as follows:

$t(½) = \ln(2)/ \lambda = \ln(2)*(Vd/CL) = 0.693*(Vd/CL)$

The elimination half-life is considered to be constant and independent of the concentration of the drug in the body.

Clinical Uses

The elimination half-life is a useful pharmacokinetic parameter as it provides an accurate indication of the length of time that the effect of the drug persists in an individual.

It can also show if accumulation of the drug is likely to occur with a multiple dosing regimen. This is helpful when it comes to deciding the appropriate dose amount and frequency.

Along with other pharmacokinetic data and values about the individual patient, the half-life can help health practitioners to estimate the rate at which a drug will be eliminated from the body, and how much will remain after a given time period. From this information, appropriate decisions to promote patient health outcomes can be made.

Related Terms

There are several other terms that are closely related to the drug half-life, including:

- Elimination rate constant (λ): the rate of drug elimination from the body as a fraction. This value is constant in first-order kinetics, and independent of drug concentration.
- Apparent half-life: in some circumstances (such as controlled release formulations), the decline in concentration of the drug is not solely dependent on elimination, but also on the rate of absorption and distribution, which influences the observed half-life.

References

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- http://sepia.unil.ch/pharmacology/?id=60
- http://pharmacologycorner.com/definition-of-half-life-of-drugs/
- http://www.annualreviews.org/doi/abs/10.1146/annurev.me.36.020185.002225?journalCode=med
- http://www.usada.org/drug-half-life/

Further Reading

- Pharmacokinetics

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