

Pharmacokinetics: Kinetics of Drug Elimination

VPT: Unit I; Lecture-17
(Dated 11.11.2020)



Dr. Nirbhay Kumar

Asstt. Professor & Head



Deptt. of Veterinary Pharmacology & Toxicology
Bihar Veterinary College, Bihar Animal Sciences University, Patna

Kinetics of Drug Elimination

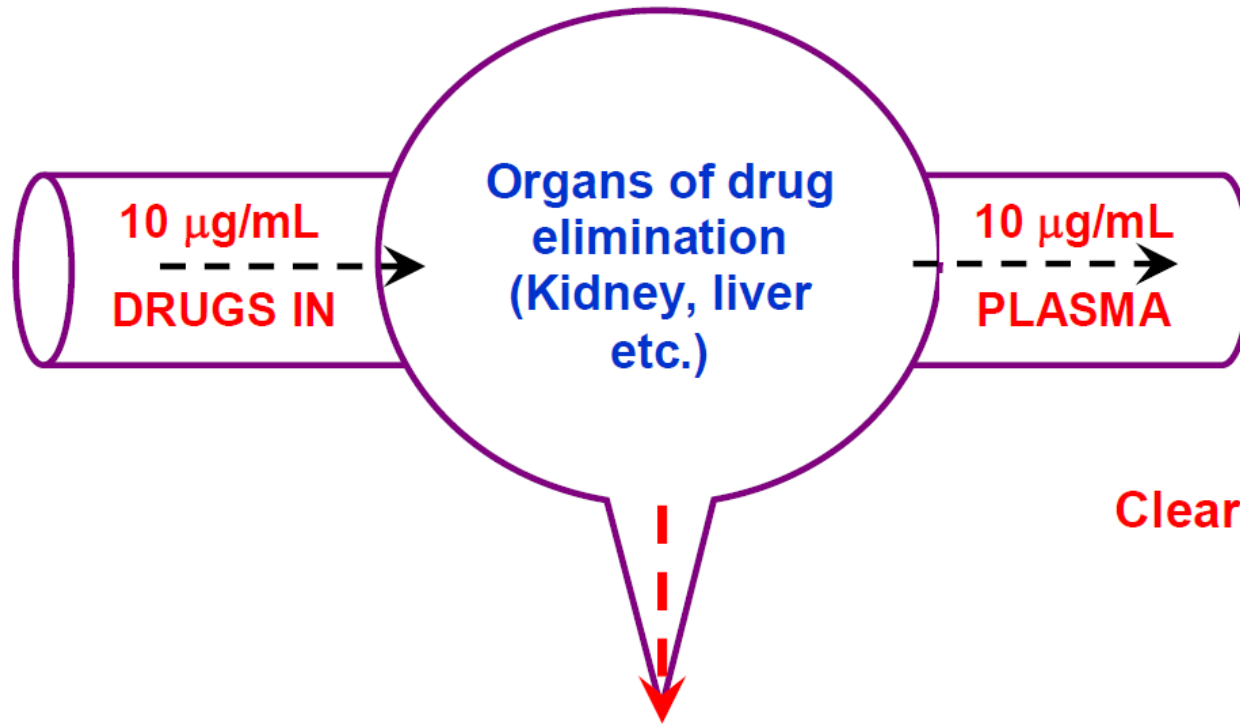
- Knowledge of kinetics of elimination helps to devise **rational dosage regimens** and to modify them according to individual needs.
- There are **three fundamental pharmacokinetic parameters** :-
 - Bioavailability (F)
 - Volume of distribution (Vd), and
 - Clearance (CL)

Kinetics of Drug Elimination contd...

Clearance (CL):

It is the theoretical volume of plasma from which the drug is completely removed in unit time.

$$\text{Clearance} = \frac{\text{Rate of elimination}}{\text{Plasma concentration}}$$



500 μg per min

$$\text{Clearance} = \frac{500 \mu\text{g}/\text{min}}{10 \mu\text{g}/\text{mL}}$$
$$= 50 \text{ ml}/\text{min}$$

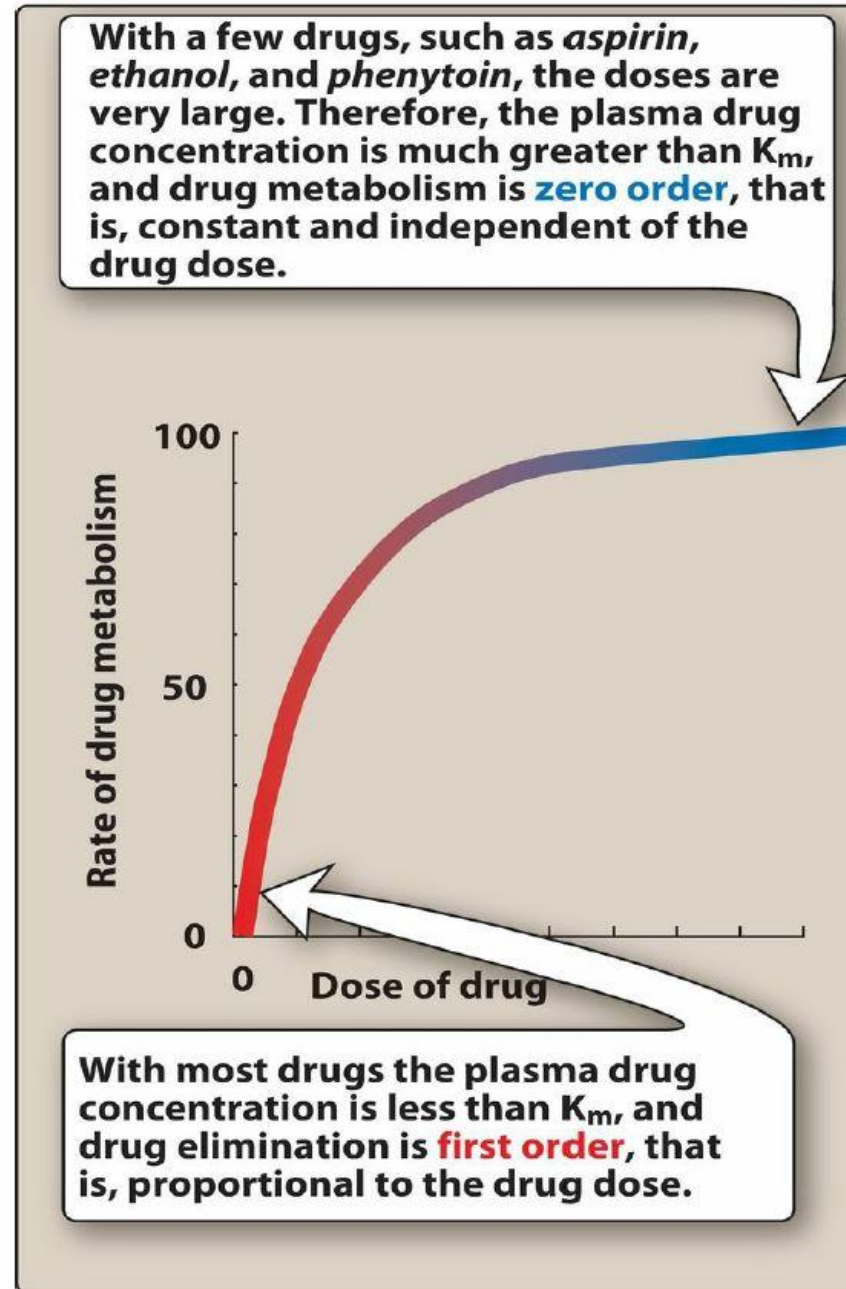
First order Kinetics:

- ✓ The rate of drug metabolism and elimination is directly proportional to the concentration of free drug.
- ✓ This means that a constant fraction of drug is metabolized per unit of time (that is, with each half-life, the concentration decreases by 50%).
- ✓ Rate of elimination is directly proportional to drug concentration.
- ✓ Clearance remains constant.
- ✓ First-order kinetics is also referred to as linear kinetics.
- ✓ Majority of drugs follow first order kinetics.

Zero order Kinetics:

- ✓ Rate of elimination remains constant irrespective of drug concentration.
- ✓ CL decreases with increase in concentration.
- ✓ A constant amount of drug is eliminated in unit time.
- ✓ Few drugs follow zero order kinetics. e.g. Ethyl alcohol.

Figure: Effect of drug dose on the rate of metabolism.



Plasma Half Life ($t_{\frac{1}{2}}$):

✓ The plasma half life of a drug is the time taken for its plasma concentration to be reduced to half of its original value.

$$✓ t_{\frac{1}{2}} = \frac{\ln 2}{k} = \frac{0.693}{k},$$

where,

$$k \text{ (elimination rate constant)} = CL/Vd$$

Plasma Half Life ($t_{\frac{1}{2}}$):

contd...

No. of $t_{\frac{1}{2}}$	% of Drug Remaining	% of Drug Eliminated
1	50	50
2	75	25
3	87.50	12.50
4	93.75	6.25
5	96.88	3.12
6	98.44	1.56
7	99.22	0.78
8	99.61	0.39
9	99.80	0.20
10	99.90	0.10

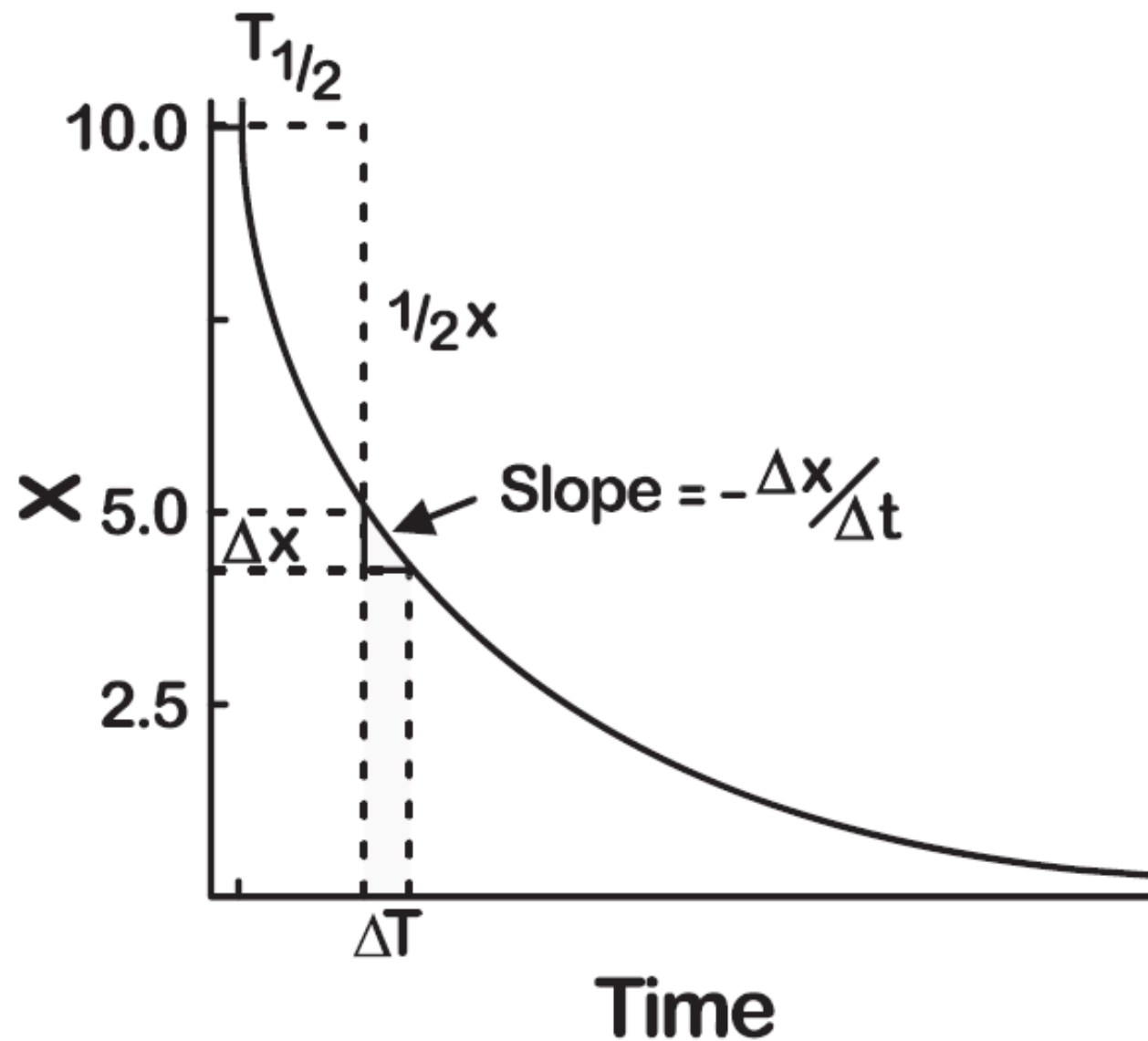


Figure: Plot of the decay in drug (X) versus time.

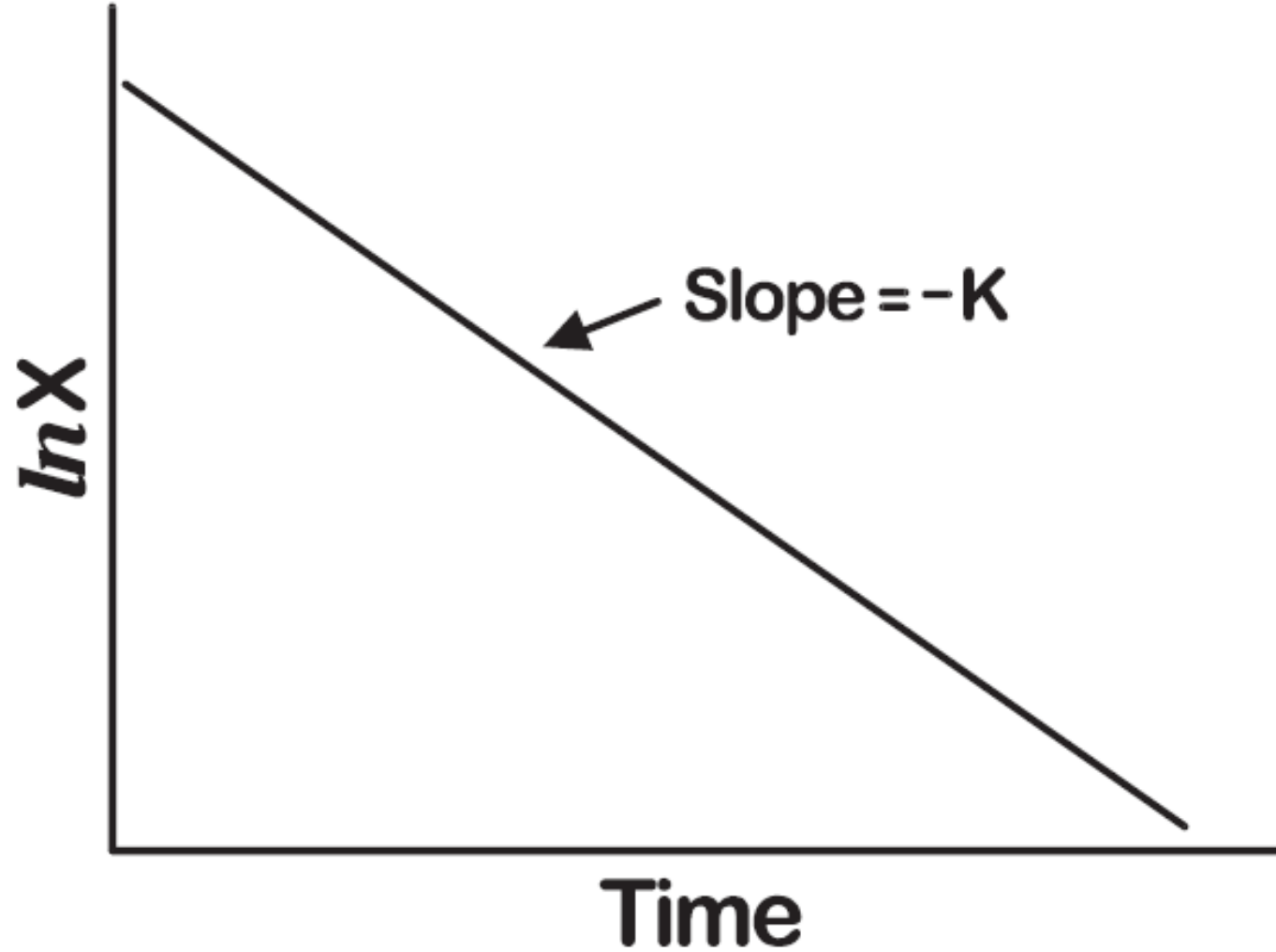


Figure: Semilogarithmic Plot of drug (X) decay versus time with slope equal to -K.

Plasma Half Life ($t_{1/2}$):

- ✓ First order kinetics: $t_{1/2}$ remains constant.
- ✓ Zero order kinetics: $t_{1/2}$ increases with dose.

Thank You

