32. Mean Residence Time (MRT)

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Today we will discuss a lesser-known pharmacokinetic parameter, one that is not a primary parameter and therefore is not addressed in most pharmacology textbooks. Because of this, it could easily be confused with another important parameter, which prompted us to prepare this entry. In fact, Mean Residence Time (MRT) is a pharmacokinetic parameter that should not be confused with the pharmacodynamic parameter *Residence Time* (of the drug-receptor complex, τ), which has been discussed in detail in another glossary entry.

Mean Residence Time (MRT) corresponds to the average amount of time a drug molecule remains in the body, expressed in units of time. It is usually calculated for the unchanged drug measured in plasma. Thus, an MRT of 5 hours means that, on average, each drug molecule remains unchanged in the body for 5 hours before being eliminated. MRT is commonly calculated from concentration-time curve data after an intravenous bolus administration, using the formula:

$$\mathbf{MRT = AUMC / AUC}$$

Where:

- **MRT** = Mean Residence Time
- **AUMC** = Area Under the First Moment Curve (integral of $t \times C(t)$ over time)
- **AUC** = Area Under the Concentration-Time Curve

MRT depends on distribution and elimination processes and is an important measure to evaluate how long a drug remains in the body, being especially useful in non-compartmental analysis.

Whereas the half-life ($t_{½}$) is associated with the decay of concentration in a specific compartment (for example, plasma), MRT represents the average time that molecules remain in the body, taking all of them into account and weighting based on the full concentration-time profile, independent of any single compartment.

In practice, MRT can indicate changes in elimination or distribution resulting from disease or drug-drug interactions. A high MRT means that the substance remains, on average, longer in the body, which may indicate slow elimination, extensive tissue binding, or enterohepatic recirculation. Conversely, a low MRT suggests rapid elimination and/or limited tissue distribution.

In the context of drug discovery, MRT is not a frontline metric for initial screening, but it is valuable for comparing formulations, optimizing delivery systems, and understanding pharmacokinetic differences between species or routes of administration.

References

Gabrielsson J., Weiner D. *Pharmacokinetic and Pharmacodynamic Data Analysis: concepts & applications.* 3rd edition. 2000. Swedish Pharmaceutical Press, Stockholm, Sweden.

Shargel L., Andrew B.C. *Applied Biopharmaceutics & Pharmacokinetics.* 4th edition. 1999. Appleton & Lange, Stamford, Connecticut, USA.