MATHEMATICAL MODELLING IN PHARMACOKINETICS

Pogrebnyak V., Strizhachenko A.V.

The National University of Pharmacy, Kharkiv, Ukraine

A.Strizhachenko@mail.ru

Mathematical modeling is the main methodical approach in pharmacokinetics. It is the processes of absorption, distribution, metabolism and excretion of medicinal substance in the organism. According to data about the concentration of a preparation in biological tests, through certain intervals of time, the curve concentration–time is constructed. The curve mathematically described by one or another way. To summarize, the pharmacokinetics possesses are difficult mathematical apparatus that used for the solving the systems of the differential equations that also may including the nonlinear equations.

Linear chambers are the most widespread models in the clinical explorations. Recoiling to it, the organism is represented the number set of homogeneous cameras (in our report it is three most widespread in clinical trials (Fig.1): tissue – the place of injection, blood and body), that are different in the extent of medicinal substance that is penetrated into them. Moreover, preparation can pass from one camera into another. Though the pharmacokinetics of many pharmaceuticals are corresponds to characteristics of two–chamber open distribution model, sometimes, for interpretation, it is better to use more difficult models. According to characteristics of three – chambered model, the process of decrease in the serum concentration of many opioids, muscle relaxant and anesthetics are better when the preparation comes to the central camera and eliminated from it interpreted.
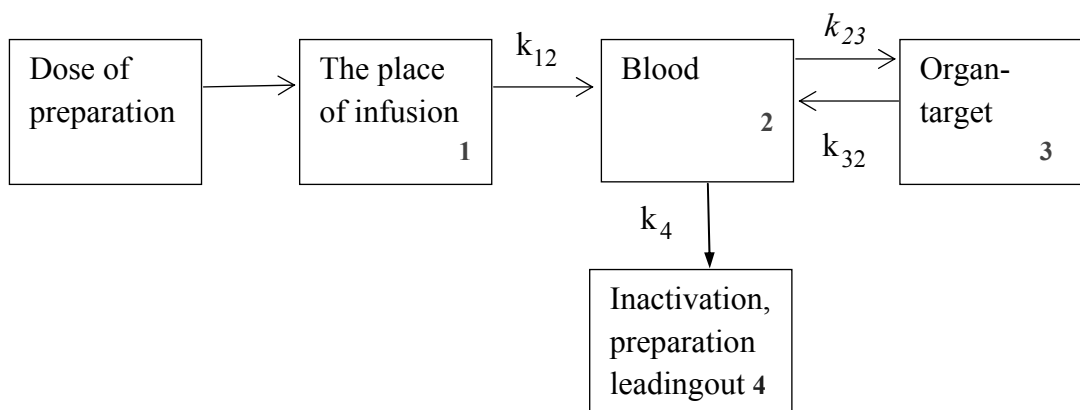

Fig.1. Three – chambered pharmacokinetic model

A double – chambered model was got in many works. The aim of this work is the three – chambered mathematical model.

The system of differential equalizations, describing the indicated process, is below given.

$$\left\{ \begin{array}{l} \dfrac{dC_1}{dt} = -k_{12}C_1 \\[2mm] \dfrac{dC_2}{dt} = k_{12}C_1 + k_{32}C_3 - (k_4 + k_{23}) \cdot C_2 \\[2mm] \dfrac{dC_3}{dt} = k_{23}C_2 - k_{32}C_3 \end{array} \right.$$

The decision of the system of differential equalizations looks like:

$$C_1 = C_0 \cdot exp(-k_{12} \cdot t);$$

where C_1 – the concentration of preparation in the chamber number 1; C_0 – initial concentration of preparation.

$$C_2 = \frac{k_{12}C_1 + k_{32}C_3}{k_{23} + k_4};$$

where C_2 – the concentration of preparation in the chamber number 2; C_3 – the concentration of preparation in the chamber number 3:

$$C_3 = C_0 \frac{k_{12}k_{23}}{k_{32}k_4 - k_{12}(k_{23} + k_4)} \cdot exp(-k_{12}t) - exp(-\frac{k_{32}k_4}{k_{23} + k_4}t).$$

CONCLUSIONS

The three – chambered model as a system of differential equalizations, describing the pharmacokinetic processes in work has been built. The analytical decision of the system of differential equalizations has been created.