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On model for estimation of integral characteristics of transport of a medicinal product in a organism

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Abstract
In this paper we introduce a model of transport of a medicinal product in a organism. The model based on estimation of integral characteristics. We introduce an analytical approach for analysis of the considered transport with account of changing of conditions. We consider a possibility to accelerate and decelerate of transport of the above medicinal product.

Keywords: Transport of a medicinal product; changing of speed of transport of a medicinal product; analytical approach for analysis

Introduction
In the present time one can find fast increasing of quantity of new medicinal products as well as intensive development of old medicinal products with questionable efficacy and safety [1-5]. Usually influence of medicinal products on organism could be done experimentally. Some time required dose of the considered products with influence on organism could be estimated. At presents several models to analyze transport of medicinal products through organism already were elaborated. In this paper we consider several models of the above transport. Based on these models we analyzed quantitatively integral characteristics of medicinal products in an organism at different regimes of their infusion regimes.

Models of regimes of infusion of medicinal products

In this section we consider several models of transport of medicinal products through organism at different regimes of their transport.

1. *Single infusion of a medicinal product*

In this case velocity p of removing of medicinal product from organism is proportional to mass m of the product, i.e.

$$p = -k\,m, \tag{1}$$

Where k is the parameter of removing of the medicinal product from organism. The parameter could be changed with time. Velocity of changing of mass of the considered product could be determine by solving of the following equation

$$\frac{d\,m}{d\,t} = p - a\,m\,m_1, \tag{2}$$

where m_1 is the mass of other substances in organism, which take a participation in chemical reaction; a is the parameter of interaction of the considered medicinal product with other substances in organism. The parameter could also be changed in time. Equation (2) with account relation (1) could be transformed to the following form

$$\frac{d\,m}{d\,t} = -k\,m - a\,m\,m_1 \tag{2a}$$

Initial condition for infused product could be written as: $m(0) = m_0$. Solution of the Eq. (2a) was obtain by standard approaches [6, 7]. Taking into account initial condition the above solution could be written as

$$m = m_0 \exp\left[-\int k(t)\,dt - \int a(t) m_1\,dt\right]. \quad (3)$$

In this situation acceleration of assimilation of the above medicinal product by organism and removing of surplus of the product it is necessary to increase both parameters *k* (*t*) and *a* (*t*).

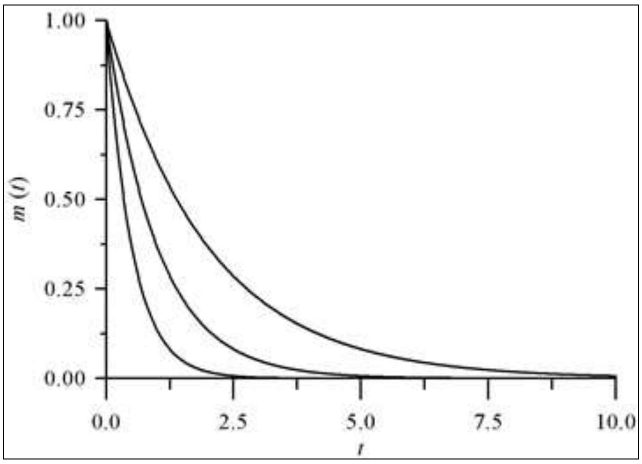

Fig 1: Typical dependences of mass of product on time at a single infusion of medicinal product

Continuous infusion of medicinal product

In this case changing of mass of medicinal product in organism depends on velocity of removing of the product and velocity of it's removing *Q*, i.e. by quantity of the product, which infusing in organism at unit of time.

$$\frac{dm}{dt} = Q(t) - k(t)m - a(t)m m_1 \quad (4)$$

Initial condition for the infused product in the considered case is: $m(0) = m_0$. Solution of the considered equation was calculated by standard approaches [6, 7] and could be presented in thee following form

$$m = \left\{\int Q(t)\cdot\exp\left[\int k(t)\,dt + \int a(t)m_1\,dt\right]dt + m_0\right\}\cdot\exp\left[-\int k(t)\,dt - \int a(t)m_1\,dt\right] \quad (5)$$

Thus to accelerate of assimilation of the above medicinal product by organism and removing of surplus of the product it is necessary to increase both parameters *k* (*t*) and *a* (*t*). Also small quantity of infused product will assimilate and remove with higher velocity in comparison with high quantity.

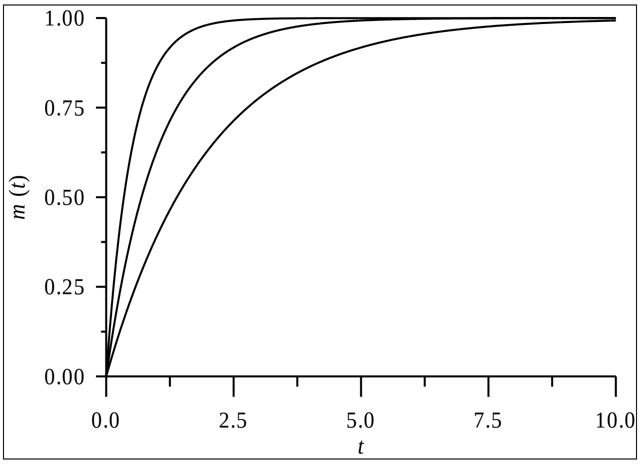

Fig 2: Typical dependences of mass of product on time at continuous infusion of medicinal product

Combined infusion medicinal product

In this section we consider combination of continuous infusion of medicinal product with additional infusion of loading dose. In this situation model to describe changing of mass of the considered product became combination of equations (2*a*) and (4). Solution of the above equation is the following function [6, 7]

$$m = \left\{\int Q(t)\cdot\exp\left[\int k(t)\,dt + \int a(t)m_1\,dt\right]dt + m_0\right\}\cdot\exp\left[-\int k(t)\,dt - \int a(t)m_1\,dt\right] \quad (6)$$

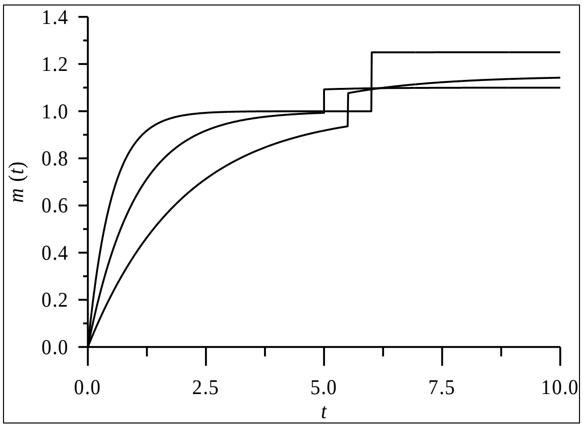

Fig 3: Typical dependences of mass of product on time at combined infusion of medicinal product

Conclusion

It has been introduced a model of transport of medicinal product in organisms. The model based on estimation of integral characteristics of mass transport. Also we consider an analytical approach for analysis of the considered transport with account changing of it's conditions. We consider the possibility to accelerate and decelerate of transport of medicinal product.

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