REALIZATION OF SIMPLE MATHEMATICAL MODEL OF INFECTIOUS DISEASE WITH THE HELP OF SPREADSHEETS

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Aspects of an organism's defense against viral and bacterial infections and the reaction of immune system to infection are the main problems in practical immunology. In addition to anti-viral and antibacterial defense, the immune system plays a decisive role in tissue incompatibility reactions, antitumor immunity, autoimmune diseases, and allergies.

Understanding of regularities in immune response provides the researchers and clinicians new powerful tools for the stimulation of the immune system in order to increase its efficiency in the struggle against antigen invasion. In this connection the development of mathematical models of immune response to an antigen irritant seems to be the only right tactics to understand these regularities.

The simple mathematical model of infectious disease was constructed on the basis of an equilibrium relation for each component that participates in an immune response. There are three main components: antigen, antibody, and plasma cell that produced antibodies. During disease the degree of damage of an organ subjected to antigen attack is of great significance, since it leads to lowering of the immune system's activity. This phenomenon must be taken into account in mathematical models.

The basic acting factors of an infectious disease are as follows: 1) concentration of pathogenic multiplying antigens, $V(t)$; 2) concentration of antibodies, $F(t)$; 3) concentration of plasma cells, $C(t)$; 4) relative characteristic of affected organ, $m(t)$. Thus, the simple mathematical model of infectious disease is represented as the following system of nonlinear differential equations:

$$\begin{cases} \dfrac{dV}{dt} = (\beta - \gamma F)V \\ \dfrac{dC}{dt} = \xi(m)\alpha V(t-\tau)F(t-\tau) - \mu_c(C - C^*) \\ \dfrac{dF}{dt} = \rho C - (\mu_f + \eta\gamma V)F \\ \dfrac{dm}{dt} = \sigma V - \mu_m m \end{cases}$$

This system of equations describes the dynamics of pathologic infection development during immune response.

Realization of simple mathematical model of infectious disease with the help of spreadsheets allows to compute the main parameters of disease and to represent graphically the different forms of disease (subclinical, chronic or acute forms).