Mathematical Model of Cancer Therapy with Condition of Multi-Phenotypes and Mutation

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We consider the problem of the choice of therapy strategy when under the influence of the chemotherapy means takes place a mutation of “main type” of cancer cells and preference passes to cancer cells with different phenotypes. For this purpose, we consider a modification of M. Eigen’s quasispecies replicator system. Namely, we introduce in this system the death rates of species. We accept the main conception of Fisher’s theorem on natural selection: “the rate of increasing (mean) fitness of any organism is equal to its genetic variance in fitness at that time” [1] and we assume that processes of Darwinian evolution can be based on the principles of this theorem [2]. The central point of this investigation is the hypothesis that the time of evolution of the fitness landscape is considerably slower than the time which describes the dynamics of the system up to stabilization in steady state [3]. In other words, we suppose that Fisher’s theorem of natural selection is valid at steady state. Then the initial problem can be reduced to the mathematical problem of searching such fitness landscapes that supply maxima for the first eigenvalue (mean steady state fitness) in the corresponding eigenvalue problem. This approach gives the possibility to understand the law of transfer of the leading role from “main type” cells to cells with different phenotypes when the “main type” is subject to regular elimination, and it gives a key for choosing a therapy strategy.

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