EVALUATION OF THE ROLE OF T-CELL RECEPTOR SELF-ORGANIZATION IN ACTIVATION

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The human immune system consists of two subsystems responsible for the recognition of pathogens by characteristic markers and adaptive selection of T-lymphocytes and antibodies specifically interacting with the pathogens identified by the first subsystem [1]. Selection of T-lymphocytes occurs as a result of interaction with short fragments of peptides (epitopes). According to existing data, a small fraction of epitopes which have a greater affinity for T-lymphocyte activates them [2].

Mechanisms of T-lymphocyte recognition of such epitopes are actively studied. The problem is of urgent relevance in connection with the fact that the experiment shows a markedly greater sensitivity and specificity than predicted by the currently available models [3]. We believe that this difference is explained by the latter not taking into account the spatio-temporal correlation of the different epitopes interactions with the T-lymphocyte. This correlation is observed *in vitro*: contact of the T-lymphocyte with the antigen leads to reversible clustering of T-lymphocyte receptors [4].

As the cluster grows, the probability of fixing new epitopes on it grows, and, consequently, the probability of its decay must fall rapidly. Our analysis allowed us to find an asymptotic expression for the probability of formation of a percolating cluster upon contact of the T-lymphocyte and the antigen presenting cell:

$$P_a = 1 - \prod_i \left(1 - e^{-\lambda_i}\right) \quad \text{, где} \tag{1}$$

$$\lambda_i = \left(1 + \delta_i\right)\alpha_i / \theta \tag{2}$$

θ is the dimensionless cluster growth rate parameter, α_i and δ_i are the dimensionless parameters of the association and dissociation rate of the T cell receptor with epitopes in the region of each cluster growth point. Apparently, the percolation probability is small while all λ_i are large, but even one contact in the region with a epitope fluctuation anomaly of epitopes with small λ_i can increase the percolation probability to 50%.

Literature

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