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Dynamics of a model of tumor-immune interaction with time delay and noise. (English)


Summary: We propose a model of tumor-immune interaction with time delay in immune reaction and noise in tumor cell reproduction. Immune response is modeled as a non-monotonic function of tumor burden, for which the tumor is immunogenic at nascent stage but starts inhibiting immune system as it grows large. Without time delay and noise, this system demonstrates bistability. The effects of response time of the immune system and uncertainty in the tumor innate proliferation rate are studied by including delay and noise in the appropriate model terms. Stability, persistence and extinction of the tumor are analyzed. We find that delay and noise can both induce the transition from low tumor burden equilibrium to high tumor equilibrium. Moreover, our result suggests that the elimination of cancer depends on the basal level of the immune system rather than on its response speed to tumor growth.

MSC:

34K60 Qualitative investigation and simulation of models involving functional-differential equations
34K25 Asymptotic theory of functional-differential equations
34K20 Stability theory of functional-differential equations
92D25 Population dynamics (general)
92C37 Cell biology
34K50 Stochastic functional-differential equations

Keywords:
time delay; stochasticity; persistence; stability; tumor-immune interaction

Full Text: DOI

References:


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