

Colloquium

A Modified Mathematical Model of Tumor Growth: a Case of Cancer without Disease

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摘 要：

In this work, a previously published mathematical model of tumor growth is modified and studied. The mathematical model exhibits bistability with two stable equilibria. One of the stable equilibria represents a microscopic tumor, which is referred to as cancer without disease. Mathematical analysis is given to estimate the range of parameter values for the existence of this steady state. The other equilibrium represents a large tumor at a size near the carrying capacity. Whether or not the immune system is able to control a microscopic tumor depends on the initial tumor size and individual variation. Numerical simulation using bifurcation analysis shows that the chemotherapy-induced damage may cause a microscopic tumor, which would never grow to become lethal if untreated, to grow to a size near the carrying capacity. Applying chemotherapy alone requires a large dosage to be successful. Numerical simulation also shows that immunotherapy is ineffective, and a combination of chemotherapy and immunotherapy produces a synergistic effect on the outcome of a treatment.