Bifurcation Analysis in a Model of the Interaction between Cervical Cancer Cells, Effector Cells, and IL-2 Compound with Immunotherapy

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We consider the bifurcation analysis of a mathematical model describing the interaction between cervical cancer cells, effector cells, and IL-2 compounds. Cervical cancer is a malignant tumor that is caused by Human Papillomavirus (HPV). Protein E6 and E7 of HPV then respectively inactivate $p53$ and pRb genes that play a role in regulating normal cell division and apoptosis. As a result, the infected cells undergo uncontrolled divisions. Whereas, the immune system in the human body is designed to detect the presence of antigens, i.e. a foreign protein in the body, and effector cells will destroy the HPV-infected cells with stimulation by IL-2. Immunotherapy is a treatment by using part of tumor tissue to enhance the immune response by in-vitro fertilization so that cervical cancer can be cured. We assume that the interaction between the three populations follow the biochemical reactions modeled with the Michaelis-Menten kinetics function. The analysis in this paper is a sequel work of Krischner [1]. In this paper we do some analytical computation to the similar system with the one in Krischner [1]. Moreover we add a perturbation term on the system which shows the fluctuation of the interaction between two type of cells, and study the dynamics and the bifurcation numerically.

References

[1] Kirschner, D., and Panetta J.C., 1998, *Journal of Mathematical Biology*, Modelling immunotherapy of the tumor-immune interaction, **37**, pp. 235-252.

[2] Dougan, M, and Dranoff, G. 2009, *Annual Review of Immunology*, Immuno therapy for Cancer, **27**, pp.83-117.