A STUDY ON MATHEMATICAL MODELLING OF TUMOR GROWTH AND TREATMENTS

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A tumor is an abnormal mass of cells that forms when the body's control mechanisms fail to regulate cell growth and division properly. Mathematical modelling is the process of representing real-world systems, phenomena, or processes using mathematical equations and concepts. We consider mathematical models of various cancer therapies. First, we propose a mathematical model for single-drug chemotherapy. Chemotherapy is one of the most common methods used to treat cancer. The drug-resistant nature of some tumor cells can be a threat to the success of the therapy. Another hurdle to the success of the treatment is the toxic effect of therapy on normal cells. For these reasons, we develop a mathematical model and derive a better treatment strategy using optimal control theory. We also provide the numerical results. Moreover, we investigate whether the use of a multiple drug chemotherapy or the use of a combination therapy can overcome the issue of drug resistance. We propose a mathematical model for multi-drug chemotherapy and design an optimal treatment strategy. The goal of the optimal control problem is to minimize the tumor size and, in the meantime, keep the number of normal cells at a healthy level by controlling the administration of the drugs with minimal toxic effects. We discuss the numerical results as well. We also provide mathematical models for combination therapies. First, we propose a mathematical model for chemoradiotherapy. We also explore the mathematical models of chemoimmunotherapy. We implement two mathematical models for chemoimmunotherapy: one is for chemotherapy with CAR T-cell therapy, and the other is for chemotherapy with TIL and IL-2 therapy. We design efficient treatment protocols for these combination therapies with the help of optimal control theory. In addition, We provide the numerical results.

References

[1] C.K. Nanditha and M. P. Rajan, An adaptive pharmacokinetic optimal control approach in chemotherapy for heterogeneous tumor, J. Biol. Syst., **30**(3), 529-551 (2022). DOI: 10.1142/S0218339022500188

[2] M. P. Rajan and C.K. Nanditha, A Multi-drug pharmacokinectic optimal control approach in cancer chemotherapy, J. Optim. Theory Appl., **195**(1), 314-333 (2022). https://doi.org/10.1007/s10957-022-02085-0