In silico modelling for the treatment of gastric cancer

Leonardo F. Martinez[1,*], Diana Gamboa[1], Paul A. Valle[1].

[1]*Postgraduate Program in Engineering Sciences, BioMath Research Group, Tecnológico Nacional de México/I.T. Tijuana, México.*

leonardo.martinez16@tectijuana.edu.mx

Abstract: Gastric cancer is a leading cause of cancer death worldwide. Most of these malignant tumors are intestinal-type gastric adenocarcinomas linked to chronic bacterial infection by the Helicobacter Pylori (H. Pylori). Long-term survival for advanced gastric cancer is low, and tumor recurrences are common after a gastrectomy. There is a significant interest in applying immunotherapies as an effective treatment to improve gastric cancer prognosis. Therefore, it is important to generate research to evaluate the treatment effect to eliminate or reduce the tumor size in the long-term. Mathematical modeling through mathematical models creation and numerical simulations could be the answer to design improved strategies for the administration of cancer treatments. In this work, we present a mathematical model of first-order Ordinary Differential Equations (ODEs), which describes some survival mechanisms of intestinal-type gastric adenocarcinoma, the influence of H. Pylori on tumor growth, and the interaction of the immune system. We explore the effects of Adoptive Cellular Immunotherapy (ACI) by incorporating a treatment parameter in the model. We study the local and global dynamics of the model and propose sufficient conditions on the treatment parameter for tumor eradication. Additionally, we perform numerical simulations to illustrate our analytical results and predictions.

Keywords: Mathematical Modelling, Gastric Adenocarcinoma, Adoptive Cellular Immunotherapy, Localizing Domain, Global Stability.