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Modeling Tumor–Microbiome Interactions in the Breast Tumor Microenvironment

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Abstract

The tumor environment is a dynamic ecosystem where tumor cells acquire nutrients and oxygen, creating conditions that complicate the disease and its management [1]. Tissue hypoxia, or the deficiency of oxygen in tissues, is a critical factor that limits the effectiveness of therapies and contributes to the aggressiveness of solid tumors [2, 3].

In this work, we highlight, through a system of nonlinear reaction-diffusion equations, the biological interaction between the evolution of a solid breast tumor, the oxygenation of tumor tissues, the progression of bacteria, and cytokine activity. This approach facilitates a deeper understanding of the tumor microenvironment and the development of innovative strategies for treating and preventing solid tumors. After introducing the model, we describe these biological parameters and present the results of the mathematical analysis obtained. Finally, we present the results of numerical simulations of these interactions in 2D, concluding with perspectives on the short term.

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