Title Mathematical Modeling of Vascular Tumors

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Abstract

Mathematical modeling of cancer is of significant interest due to its potential to aid in our understanding of the disease, including study into which factors are most important in the progression of cancer. With this knowledge different paths of treatment can be examined; first, by simulation of different treatment techniques followed by the more costly venture of testing on animal models. Significant work has been done in the field of cancer modeling with models ranging from the more broad systems, avascular tumor models, to smaller systems, models of angiogenic pathways. We have developed a preliminary model of a vascularized tumor; the model is based on fundamental principles of mechanics and will serve as the framework for a more detailed model in the future. The current model is a system of nonlinear partial differential equations (PDEs) separated into two basic sections, avascular portion and the angiogenesis. The avascular portion of the model is primarily based of Fickian diffusion of nutrients into the tumor, with this information the developing regions (proliferative, hypoxic, and necrotic) can be found. The angiogenesis portion is based on the diffusion and chemotaxis of active sprout tips into the tumor, as well as the release of AGF (Angiogenic Growth Factor) by hypoxic cells. These two portions of the models allow the effects of microvessels on nutrient concentration within the tumor, as well as the effect of the tumor in driving angiogenesis (through the release of AGF) to be examined. Our preliminary results qualitatively match much of the expected behavior of such a tumor and we are currently seeking appropriate data in order to further our study.

Keywords

Mathematical Model Angiogenesis Tumorigenesis