MULTISCALE MODELING OF SOLID TUMOR GROWTH AND ANGIOGENESIS: THE EFFECT OF THE MICROENVIRONMENT

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ABSTRACT

We present and investigate models for solid tumor growth that incorporate features of the tumor microenvironment, including tumor-induced angiogenesis. Using analysis and efficient 2D/3D numerical simulations, we explore the effects of the interaction between the genetic characteristics of the tumor and the tumor microenvironment on the resulting progression and morphology. We account for variable cell-cell/cell-matrix adhesion in response to environmental conditions (e.g., hypoxia) and to the presence of multiple tumor cell species. The model provides resolution at various tissue physical scales and quantifies functional links of molecular factors to phenotype that for the most part can only be tentatively established through laboratory or clinical observation. This allows observable properties of a tumor (e.g., morphology) to be used to both understand the underlying cellular physiology and to predict subsequent growth or treatment outcomes, thereby providing a bridge between observable, morphologic properties of the tumor and its prognosis. This is joint work with Vittorio Cristini (SHIS; UT, Houston) and John Lowengrub (Math; UC, Irvine).