9th Conference for African–American Researchers in the Mathematical Sciences
Purdue University, June 24–27, 2003

A MECHANICAL MODEL OF TUMOR ENCAPSULATION AND INVASION

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A mathematical modeling framework is presented which describes the growth, encapsulation, and transcapsular spread of solid tumors. The model is based on the physical forces and cellular interactions involved in tumorigenesis and is used to test and compare the active (Foreign Body Hypothesis) and passive (Expansive Growth Hypothesis) hypotheses of capsule formation. The model simulations predict that although an active response can successfully control tumor growth via the deposition of large amounts of collagen, this alone is insufficient for capsule formation. In contrast, a solely passive response is capable of producing an encapsulated tumor with minimal accumulation of connective tissue within the tumor mass. When both mechanisms are operative, the tumor becomes significantly more fibrous and a denser capsule forms. Using a modified version of the model, in which tumor cells are able to cause the degradation of surrounding connective tissue, it is also possible to show that transcapsular spread or invasion may be due tumor-synthesized proteases and their subsequent action.