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Modelling the role of cell-cell adhesion in the growth and development of carcinomas.

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Summary: A mathematical model is presented to describe the evolution of an avascular solid tumour in response to an externally-supplied nutrient. The growth of the tumour depends on the balance between expansive forces caused by cell proliferation and cell-cell adhesion forces which exist to maintain the tumour's compactness. Cell-cell adhesion is incorporated into the model using the Gibbs-Thomson relation which relates the change in nutrient concentration across the tumour boundary to the local curvature, this energy being used to preserve the cell-cell adhesion forces.

Our analysis focuses on the existence and uniqueness of steady, radially-symmetric solutions to the model, and also their stability to time-dependent and asymmetric perturbations. In particular, our analysis suggests that if the energy needed to preserve the bonds of adhesion is large then the radially-symmetric configuration is stable with respect to all asymmetric perturbations, and the tumour maintains a radially-symmetric structure – this corresponds to the growth of a benign tumour. As the energy needed to maintain the tumour's compactness diminishes so the number of modes to which the underlying radially-symmetric solution is unstable increases – this corresponds to the invasive growth of a carcinoma. The strength of the cell-cell bonds of adhesion may at some stage provide clinicians with a useful index of the invasive potential of a tumour.

MSC:

92C50 Medical applications (general)
35Q92 PDEs in connection with biology, chemistry and other natural sciences

Cited in **62** Documents

Keywords:

cancer; asymmetric tumour growth; cell-cell adhesion; Gibbs-Thomson relation

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