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Mathematical modelling of cancer invasion: the importance of cell–cell adhesion and cell–matrix adhesion

The process of invasion of tissue by cancer cells is crucial for metastasis – the formation of secondary tumours – which is the main cause of mortality in patients with cancer. In the invasion process itself, adhesion, both cell–cell and cell–matrix, plays an extremely important role. A mathematical model of cancer cell invasion of the extracellular matrix is developed by incorporating cell–cell adhesion as well as cell–matrix adhesion into the model. Considering the interactions between cancer cells, extracellular matrix and matrix degrading enzymes, the model consists of a system of reaction–diffusion partial integro–differential equations, with nonlocal (integral) terms describing the adhesive interactions between cancer cells and the host tissue, i.e. cell–cell adhesion and cell–matrix adhesion. Having formulated the model, we prove the existence and uniqueness of global in time classical solutions which are uniformly bounded. Then, using computational simulations, we investigate the effects of the relative importance of cell–cell adhesion and cell–matrix adhesion on the invasion process. In particular, we examine the roles of cell–cell adhesion and cell–matrix adhesion in generating heterogeneous spatio–temporal solutions.

References

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