Modelling the Growth of Tumour Spheroids and Their Response to Radiation

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A computational model describing the growth of tumour spheroids is presented as understanding how a tumour may grow and also respond to treatment is pivotal in obtaining optimal results for patients undergoing cancer treatment. Tumour spheroids are of specific importance as being three dimensional they provide a way to study tumour growth dynamics in a more biologically relevant fashion than traditional two dimensional petri dish cell cultures.

This model hybridises and furthers the work of two previous studies; Waclaw\(^1\) and Molina-Pena\(^2\). Waclaw’s stochastic spatial model of tumour growth describes tumour cells as cubes on a three-dimensional lattice, as the model runs cells divide with biologically informed replication rates to occupy a random neighbouring site. Molina-Pena’s multi-compartmental model describes tumour growth analytically and incorporates the cancer stem cell hypothesis.

Hybridising elements of these models and applying them to tumour spheroids produces a spatial growth model for three subpopulations of cancer cell; undifferentiated cancer stem cells, progenitor cells and fully differentiated cells. For each subpopulation the rate at which cellular events, namely replication and death, occur is governed by individual parameters. This provides a mechanism by which intervention measures may be incorporated. For instance, at a certain time into the simulation treatment with radiation may be applied altering the growth dynamics of each subpopulation of cell. It is hoped that this model can therefore provide a testing ground for the effects of such treatments as well providing a tool to better understand the dynamics of tumour growth.

References:
