Bystander effects and their implications for clinical radiation therapy: A mathematical modelling approach

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The spatio-temporal changes in the intracellular cell-cycle dynamics and variations in microenvironment oxygen levels play a vital role in mediating a cell’s sensitivity and response to the radiation therapy. Moreover, in addition to tumour control, the ionizing radiation indirectly induces other local and nonlocal bystander effects whose consequences are poorly characterised but which will certainly include secondary malignancies (metastases). Here, we consider a hybrid multiscale mathematical and computational model to study the direct effects of radiation as well as radiation-induced bystander effects on a tumour growing within host tissue. We use the model to study the role of radiation-induced bystander effects when tumour cells are treated with different therapeutic schedules and analyse their clinical and diagnostic implications.