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Editorial

Microtissues in cancer modeling

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Microtissues have emerged in bioengineering as an interesting in vitro tool to bridge the gaps between the cell and the tissue scales. Intere stingly, MultiCellular Tumor Spheroids (MCTS) mimic the biophysical behaviours of in vivo microtumors, especially in terms of response to mechanical, or electrical stresses. It is now widely accepted that they accurately reproduce the 3D architecture of solid tumours, filling the gap between monolayer cultured cells and animal models. Their ability to evaluate new anticancer strategies is increasingly recognized. In particular, MCTS are complex cell aggregates which can reproduce the mechanical behaviors of microtumors. MCTS thus provide an interesting tool to investigate new cancer therapeutical strategies as drugs and nanodrugs uptake and its effect on the tumor growth, effect of electric field on the growth and the uptake of molecules.

From the mathematical modeling view point, microtissues are of great interest because the provide a well-controlled biological set-up, that enables to discriminate between different phenomena, which is not possible with in vitro experiments. Therefore specific modeling and parameter estimation for microtissues is promising research tracks in mathematical biology.

The aim of this special issue is to present four recent achievements on the mathematical modeling of microtumors and of their interactions with the environment. Yaacob et al. propose a free-boundary problem to describe the formation of invadopodium, the preliminary step to cancer invasion: the cell produce an enzyme that degrades the extracellular matrix, enabling the cell to invade the matrix. Macfarlan et al. propose a cell population approach to investigate the influence of phenotypic heterogeneity on tumour growth. Their model tracks the spatial evolutionary dynamics of single cells, which undergo pressure-dependent proliferation, heritable phenotypic changes and possibly directional movement in response to pressure stresses. Nakazawa et al. propose a mathematical model for the dynamics of endothelial cells in the neo-angiogenesis of microtumors, leading to the formation of microvasculature. Finally, Collin et al. investigate the growth specificities of cancer cells spheroids subjected to pulsed electric field. Interestingly, their results provide a first numerical quantification of the impact of electroporation on multicellular spheroids growth, and suggest a booming growth of

partially irreversible electric pulses, leading to an accelerated regrowth. These result shed a new light on the use of pulsed electric field in tumour ablation, especially in terms of margins of the ablation area.