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(G*) (POS-32) The effect of area distribution of benign tissues on metastasis

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In the early stages of cancer, malignant cells are confined within the boundaries of a tissue. With the rapid division of these cells, large pressure gradients form across the borders. When the force resulting from this pressure overpowers the intercellular adhesion, the cells gain the ability to invade and spread through the adjacent tissues [1]. Understanding the details behind this process is of utmost importance as it may lead to novel methods for the early detection or treatment of cancer. New experimental data hints at a connection between the cross-sectional area of the compressed cells within the benign tumors and the likelihood of them spreading into bordering tissues. To investigate this relation better, we employ computational methods to study such systems in silico. Here we use the CellSim3D [2, 3] off-lattice model to study epithelial tissue growth in the presence of cancerous cells. CellSim3D allows the simulation of the mechanical aspects of growth, division, migration, and the interaction of cells with each other and their environment. Our study focuses on showing the connection between the area distribution of the cells within the benign tumors and the likelihood of them metastasizing to new sites in the body. The system of study is an epithelial tissue grown from a single rigid cell, in which a limited number of softer cells are introduced, and the system is left to evolve. The observations from this system follow the experimental findings and prove the effectiveness of employing computational methods in studying malignant tissues.

References
[1] P. Madhikar, J. ˚Astr¨om, B. Baumeier, and M. Karttunen, Jamming and force distribution in growing epithelial tissue, Phys. Rev. Res. 3, 023129 (2021).
[2] P. Madhikar, J. ˚Astr¨om, J. Westerholm, and M. Karttunen, CellSim3D: GPU accelerated software for simulations
of cellular growth and division in three dimensions, Comput. Phys.Commun. 232, 206 (2018).
[3] https://github.com/SoftSimu/CellSim3D

Keyword-1

Cell and Tissue Mechanics

Keyword-2

Physics of Cancer

Keyword-3

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