Abstract ID 63

COMBINING EXPERIMENTS AND IN SILICO MODELING TO INFER THE ROLE OF ADHESION AND PROLIFERATION ON THE COLLECTIVE DYNAMICS OF CELLS

Hygor P. M. Melo[1], Fatima R. Maia[2], André S. Nunes[3], Rui L. Reis[2], Joaquim M. Oliveira[2], Nuno A. M. Araújo[4]
[1]Centro de Física Teórica e Computacional, Faculdade de Ciências, Universidade de Lisboa, Portugal
[2]3B´s Research Group, I3Bs - Research Institute on Biomaterials, Biodegradables and Biomimetics of University of Minho, Headquarters of the European Institute of Excellence on Tissue Engineering and Regenerative Medicine, Portugal & ICVS/3B´s – PT Government Associate Laboratory, Braga/Guimarães, Portugal
[3]Centro de Física Teórica e Computacional, Faculdade de Ciências, Portugal & Electric Ant Lab, Science Park, The Netherlands
[4]Centro de Física Teórica e Computacional, Faculdade de Ciências, Universidade de Lisboa, Portugal & Departamento de Física, Faculdade de Ciências, Universidade de Lisboa, Portugal
hpmelo@fc.ul.pt, raquel.maia@i3bs.uminho.pt, and.sousanunes@gmail.com, rgreis@i3bs.uminho.pt, miguel.oliveira@i3bs.uminho.pt, nmaraujo@fc.ul.pt

Keywords: Surfaces, interfaces and thin films, Cell adhesion, Cell proliferation

Summary: The collective dynamics of cells on surfaces poses theoretical challenges with important applications in the study of morphogenesis, tissue engineering, and cancer [1]. Different mechanisms are at play, including cell-cell adhesion, cell motility, and proliferation. However, the relative importance of each is elusive [2]. We developed a particle-based model, which can be combined with experimental results to infer the rate of each mechanism [3]. *In vitro* experiments were performed using a culture of glioblastoma multiform (GBM) cell line, U87MG. The position of the cell nucleus was determined automatically with image processing algorithms and the time evolution of the spatial cell-cell correlation was analyzed over a period of 24 h. By parametrizing the adhesion and proliferation rates in the model, it was possible to reproduce the evolution of the two-dimensional spatial heterogeneous distribution of cells, which provides insight into the underlying dynamics. The results revealed a reduction in cell-cell adhesion in response to the increase of cell density in the substrate as a function of time. This mechanism is consistent with a reduction in contact inhibition and, consequently, an increase enhancement on cells' migration.

References

[1] Trepat, X., Chen, Z., and Jacobson, K. (2012). Cell migration. Comprehensive Physiology, 2(4), 2369-2392.
[2] Qu, Z., Garfinkel, A., Weiss, J. N., and Nivala, M. (2011). Multi-scale modeling in biology: how to bridge the gaps between scales? Progress in biophysics and molecular biology, 107(1), 21-31.
[3] Melo, H.P.M., Maia, F.R., Nunes, A.S., Reis, R.L., Oliveira, J.M., and Araújo, N.A.M. (2021). Combining experiments and in silico modeling to infer the role of adhesion and proliferation on the collective dynamics of cells, Scientific Reports, 11, 19894.