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Evgeniy received his PhD in Physics from the Hebrew University of Jerusalem, Israel, in 2005. He then came to the University of Michigan for a postdoctoral fellowship; in 2007, he joined Oakland University. Evgeniy's research interests are in the fields of theoretical biological physics, nonlinear dynamics, condensed matter physics, and non-equilibrium statistical mechanics, from collective phenomena in biological systems to driven granular media.

Physics of clustering and invasion of living cells

Biological multicellular systems exhibit a variety of nonlinear phenomena that are fascinating from the physics perspective. Brain tumor cells are able to migrate, proliferate (divide), and experience cell-cell adhesion. In this talk I will focus on clustering of cells on a surface (Figure 1). We formulated a stochastic model and identified two mechanisms of cell clustering. First, there is a critical value of the strength of cell-cell adhesion; above the threshold, large clusters grow from a homogeneous suspension of motile cells; below it, the system remains homogeneous, similarly to the ordinary phase separation. Second, when cells form a cluster, we have evidence that they increase their proliferation rate. We have successfully reproduced the experimental findings and found that both mechanisms are crucial for cluster formation and growth. We also analyzed cell invasion, a phenomenon that plays an important role in tumor growth and wound healing. When the strength of cell-cell adhesion exceeds a certain threshold (and proliferation is small), large isolated clusters are formed ahead of the cell invasion front.

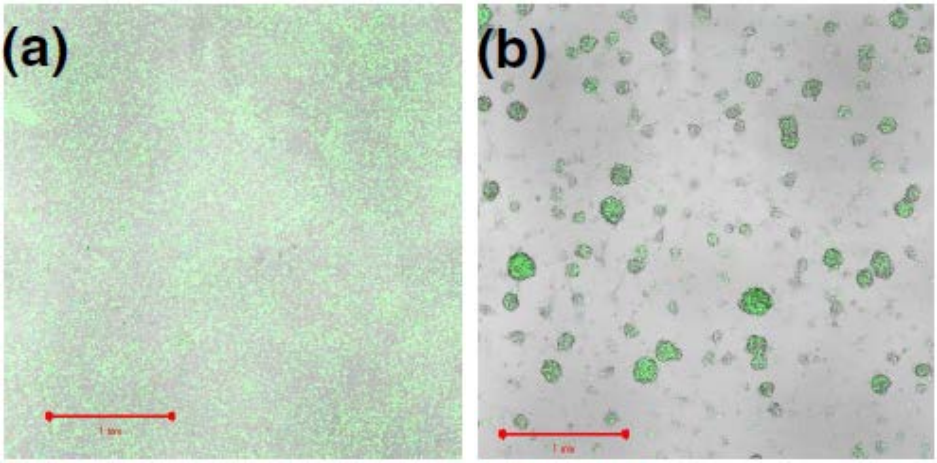

Figure 1: Snapshots of the system for the two cell lines five days after the beginning of the experiment. Mutant cells form clusters (b), while wild type cells are homogeneously distributed over the system (a). The typical cell diameter is 10-20 μm, so each cluster in (b) contains hundreds of cells.