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Fronts of cells invading a wound: from discrete stochastic approach to continuum description

We present a stochastic model that describes fronts of cells invading a wound. In the model, cells can migrate, proliferate, and experience cell-cell adhesion. We find several qualitatively different regimes of front motion and analyze the transitions between them. Above a critical value of adhesion and for small proliferation, large isolated clusters are formed ahead of the front. This is mapped onto the well-known ferromagnetic phase transition in the Ising model. The results are compared with experiments, and possible directions of future work are proposed. We also focus on a continuum description of this phenomenon by means of a generalized Cahn-Hilliard equation (GCH) with a proliferation term. As in the discrete model, there are two interesting regimes. For subcritical adhesion, there are propagating "pulled" fronts, similarly to those of Fisher-Kolmogorov equation. The problem of front velocity selection is examined, and our theoretical predictions are in a good agreement with a numerical solution of the GCH equation. For supercritical adhesion, there is a nontrivial transient behavior, where density profile exhibits a secondary peak. The results of continuum and discrete models are in a good agreement with each other for the different regimes we analyzed.