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Stretch-dependent proliferation in a one-dimensional elastic continuum model of cell layer migration

Collective cell migration plays an important role in maintaining the cohesion of epithelial cell layers and wound healing. Disruption of cell migration can cause disease such as necrotizing enterocolitis, an intestinal inflammatory disease that is a major cause of death in premature infants. A recently developed mathematical model of cell layer migration during experimental necrotizing enterocolitis based on an assumption of elastic deformation of the cell layer leads to a generalized Stefan problem. The model is here extended to incorporate stretch-dependent proliferation, and the resulting PDE system is solved analytically and numerically. The efficiency and accuracy of adaptive finite difference and MOL schemes for numerical solution of the problem are compared. We find a large class of assumptions about the dependence of proliferation on stretch that lead to traveling wave solutions.