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Cell-based modeling of angiogenic blood vessel sprouting: cell-ECM interaction and tip-cell selection

Angiogenesis is a topic of intensive experimental investigation so its phenomenology and the molecular signals contributing to it have been well characterized. Yet it is poorly understood how the biological components fit together dynamically to drive the outgrowth of blood vessels. Cell-based simulation models of angiogenesis describe endothelial cell behaviour in detail, help analyze how cells assemble into blood vessels, and reveal how cell behaviour depends on the microenvironment the cells themselves produce. Our previous simulation models, based on the Cellular Potts model, have shown that the elongated shape of endothelial cells is key to correct spatiotemporal in silico replication of vascular network growth [1]. We also identified a new stochastic mechanism for angiogenic sprouting [2]. Here I will briefly discuss new insights into the role of cell shape and stochastic motility during vascular branching. Then I will present recent results on the role of tip cells, suggesting that tip cell-stalk cell interactions accelerate angiogenic sprouting. I will also discuss our recent cell-based modeling studies of cell-extracellular matrix interactions during angiogenesis.

References

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[2] Merks, R.M.H., E.D. Perryn, A. Shirinifard, Glazier J.A. *Contact-inhibited chemotaxis in de novo and sprouting blood-vessel growth* PLoS Computational Biology **4** e1000163, 2008.