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Homeostatic pressure, tumor growth and fingering of epithelial tissues: Some generic physics arguments[1]

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We propose that one aspect of homeostasis is the regulation of tissues to preferred pressures, which can lead to a competition for space of purely mechanical origin and be an underlying mechanism for tumor growth. Surface and bulk contributions to pressure lead to the existence of a critical size that must be overcome by metastases to reach macroscopic sizes. This property qualitatively explains the observed size distributions of metastases, while size-independent growth rates cannot account for clinical and experimental data. It also potentially explains the observed preferential growth of metastases on tissue surfaces and membranes, suggests a mechanism underlying the seed and soil hypothesis introduced by Stephen Paget in 1889, and yields realistic values for metastatic inefficiency [1]. Treating epithelial tissues as viscous fluids with effective cell division, we find a novel hydrodynamic instability that leads to the formation of fingering protrusions of the epithelium into the connective tissue. Arising from a combination of viscous friction effects and proliferation of the epithelial cells, this instability provides physical insight into a potential mechanism by which interfaces between epithelia and stroma undulate, and potentially by which tissue dysplasia leads to cancerous invasion.

[1] M. Basan, T. Risler, J.-F. Joanny, X. Sastre-Garau, and J. Prost, *HFSP Journal*, **3**, 4, p.265

[1]In collaboration with M. Basan, J.-F. Joanny, X. Sastre-Garau and J. Prost.