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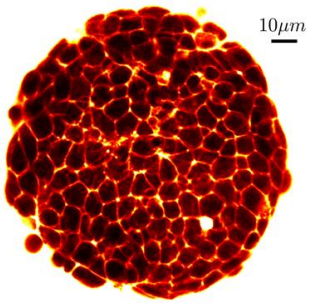
M2 internship: Cell volume control in biological tissues

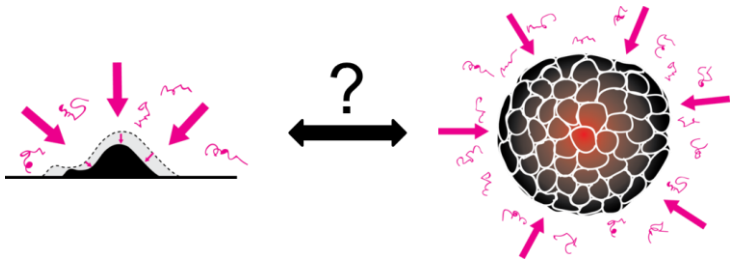
Within an organism or in laboratory culture conditions, mammalian cells need to actively regulate their size. This control is required to maintain tissue homeostasis, regular development or cope with osmotic or mechanical stress applied by the environment. For example in cancer, tumor unbounded growth exerts pressure on the surrounding tissues and reciprocally within the tumor itself. How this stress affects the tumor and its microenvironment is still unclear, and the molecular mechanisms involved in cellular volume control at the single cell or at the tissue level need to be unraveled.



Our lab is working on model tissues advantageously mimicking cancerous tumors in controlled laboratory conditions. We have shown recently that a cell aggregate reacts differently than single cells to osmo-mechanical constraints. Indeed, this compression is different according to the position within the aggregate and larger than for cells cultured in regular 2D conditions. Using microfluidic devices combined with quantitative microscopy approaches, we aim at understanding the response 1) at the single cell level and 2) at the scale of a biological tissue. The candidate can choose between two projects:

Project 1: How single cells define a homeostatic size/volume, a biophysical approach?
Using microfluidic devices to measure single cell volume, the intern will characterize the single cell response and adaptation to osmotic stress. The role of the main mechanosensitive actors i.e. cytoskeleton or ion channels, and adhesion will be decipher using drugs or gene silencing approaches.

Project 2: Characterization of the collective response of a tissue to osmo-mechanical stress:
The intern will use live microscopy technics to quantify the response of biological tissues to osmo-mechanical constraints. He will perform experiments and participate in the development of image analysis tools quantify the stress and the volume of the cells within the tissue.



Key words: cell mechanics, tissue mechanics, size, volume, pressure, microfluidics, microscopy, image analysis, quantitative analysis.

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