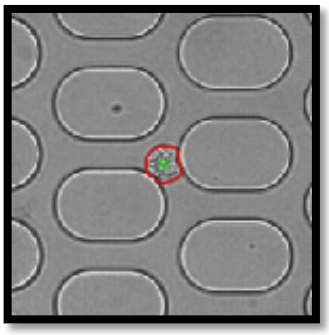
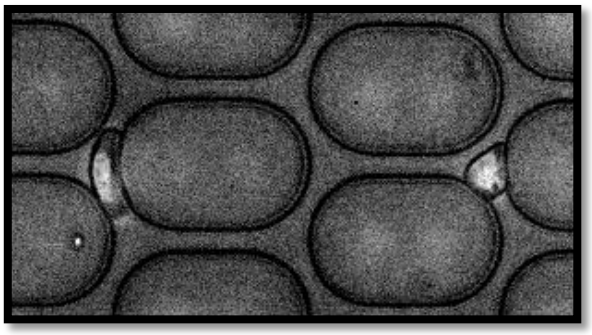
Dynamics of WBC in microfluidic channels network

Dupire Jules, Annie Viallat
Laboratoire Adhésion et Inflammation
INSERM U600 / CNRS UMR 6212 / Université Aix-Marseille 2
163 av. de Luminy
13009 Marseille
jules.dupire@inserm.fr





With a contact surface of 100m², the lungs are the most extended immune battle field of the body. The motion of white blood cells in the pulmonary blood capillaries is thus very important. Many channels are smaller than the leukocytes. Subjected to a continuous hydrodynamic stress and a strong geometrical confinement, they must strongly deform to cross the network. This specific dynamic leads to the creation of a marginated pool of immune agents: neutrophil concentration is 50 times higher there than is the body.

Our study aims to understand the interplay between the cells' rheology and their motion. To do so, we use a PDMS microfluidic set-up with a regularly organized structure of biomimetic channels. Experimental cells are THP-1, a monocytic cell-line.

All the following experiments were performed on normal and drugged cells. This allowed the investigation of the role of the actin cytoskeleton on their shape adaptation and their motion. Driven by a difference of pressure, cells travel through the network showing 3 stages. The entrance acts like an included micro-rheometer and helps determining a characteristic parameter of the cell. The adaptation phase reproduces the hops motion seen in the lung. Using a fluorescent dye, we studied the role of the nucleus position in the cells motion (stretching, flip, asymmetry emergence). Reaching the stationary regime, cells shows a periodic trajectory following the current lines with a constant mean velocity scaling with the friction surface. In this regime, the cells' shape seems to have reached an optimum for motion and the surface to volume ratio is constant.