

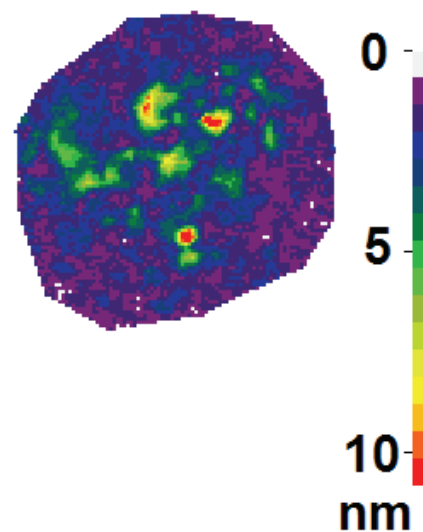
Dynamics of the Leukocyte Surface

Pierre Bongrand

Lab. Adhesion & Inflammation
INSERM UMR600/CNRS UMR6212, Marseille

Many aspects of cell behaviour, including shape control, migration patterns, differentiation or mediator secretion, are strongly influenced by interactions with their nearby environment. Recently, numerous reports showed that in addition to the presence of specific ligands cells could sense physical properties of surrounding surfaces, such as stiffness and topography at the micrometer or submicrometer level (see¹ for a brief review). However, the mechanisms involved in this sensing process remain incompletely understood. Thus, while it is well demonstrated that cells adhering to a surface exert a tension that is related to substratum stiffness, it is not known how this tension is regulated.

Recent experiments suggest possible mechanisms for rapid probing of surrounding tissues by a living cells. The surface of monocytic THP-1 cells approaching fibronectin-coated surfaces was found with interference reflection microscopy to display continuous undulations with an amplitude of a few nanometers². Interestingly, the amplitude of these movements was influenced by the presence of a surface separated from the membrane by a distance of order of 50 nm. Now, it would be important to determine whether these changes were actually perceived by cells, i.e. whether they might generate any signalling process. Can a cell sense a hard surface it meets when pushing forward a filopodium or lamellipodium ? Conversely, how can a cell sense the mechanical properties of a ligand-bearing surface during filopodium or lamellipodium retraction ?



Imaging the amplitude of transverse fluctuations of the membrane of a monocytic cell approaching an adhesive surface

Interestingly, this question might be addressed by studying the motion of receptor-coated microspheres subjected to hydrodynamic forces and brownian motion near a ligand-bearing surface in a flow chamber³. A growing number of experiments strongly suggest that cell membrane receptors can form rapidly very transient bonds with ligands they encountered.

Together with membrane transverse fluctuations, this provides a potential mechanisms for sensing the mechanical properties of the ligand bearing substrates.

Much work is required to connect aforementioned experiments by investigating possible relationships between cell membrane undulations near a surface, kinetic and mechanical properties of ligand-receptor interactions between the cell and the surface, and substratum topography and stiffness.

References.

- ¹ Cretel E, Pierres, A., Benoliel A. M., Bongrand P. (2008) How cells feel their environment : a focus on early dynamic events. *Cellular & Molecular Bioengineering* 1:5-14.
- ² Pierres, A., Benoliel A. M., Touchard D, Bongrand P. (2008) How cells tiptoe on adhesive surfaces before sticking. *Biophys. J.* 94:4114-4122.
- ³ Pierres A, Prakasam A, Touchard D, Benoliel AM, Bongrand P, Leckband D (2007) Dissecting subsecond cadherin bound states reveals an efficient way for cells to achieve ultrafast probing of their environment. *FEBS Lett.* 581:1841-1846.