Molecular forces at cell surface
Single cell force spectroscopy by AFM approach

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Abstract

[...] The establishment of cell adhesion involves specific recognition events between individual cell-surface receptors and molecules of the cellular environment. However, characterizing single-molecule adhesion events in the context of a living cell presents an experimental challenge. The atomic force microscope (AFM) operated in force spectroscopy mode provides an ultrasensitive method to investigate cell adhesion forces at the level of single receptor-ligand bonds. With a living cell attached to the AFM cantilever, the number of cell-substrate interactions can be controlled and limited to the formation of single receptor-ligand bonds. From force-distance (F-D) curves recorded during cell detachment, the strength of single receptor-ligand bonds can be determined. Furthermore, by varying the rate of force application during bond rupture, a dynamic force spectrum (DFS) can be generated from which additional parameters that describe the energy landscape of the interaction, such as dissociation rate and energy barrier width, can be obtained. [...]

In a first part, I will introduce the use of atomic force microscopy (AFM) in the force mode, and present the way the data is gained and analysed. Then I will introduce the pros and cons of analysing the recognition / adhesive events at cellular surface. I will then focus on the methodology and requirements to measure single molecule adhesive forces, starting with cell to "semi-artificial surfaces" interactions.

Based on published results, I will present the conclusions, both on the type and on the mechanisms of the measured recognition events. The need of a critical eye on the kind of controls that such a technique requires will be emphasized. The extension to the measure of single molecule forces between cells will be presented and perspectives will be drawn, in regards to cell mechanics and cytoskeletal interactions.

References

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