Quantifying Receptor-Ligand Interaction Using Optical Trap Assay

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Direct measurement of two-dimensional (2D) kinetics rates and force spectrum is indispensable to understand the biophysical bases of receptor–ligand interactions in regulating cell adhesions[1].

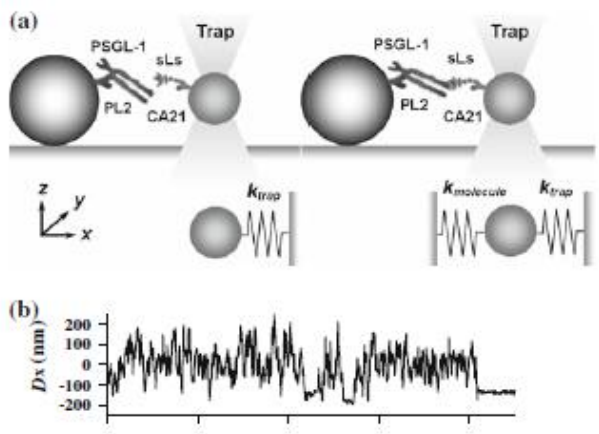

Fig. 1 (a) Schematic of thermal fluctuation approach using optical trap (not in scale). (b) Time course of displacement of selectin-coupled microbead along *x*-axis (D_x).

Here we developed a thermal fluctuation assay using optical trap technique [2] to monitor receptor-ligand interactions between two apposed surfaces when P-selectin and P-selectin glycoprotein ligand 1(PSGL-1) molecules were respectively captured onto the surface of silica bead. The Brownian motion of a microbead in weak trap (~10^{-3}pN/nm) was monitored in real-time and the resulted displacement was used to identify sequential association and dissociation events of receptor-ligand bond (Fig. 1). Data were analyzed upon first order kinetics to obtain association k_f and dissociation rate k_r. And we also used optical trap approach to get force spectrum of P-selectin and PSGL-1 bond at $r_f \leq 188$ pN/s with low spring cosntant(~10^{-3}-10^{-2} pN/nm). Our data indicated that the bond rupture force depended on both the loading rate and the mechanical compliance of force transducer at low r_f.

The thermal fluctuation assay provides direct measurement of receptor-ligand Interaction, and the force spectrum at low k and r_f further our understandings of the impact of experimental technique on the measurement of rupture force.

References

[1] T. A. Springer, "Traffic Signals on Endothelium for Lymphocyte Recirculation and Leukocyte Emigration," Annual Review of Physiology 57, 827-872 (1995).
[2] A. Ashkin, "Acceleration and Trapping of Particles by Radiation Pressure," Physical Review Letters 24(4), 156-159 (1970).