ESPCI
Laboratoire PMMH
10 rue Vauquelin, 75231 Paris Cedex 05

Séminaire café PMMH

Bureau d'Études, Batiment L, 2 eme étage

Jeudi 07 avril 2016, 13h30-14h30

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Ultrasound-assisted Interactions of Natural Killer Cells with Cancer Cells and Solid Tumors

In this Thesis, we have developed a microtechnology-based method for culturing and visualizing high numbers of individual cells and cell-cell interactions over extended periods of time. The foundation of the device is a silicon-glass multiwell microplate (also referred as microchip) directly compatible with fluorescence microscopy. The initial microchip design involved thousands of square wells of sizes up to $80\mu m$, for screening large numbers of cell-cell interactions at the single cell level. Biocompatibility and confinement tests proved the feasibility of the idea, and further investigation showed the conservation of immune cellular processes within the wells. Although the system is very reliable for screening, limitations related to synchronization of the interaction events, and the inability to maintain conjugations for long time periods, led to the development of a novel ultrasonic manipulation multiwell microdevice. The main components of the ultrasonic device are a 100-well silicon-glass microchip and an ultrasonic transducer. The transducer is used for ultrasonic actuation on the chip with a frequency causing half-wave resonances in each of the wells ($2.0 - 2.5MHz$ for wells with sizes $300 - 350\mu m$). Therefore, cells in suspension are directed by acoustic radiation forces towards a pressure node formed in the center of each well. This method allows simultaneous aggregation of cells in all wells and sustains cells confined within a small area for long time periods (even up to several days). The biological target of investigation in this Thesis is the natural killer (NK) cells and their functional properties. NK cells belong to the lymphatic group and they are important factors for host defense and immune regulation. They are characterized by the ability to interact with virus- infected cells and cancer cells upon contact, and under suitable conditions they can induce target cell death. We have utilized the ultrasonic microdevice to induce NK-target cell interactions at the single cell level. Our results confirm a heterogeneity within IL-2 activated NK cell populations, with some cells being inactive, while others are capable to kill quickly and in a consecutive manner. Furthermore, we have integrated the ultrasonic microdevice in a temperature regulation system that allows actuating with high-voltage ultrasound, but still sustaining the cell physiological temperature. Using this system we have been able to induce formation of up to 100 solid tumors (HepG2 cells) in parallel without using surface modification or hydrogels. Finally, we used the tumors as targets for investigating NK cells ability to infiltrate and kill solid tumors. To summarize, a method is presented for investigating individual NK cell behavior against target cells and solid tumors. Although we have utilized our technique to investigate NK cells, there is no limitation of the target of investigation. In the future, the device could be used for any type of cells where interactions at the single cell level can reveal critical information, but also to form solid tumors of primary cancer cells for toxicology studies.

Prochain séminaire : jeudi 14 avril 2016 **à 13h**,
Lucie Domino, Etienne Guyon et Guillaume Paoletti (1er violoncelle solo orchestre de chambre Paris)

Programme des séminaires café : www.pmmh.espci.fr, onglet *Séminaires PMMH>Séminaires café (interne)*
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