IBEC International PhD Programme Fellowships

IBEC Institute for Bioengineering of Catalonia

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Nanobioengineering group

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Liquid Biopsies Platforms: Towards a fully informed design of personalized medicine

The thesis project goal is to develop a non-invasive approach for detection, diagnostic and prognostic of biomarkers in liquid biopsy. The concept includes differential potential approaches for detecting blood biomarkers cancer patients. Genotyping tumor tissue in search of somatic genetic alterations for actionable information has become routine practice in clinical oncology. Although these sequence alterations are highly informative, sampling tumor tissue has significant inherent limitations. For example, tumor tissue represents a single snapshot in time, is subject to selection bias resulting from tumor heterogeneity, and can be difficult to obtain. The term “liquid biopsies” is often used only for cytophatological assessment of circulating tumor cells (CTC), additional blood-based biomarkers such as circulating free DNA (cfDNA), circulating RNA or microRNAs can also be detected.

The project will combine physical/mechanical-based microfluidic filtration devices (short processing time) with aptamer/immunomagnetic beads-based separation procedures (high purity) to enrich CTCs at a higher frequency with low background interference. This platform can be integrated in a lab-on-chip system to perform detection, quantification and analysis of the isolated CTCs.

The developed device will be able to separate the target DNA (circulant or pathogenic) and nanovesicles from other biomolecules that might cause interference for detection (cellular DNA, proteins, etc.). The microchip will be conceived to perform previous separation and filtration to eliminate cells and debris and then the resulting cell-free sample will be processed to isolate the DNA of interest. For this purpose, we will use Deterministic Lateral Displacement consisting of ordered array of posts in a microfluidic channel to create deterministic displacement dependent on the particle size. It is based on the use of a regular lattice of asymmetric obstacles to rectify the lateral Brownian motion of the molecules so that species of different sizes follow different trajectories through the device. For exosomes, nanofiltration and nanostructures embedded in the microfluidic systems will be designed.

The complete liquid Biopsy platform aims to provide a fast-molecular diagnosis from clinical labs to medical doctor office. This platform could work with a wide range of clinical samples and it can analyse, CTC, DNA coming from circulant (cfDNA) and exosomes.

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