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Manipulation of cells by Ultrasounds: isolation, migration and cell aggregation in new ultrasonic lab-on-chip platforms

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Abstract (300 word limit)

Study of cancer involving cell behaviors in different conditions is a current tending topic in scientific investigations. Blood samples can be used as liquid biopsy for early diagnosis and monitoring of chemotherapy in cancer patients. Separation of rare cells from blood samples by acoustic waves "acoustophoresis" repesentss a new label-free and biocompatible technique. Acoustic sorting works on the basis of the different physical cell properties and works at power intensities and frequencies similar to the ultrasonic imaging, with a little impact on the cell viability (high biocompatibility). It presents clinical advantages such as the fact the media in which cells are cultured and separated does not need to be modified, thus no labeling is required.Our recent microfluidic device: "THINUS-Chip", actuated by ultrasounds flow-through separation approach, provides an efficient separation of tumor cells (TCs) from white blood cells (WBCs) in. With this microfluidic device we have introduced for the first time the concept of plate acoustic waves (PAW) applied to acoustophoresis as a new strategy in low-cost devices for clinical applications. We have also explored the effects of low intensity continuous ultrasound (LICU) on the inflammatory response of mouse pancreatic tumor explants. We found a significant upregulation of IFN-γ, IL-1β, and TNF-α on the tumor explants exposed to LICU. Meanwhile, no detectable effects were observed on tumor vasculature or collagen I deposition. This paper showed for the first time the ability of our technology based on the application of low intensity ultrasounds as a noninvasive actuator in cancer processes associated to tumor growth, enhancing some anti-tumor markers and inhibiting others related to a tumor progression.

Herein we describe our studies to remark the relevance of the LICUS as future medical solutions involving blood or tissue cell manipulation.

Image

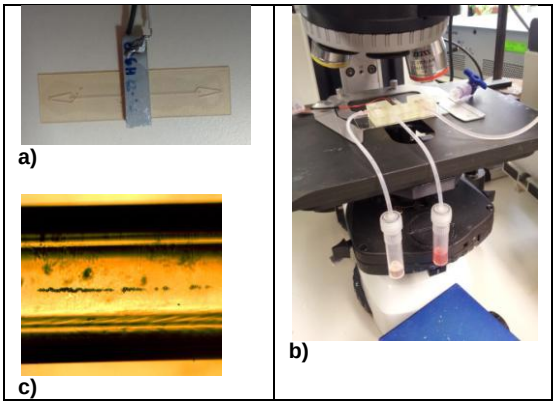


Figure 1: Ultrasounds combined with microfluidics for different purposes : a) blood plasmapheresis; b) isolation of tumor cells, both based on c) cell enrichment.

Recent Publications

1. I. Gonzalez, J. Earl, A. Pinto, L.J. Fernandez, B. Sainz ., A. Carrato, (2018) A disposable thin chip for rapid isolation of tumor cells and aggregates by ultrasounds, Micromachines, 9, 129-143.
2. D. Bazou D., Maimon N., Munn L, I. Gonzalez (2017) Effects of low intensity continuous ultrasound (LICUS) on mouse pancreatic tumor explants, Applied Science, 7, 1275-1285;
3. I. González, et al. (2015) Ultrasonic enrichment of flowing blood cells in capillaries O., Physics Procedia 0, 72-75, (2015)
4. I González et al (2015) Optimizing Polymer Lab-on-Chip Platforms for Ultrasonic Manipulation: Influence of the Substrate, Micromachines 6 (5), 574-591.




Itzíar González is Dr. in Physics. She belongs to the scientif staff of the Research Council of Spain CSIC. She has her expertise in the development of new technologies based on strategic application of ultrasounds. She and her group RESULT of ultrasonic resonators for manipulation in the National have developed low-cot polymeric chips to perform particle and cell sorting based on their whole structure resonance, with application in early detection of circulating tumor cells in peripheral blood samples. She leads various competitive research projects involving cancer solutions.

Julie Earl is Dr. in Oncologic Biology. She works in the Univ. Hospital Ramón y Cajal of Madrid. She leads competitive research projects involving cancer desease.and has several publications related to it, in particular to circulating tumor cells.

Currently they work as a trans-disciplinary group on cancer tissues & Ultrasounds

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Notes/Comments: