Bioingegneria, biotecnologia e tecnologie per la salute
Bioengineering

BioERA Lab: Biological engineering research and application

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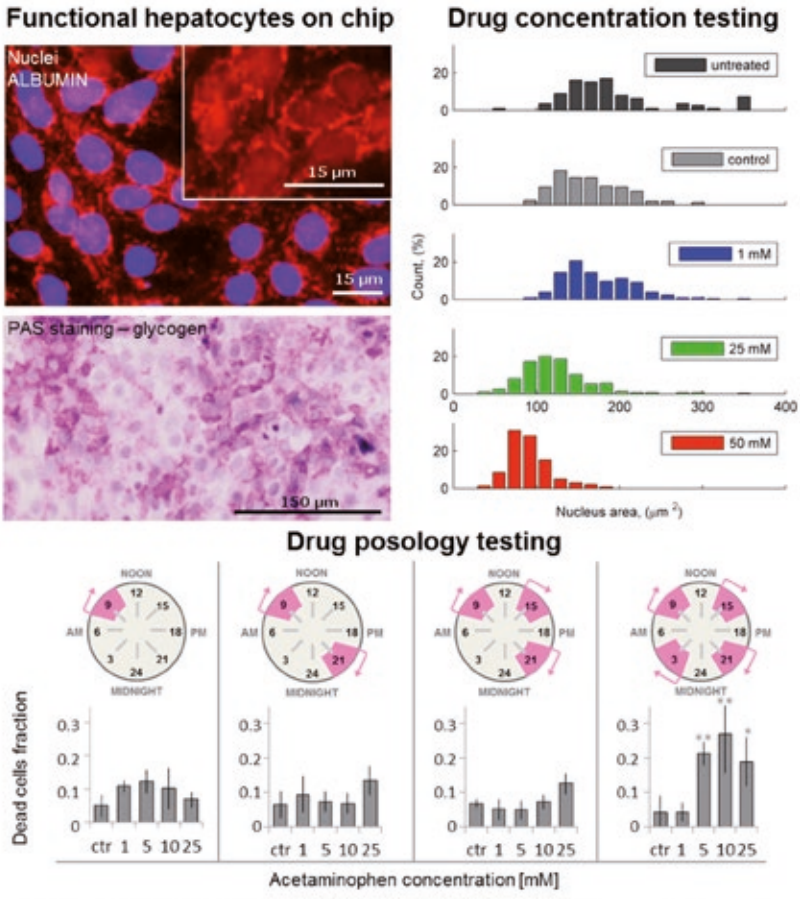
BIOERA
biological engineering research and application

Main research topics:

- Human stem cell engineering
- Microfluidic technology for bioengineering applications
- Biomimetic material design for mechanotransduction studies
- Lab on a chip for tissue development, disease model and functional assay
- Micro and nano-structured electrochemical biosensor design and development

Human organs on chip: in vitro models for patient-specific therapy development

The percentage of failure in the drug discovery pipeline is still very high, especially at late stages, and research expenses are not compensated by yielding new products. More predictive models and assays are necessary to increase the success rate, anticipating the failure of bad lead compounds before clinical trials. Multiple governmental authorities are thus opening to innovative tools for drug screening, in particular to in vitro cell-based or tissue-based models reproducing human physiology and, in perspective, pathophysiology.
Within BioERA lab, we work on development of organ-on-chip systems that integrate microfluidic technology and human living cells. Their small scale enables precise control of culture conditions and high-throughput experiments, both not pursuable at a macroscopic level.
Given the necessary scarce availability of human biopsies, as a cell source for on-chip integration we use embryonic-like stem cells, called human induced pluripotent stem cells (hiPSC), that we are able to derive from a skin biopsy. These cells have two main advantages: they preserve the genetics of the patient donor, paving the way for personalized medicine applications, and can be differentiated into all cell types of the human body.
We recently developed a robust multi-stage method for differentiating hiPSCs into hepatic and cardiac organs on chip. We characterized the cells obtained to show that they are fully functional on chip and that can be used for toxicological studies. Taking advantage of microfluidics precision in generating dynamic perturbations, we also showed the importance of drug administration posology by performing repeated perturbations in a 24-hour time span.



Giobbe GG, Michielin F, Luni C, Giulitti S, Martewicz S, Dupont S, Floreani A, Elvassore N. 2015. Functional differentiation of human pluripotent stem cells on a chip. **Nat Methods**. 12:637–640.