Bioingegneria, biotecnologia e tecnologie per la salute
Bioengineering

DII research group

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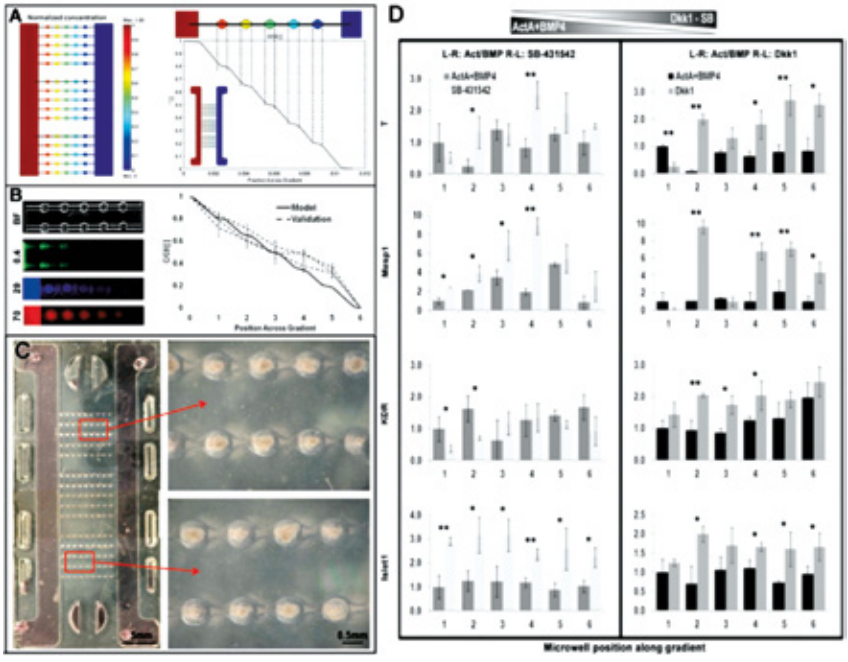
This work was performed at Columbia University (New York, USA) in the laboratory for Stem Cell and Tissue Engineering directed by Prof. Gordana Vunjak-Novakovic
It was also supported by the New York Stem Cell Foundation
(NYSCF, New York, USA)

Main research topics:
- Microscale technologies for stem cells studies
- Microfluidic platforms
- Cancer Stem Cells
- Microphotobioreactors for microalgae studies
- Bioreactors for Tissue Engineering

Microscale technologies as a tool for understanding stem cell behavior

Bioengineered environments that combine tissue-specific transport and signaling are becoming critical in studies of development, regeneration and disease under settings predictive of human condition. Microbioreactors and microfluidic platforms are key in enabling highly controllable and sophisticated experiments at biologically relevant scales and with real-time insights into cellular responses. Laminar flow in micro-channels and short transport distances facilitate the tight control and fine-tuning of the variables of interest. Microbioreactors work at steady state, resembling homeostasis in vivo, and perturbations in the local composition of the microenvironment can be introduced to measure fast dynamic changes in cellular responses.
These technologies combine flexibility of design, precision, and reduced costs to highthroughput and multiparametricity. They can be adapted to a wide range of studies, with the potential to uncover still-elusive cellular behaviors, leading to important advances for global healthcare problems.
In a recent study, we were able to evaluate mesodermal induction in human embryonic stem cells by measuring and correlating the expression of key genes after exposure to concentration gradients of mesodermal-inducing/inhibiting morphogens. The modulation of pathway activations by the local microenvironment resulted in non-linear cell responses to linear concentration gradients: a physiologically relevant behavior, reflecting the complex regulation of mesodermal/mesendodermal differentiation programs by sequences of factors evolving in space and time.



Cimetta E, Vunjak-Novakovic G. "Microscale technologies for regulating human stem cell differentiation". Exp Biol Med. 2014; 239(9): 1255-1263.
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