Marie Cuvellier et al., J Tissue Sci Eng 2018, Volume 9
DOI: 10.4172/2157-7552-C4-055

Development and optimization of complex liver models by 3D bio-printing

Marie Cuvellier[1], Frédéric Ezan[1], Hugo de Oliviera[2], Sophie Rose[1], Sophie Langouet-Prigent[1], Jean-Christophe Fricain[2] and **Georges Baffet[1]**
[1]Research Institute for Environmental and Occupational Health, France
[2]French National Institute of Health and Medical Research, France

The use of conventional 2D in vitro culture models is increasingly questioned and their ability to accurately mimic the complete physiological function of the organs or tissues of interest can be limited. For a few times now, 3D models have been successfully developed by the team Dymec of IRSET, with improved function and phenotypes of many cells type, including primary and transformed hepatic cells. The project aims to improve those 3D models by building a multicellular organoid-like liver model, with an organized architecture and in a reproducible and high-throughput way. We relied on extrusion based bioprinting technology, which allows the precise and spatially controlled deposition of a biological material containing cells to form definite microarchitectures. The first step of the work was to define the printing parameters: hydrogel concentrations, step of cross linking, printing temperature, pressure and speed, have been optimized to obtain a printable structure which remained stable over the long term. Secondly, the long-term biocompatibility of these structures was tested by encapsulation of transformed hepatic cells. They preserved their long-term viability (>30 days) and were able to proliferate in this biomatrix optimized for bioprinting. They organized themselves into spheroids/acini-like structures and displayed an apico-basal polarity after seven days of culture. The next step aim was to improve the liver function of the created structures, by bioprinting an architecturally organized co-cultures with parenchymal cells, by adding to the currents bioprinted structures non-parenchymal cells.

Recent Publications

1. Bomo J, Ezan F, Tiaho F, Bellamri M, Langouët S, Theret N and Baffet G (2016) Increasing 3D matrix rigidity strengthens proliferation and spheroid development of human liver cells in a constant growth factor environment. J. Cell. Biochem. 117:708–720.
2. Lauschke V M, Hendriks D F G, Bell C C, Andersson T B and Ingelman Sundberg M (2016) Novel 3D culture systems for studies of human liver function and assessments of the hepatotoxicity of drugs and drug candidates. Chem. Res. Toxicol. 29(12):1936-1955.
3. Murphy S V and Atala A (2014) 3D bioprinting of tissues and organs. Nature Biotechnology 32:773–785.
4. Pampaloni F, Reynaud E G and Stelzer E H (2007) The third dimension bridges the gap between cell culture and live tissue. Nature Reviews Molecular Cell Biology 8:839.
5. Ozbolat I T and Hospodiuk M (2016) Current advances and future perspectives in extrusion-based bioprinting. Biomaterials 76:321–343.

Biography

Marie Cuvellier started her PhD after completing her degree in Pharmaceutical Sciences at the Faculty of Pharmacy of Rennes I, and an MSc in Human Toxicology from the University of Paris Descartes. Her work at the IRSET focuses on the development of 3D multicellular liver models through 3D bioprinting, while working on the implementation of this technology at a larger scale within the institute.

marie.cuvellier@inserm.fr