Microfluidic perfusion culture for hepatic differentiation of human skin stem cells

Created on: 13-03-2019 - Last modified on: 23-07-2025

Contact person

Robim Rodrigues

Organisation

Name of the organisation Vrije Universiteit Brussel (VUB)
Department Pharmaceutical and Pharmacological Sciences
Specific Research Group or Service In Vitro Toxicology and Dermato-Cosmetology
Country Belgium
Geographical Area Brussels Region

SCOPE OF THE METHOD

The Method relates to	Human health
The Method is situated in	Basic Research, Translational - Applied Research
Type of method	In vitro - Ex vivo
Specify the type of cells/tissues/organs	human skin stem cells

DESCRIPTION

Method keywords

microfluidics
pump system
in vitro
flow rate

Scientific area keywords

hepatic differentiation
Human skin stem cells
Toxicology
dynamic culture system

Method description

The effect of fluidics that mimic the blood flow in the liver sinusoids, is evaluated during the hepatic differentiation of human skin-derived precursors (hSKP). In a standard bi-dimensional (2D) cell culture system, hSKP are differentiated to hSKP-HPC for 24 days in static conditions. In a perfusion system hSKP are grown in a commercially available microfluidic device or chip (ibidi, Germany) connected to a pump system. The chip

consists of a 50mm long channel with a cell growth area of approximately 2 cm^2. Two inlet ports are located at the edges of the device allowing direct connection to the perfusion system, which simulates physiological conditions through a continuous unidirectional culture medium flow. The large area of the fluidic channel offers a uniform shear stress (which is the mechanical tension of the fluid imposed to the cells) and a homogeneous cell distribution. In addition, the chip can be supplied with different extracellular matrix proteins such as poly-lysine, fibronectin and collagen for enhancement of cell adhesion to the material when exposed to flow. A shear stress of 0.4 dyn/cm^2 and a flow rate of approximately 1.4 ml/min are the parameters set to differentiate hSKP for 24 days. In parallel standard 2D cultures are kept as a control.

Lab equipment

Cell culture laboratory;
Laminar air flow;
Ibidi pump system;
Microfluidic chip.

Method status

Still in development

PROS, CONS & FUTURE POTENTIAL

Advantages

Applicable to many cell types. Potential improvement of hepatic functionality. Cells-on-a-chip are cultured in a more physiological environment (human-like), with potential applicability in drug screening for the assessment of hepatotoxicity.

Challenges

Possibility of air bubbles in the system and contamination. When several microfluidic chips are running simultaneously, the pump may generate variable flow rate speeds. Optimization of perfusion regiment, flow rate. Specific kits for RNA extraction tailored for few number of cells need to be considered.

Future & Other applications

Application for anticancer drug testing.

REFERENCES, ASSOCIATED DOCUMENTS AND OTHER INFORMATION

References

J. G. Toma, I. A. McKenzie, D. Bagli, and F. D. Miller, “Isolation and Characterization of Multipotent Skin-Derived Precursors from Human Skin,” Adv. Environ. Biol., vol. 23, no. 6, pp. 727–37, 2005
R. M. Rodrigues et al., “Human skin-derived stem cells as a novel cell source for in vitro hepatotoxicity screening of pharmaceuticals.,” Stem Cells Dev., vol. 23, no. 1, pp. 44–55, 2014

Coordinated by

Financed by