Editorial

Organs-on-chips: latest developments

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Welcome to the collection of the current must-read open-access papers in the field of organs-on-chips that have become available in the second half of 2018. This quarterly editorial column will be compiled by Dr. Andries D. van der Meer, University of Twente, The Netherlands. Feel free to contact him with tips about open-access papers on organs-on-chips and microphysiological systems that you feel should be included in upcoming collections.

Low oxygen keeps the gates closed in a blood-brain barrier-on-chip

The human brain is protected from many substances in the blood by maintenance of the blood-brain barrier. Because the blood-brain barrier is also important in regulating access of therapeutic compounds to the brain tissue, realistic models of this complex biological barrier are essential. Many organ-on-chip models of the blood-brain barrier have already been published, but it has proven difficult to maintain a tight and stable barrier. In this study, a team led by researchers from the Wyss Institute of Harvard University, it is shown that by limiting the amount of oxygen in an organ-on-chip with stem cell-derived blood vessel cells, a tight barrier can be maintained for longer periods of time (1).

Tuning the extracellular matrix improves interaction between brain cells and microvessels

Even more developments in the area of blood-brain barrier-on-chip technology are presented in this study carried out by researcher of Seoul National University in South Korea (2). In a three-dimensional microvessel-on-chip model, the researchers show that interactions between glial cells and vascular cells play a key role in tuning the geometry of brain microvascular networks and their function. Moreover, they show that these interactions are partially governed by the extracellular matrix that the cells reside in.

Six alveoli breathing in parallel inside a single lung-on-chip device

Many researchers working with organ-on-chip systems are familiar with the challenge of running multiple independent conditions in parallel, similar to what is normally done in tissue culture wells-plates. This becomes even more complicated if long-term experiments are required. In this paper, led by researchers from the University of Bern and their spin-off AlveoliX, a clear example is presented of how innovative platform technology is now becoming increasingly more successful in addressing this major challenge in the field (3). Not only does their platform allow six alveoli-on-chips to run in parallel in a single system, the lung cell co-cultures were stable for at least 21 days.

Translating data from microphysiological systems to humans

Microphysiological systems will find future applications in assessing whether specific drugs are safe and efficacious for patients. However, given their nature as simplified models, microsystems will not offer results that will not capture the full picture of the fate of a drug inside a human. In the coming years, it will become essential to combine the data from microphysiological systems with other experimental data on expected drug behavior in the body into more comprehensive computational models. These researchers from the Massachusetts Institute of Technology

and a consulting company, Stokes Consulting, discuss the challenges that lie ahead in this Perspective piece (4).

Clicking full-thickness skin into an organ-on-chip system

Cell culture-based models of the human skin are already widely applied in biomedical research, pharmaceutical research and research on cosmetics. Such models are typically based on membrane-based plastic holders, known as Transwell inserts. In this study, a team led by researchers from TU Berlin and its spin-off company, TissUse, demonstrate that it is not necessary to start from scratch when developing skin-on-chip models (5). The current cell culture models based on Transwell inserts can simply be integrated into microfluidic devices, thereby adding features like dynamic flow and small culture volumes.

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Footnote

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