Modular, Pumpless Multi-organ Microdevice Allowing Unidirectional Medium Flow

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Technology description

The invention relates to a microfluidic-based body-on-a-chip device that comprises single-organ chips or discs which can be assembled at will. The design of this device allows for independent maturation of the tissue cells (modularity of the chips) and for unidirectional re-circulation of the liquid medium via for example a new passive valve.

Multi-organ microphysiological systems have been developed to mimic the human metabolism in microfluidic devices. Called, body-on-a-chip system, it enables to study the reaction of miniature organs (culture of tissue cells in a chip) to the same environment (media) and the interaction between each other. The aim is to evaluate drug candidates in terms of toxicity, efficacy and delivery.

The present device developed at Cornell University addresses limitations of current body-on-a-chip systems:

The dependence on the use of an external or integrated micro-pump, which renders the system difficult to maintain at long term (bubble formation and cost);

The use of less media thus less growth factors, nutrients, etc.;

A recirculating media system that allows creating an adequate growing environment for each tissue and preserving the functionality of the tissues (shear stress).

Cornell researchers have designed a pumpless microfluidic platform that allows **stacking** multiple single-organ chips into a microdevice. The advantage of this design is multiple: (i) it enables to grow each tissue cells separately; (ii) it allows gravity-driven fluidic flow and passive fluid controls via hydraulic resistant of the microfluidic channel network (Fig. 1.3); (iii) unique, newly valve designs prevent the liquid medium from flowing backwards through capillary forces (Fig. 1.3).

Please download the Technology Brief for additional information

Additional Information

Patent Application in the U.S. 20180273888

Mandy B. Esch, et al. (2016). Modular, pumpless body-on-a-chip platform for the co-culture of GI tract epithelium and 3D primary liver tissue.Lab Chip16, 2719-2729. DOI: 10.1039/c6lc00461j

For similar technologies, please see D- 4601

For additional technologies from the same inventor, see D- 5978 "3D Porous Membrane that Mimics in vitro Epithelia "

Application area

Drug testing in co-culture (toxicity, efficacy and delivery)
Adaptable to high throughput screening.

Advantages

Easy, leak-free and air bubble-free assembly of microfluidic devices
Inexpensive and easy to use
Allows for co-culture of tissuein vitro
Allows for independent tissues maturation and suitable to study cell lines that reach confluency at different time
Unidirectional flow eliminating fluid shear effects thus suitable to culture barrier tissues that are sensitive to the direction of the shear
Allows for personalize design of systems with multiple organ settings by stacking of single-organ chips
System can be singular or adapted to fit multiple well plates.

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