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Opinion

A Gargantuan Effort

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Opinion

"Human-on-a-Chip" is an intricate experimental system designed to study an aspect of the human body under controlled conditions. The design of such a system requires the knowledge of the human body, biological systems and engineering to set-up and install regulated control systems to support living cells. Microfluidic devices provide dynamic conditions and keep cells alive with continuous monitoring to conduct specific experiments. However, the human body is a complex system of many cells. Scientists Sender, Fuchs and Milo from Weizmann Institute reported that the number of human cells in a 70 kg "reference man" is estimated to be about 30 trillion and the number of bacterial cells found throughout the body is about 39 trillion. These trillions of human and bacterial cells live together in the body in a coordinated fashion influenced by countless external and internal signals, hormones, cytokines, local responses and mediators. How easy will it be to design a system that includes these trillions of different cells and signals? Even though the microfluidic channels do provide layers of cells attached to a plastic substratum, the materials used are far-removed from the living world of the architecture of the microcirculation and capillary beds. The synthetic material commonly used is PDMS (polydimethylsiloxane) which has been explicitly shown to adsorb biomolecules. Thus, surface chemists can provide expertise to modify such surfaces or develop alternative materials for better compatibility with cells and less adsorption of molecules.

Researchers at the Wyss Institute, Harvard University developed microfluidic devices as "Human Organs-on-Chips" as an alternative means to model human diseases *in vitro* for the development of new drugs. Several "human-organs-on-chips" can be connected to investigate the interaction between different biological systems. These devices are coated with human cells from the organs and can be used to predict pharmacokinetic and pharmacodynamic (PK/PD) responses to drugs *in vitro*. Microfluidic systems have multiple advantages. They are an excellent alternative to animal testing. Many animals are subjected to pain and distress during testing and some do not even survive until the end of the experiments. Animal experiments take a long time and require expensive animal facilities. Furthermore, animals do not provide an exact replica of humans! Thus, these systems can be used to model diseases and test various conditions or treatments. It is a heroic attempt to set-up a "Human-on-a-Chip" but how many questions can be addressed, studied or explored in one set-up or multiple connected set-ups? A student who had conducted research in this area once commented that the biological aspect of the problem was drowned in addressing the overwhelming problems associated with the engineering design and computerized monitoring systems needed to keep the cells alive and conduct the experiments.

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Conflict of Interest

No conflict of interest.

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