Medical Xpress

Wake Forest Baptist leads $24 million project to develop 'Body on a Chip'

September 10 2013

Whether it's the Ebola virus or Sarin and Ricin, a key to responding to chemical or biological attacks is having effective antidotes at the ready. To accelerate the development of new therapies, Wake Forest Baptist Medical Center's Institute for Regenerative Medicine is leading a unique $24 million federally funded project to develop a "body on a chip" that will be used to develop these countermeasures.

This contractual effort was awarded by Space and Naval Warfare Systems Center, Pacific (SSC Pacific), on behalf of Defense Threat Reduction Agency (DTRA). The goal is to build a miniaturized system of human organs to model the body's response to harmful agents and develop potential therapies. This approach has the potential to reduce the need for testing in animals, which is expensive, slow, and has results that aren't always applicable to people.

"Miniature lab-engineered, organ-like hearts, lungs, livers and blood vessels – linked together with a circulating blood substitute – will be used both to predict the effects of chemical and biologic agents and to test the effectiveness of potential treatments," said Anthony Atala, M.D., institute director and lead investigator on the project. "We are fortunate to have experts from around the country join us on this effort."

The "body on a chip" concept is possible because of advances in micro-tissue engineering and micro-fluidics technologies. It is based on similar accomplishments in the electronics industry. Rather than miniaturizing electronics on a chip, however, researchers are miniaturizing human

organs, monitoring devices and laboratory processes.

The project involves using human cells to create tiny organ-like structures that mimic the function of the heart, liver, lung and blood vessels. Placed on a 2-inch chip, these structures will be connected to a system of fluid channels and sensors to provide on-line monitoring of individual organs and the overall organ system.

The circulating blood substitute will keep the cells alive and can be used to introduce chemical or biologic agents, as well as potential therapies, into the system. Hollow channels will automatically guide the toxins or therapies that are being evaluated from one tissue to the next and sensors will measure real-time temperature, oxygen levels, PH and other factors.

"If successful, the platforms established under the eX Vivo Capabilities for Evaluation and Licensure (X.C.E.L.) program would significantly decrease the time and cost needed to develop medical countermeasures which would have a direct and positive affect on the ability of the United States government to respond to a chemical or biological attack," said Dr. Clint Florence, acting branch chief of vaccines within the Translational Medical Division at DTRA. "A long-term goal of this research is to explore the potential for this technology to reduce the overall burden of in vivo testing in the development and management of products for human use by accurately predicting human safety, efficacy and pharmacokinetics of candidate Medical Countermeasures (MCMs)."

Wake Forest Baptist's one-of-a-kind 3-D printer will be used to print the organoids onto the chip. Other partners on the project – and the expertise they will contribute – are:

- Brigham and Women's Hospital, Boston – micro- and nanoscale bioengineering devices for controlling cellular behavior.
- University of Michigan – microscale models of the body and

biomolecular devices and technologies for high-throughput drug testing.
- The U.S. Army Edgewood Chemical Biological Center – chemical warfare agent research, development, engineering, and testing.
- Morgan State University – laboratory testing of cell cultures to identify the ideal blood surrogate.
- The Johns Hopkins Bloomberg School of Public Health – toxicity testing and identification.

While the idea of culturing 3D human tissue on a chip is not new, this will be one of the first efforts to combine several organs in the same device to model the human response to chemical toxins or biologic agents. It is hoped that the system can also identify pre-symptomatic "biomarkers" of exposure and assess the effectiveness of treatment.

Provided by Wake Forest University Baptist Medical Center

Citation: Wake Forest Baptist leads $24 million project to develop 'Body on a Chip' (2013, September 10) retrieved 27 April 2024 from https://medicalxpress.com/news/2013-09-forest-baptist-million-body-chip.html

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