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Stem cell based human on a chip models for drug efficacy safety and precision medicine

The utilization of human-on-a-chip (HoaC) systems for compound efficacy and safety testing which could ultimately lead to precision, personalized medicine is a topic that has recently received much attention. Of critical importance to the development of these systems is the incorporation of organ modules derived from human stem cells. Stem cells provide an inexhaustible source of cells that can be differentiated in multiple lineages with induced pluripotent stem cells (iPSCs) serving as the benchmark for personalized medicine. Key characteristics needed for these systems are the ability for organ-to-organ communication in a serum-free recirculating medium, and incorporation of induced pluripotent stem cells that allow for understanding individuals' genetic variation and for construction of systems using diseased patients' cells. Additionally, real-time monitoring of organ health and physiology using non-invasive, functional readouts is a desirable system characteristic for repeat dose or chronic drug treatment programs. Currently, these are only possible using animal models or human clinical trials. Hesperos has constructed stem cell-based, human body-on-a-chip systems demonstrating physiological responses to compounds in configurations of up to five organs. System configurations have included stem cell-derived cardiomyocytes, skeletal muscle myotubes, brain micro vascular endothelial cells, motoneurons, sensory neurons and cortical neurons. Acute and chronic compound testing in our HoaC systems (>28days) has generated responses similar to those seen in clinical data or reports in the literature.

Biography

John W Rumsey is leading and performing biomedical research in the areas of neural tissue engineering and cell metabolism serves as a foundation for research into establishing human-on-a-chip systems that mimic the structural, physiological and metabolic properties of the in-system tissues. He had experience in establishing models of spinal cord and sensory neuron myelination with node of Ranvier formation and contractile skeletal muscle myotubes. He also had experience in using photolithography and bioMEMs devices integrated with primary cells to direct growth, differentiation, and functional property maturation of neurons and muscle. Additionally, he has investigated the metabolic programming of skeletal muscle using *in vivo* and *in vitro* models, ultimately elucidating the role of the PGC-1 family of transcriptional co-activators in oxidative metabolic programming, fiber type determination and the endurance phenotype. At Hesperos, Inc. he had been involved in the development of human-on-a-chip models of physiology and disease using organ modules including cortical neurons, motoneurons, skeletal muscle, liver, cardiomyocytes, adipocytes, kidney and various barrier tissues. These human-on-a-chip model systems have been used for disease modeling and drug discovery purposes.

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