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New microdevice replicates embryonic spinal cord development

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Researchers at the University of Maine MicroInstruments and Systems Laboratory (MISL), in collaboration with The Jackson Laboratory, have developed a new microfluidic tool that reproduces in the laboratory the same physiochemical environment that instructs embryonic stem cells to develop into organized tissue.

Using this device, the research team has successfully cultured a portion of a spinal cord on chip.

During embryonic development, specific chemicals called morphogens direct stem cells to develop and organize into their appropriate tissues. Using the new microdevice to duplicate that spatial distribution of morphogens in the laboratory results in the same tissue organization, says UMaine professor Scott Collins.

Using the same equipment and techniques employed in making integrated circuits and computer chips, the research team designed and fabricated a microfluidic chip consisting of a labyrinth of tiny culture chambers and interconnecting fluidic channels to generate the same morphogen distributions known to induce spinal cord development.

The research was the topic of a UMaine doctoral dissertation by Christopher Demers, now a postdoctoral research fellow at the Francis Crick Institute in London.

"Of course, not all neural subtypes were fully expressed in our device,

indicating that we did not duplicate the exact embryo environment, but it will certainly be interesting finding out what is missing," Demers said.

The microfluidic device promises to provide developmental biologists with a powerful new tool with which to study how cells make differentiation decisions during embryonic development.

The microdevice also has potential for studying limb and organ regeneration, diagnostics and therapeutics for neuromuscular diseases, such as amyotrophic lateral sclerosis (Lou Gehrig's disease), spina bifida and anencephaly, as well as drug discovery and personalized medicine.

The work was performed at the University of Maine MicroInstruments and Systems Laboratory (MISL) in collaboration with researchers at The Jackson Laboratory under a grant from the National Science Foundation [IOS-1145949]. The research team is now collaborating with the Francis Crick Institute to further develop the technology for developmental biologists.

More information: Christopher J. Demers et al. Development-on-chip:neural tube patterning with a microfluidic device, *Development* (2016). DOI: 10.1242/dev.126847

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