Miniature Livers Created in Wake Forest Lab

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The next step, said lead author Pedro Baptista, PharmD, PhD, is to see if the livers will function after they're transplanted in an animal model.

The ultimate goal of the research, explained Baptista, is to provide a solution to the shortage of donor livers available for patients who need transplants. Laboratory-engineered livers could also be used to test the safety of new drugs. "Our hope is that once these organs are transplanted, they will maintain and gain function as they continue to develop," he said.

The engineered livers, which are about an inch in diameter and weigh less than an ounce, would have to weigh about 1 pound to meet the minimum needs of the human body. Even at this larger size, the organs wouldn't be as large as human livers, but would likely provide enough function. Research has shown that human livers functioning at 30 percent of capacity are able to sustain the human body.

To engineer the organs, Baptista's group used animal livers that were treated with a mild detergent to remove all cells—a process called decellularization—leaving only the collagen scaffold. The researchers then replaced the original cells with two types of human cells: immature liver cells known as progenitors, and endothelial cells that line blood vessels.

The cells were introduced into the liver scaffold through a large vessel that feeds a system of smaller vessels in the liver. This network of vessels remains intact after the decellularization process. The liver was next placed in a bioreactor, an important piece of laboratory equipment that provides a constant flow of nutrients and oxygen throughout the organ.

After a week in the bioreactor system, the scientists documented the progressive formation of human liver tissue, as well as liver-associated function. They observed widespread cell growth inside the bioengineered organ.

The ability to engineer a liver with animal cells had been demonstrated previously. However, the possibility of generating a functional human liver was still in question.

The researchers said the current study suggests a new approach to whole-organ bioengineering that might prove to be critical not only for treating liver disease, but also for growing organs such as the kidney and pancreas. In fact, scientists at the Wake Forest are working on projects focusing on the kidney and pancreas as well as many other tissues and organs. They're also working to develop cell therapies to restore organ function.

Bioengineered livers could also be useful for evaluating the safety of new drugs. “This would more closely mimic drug metabolism in the human liver, something that can be difficult to reproduce in animal models,” Baptista noted.
