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New engineering method could overcome barriers in diabetes cell therapy

by Amirah Al Idrus |
May 8, 2018 4:28pm

The researchers tested their culture method with donated human organ cells, mouse organ cells and induced pluripotent stem cells. (CSIRO)

Pancreatic cell transplants have the potential to be a permanent treatment for Type 1 diabetes. Problem is, the cells have trouble forming the blood vessel networks they need to thrive and provide insulin to patients. So scientists in the U.S. and Japan devised a new tissue engineering method to tackle this blood-supply problem in pancreatic cell transplantation. Using the method, they created pancreatic islets that cured severe Type 1 diabetes when they were transplanted into mice.

Human pancreatic islets tend to lose their blood vessels while being prepped for transplant, and attempts to combat this—including creating new islets from stem cells—have been largely unsuccessful, the researchers, from Cincinnati Children's Hospital and Yokohama City University (YCU), wrote in their study. So to speed up vascularization in transplanted tissues, the researchers, led by Takanori Takebe of Cincinnati Children's and Hideki Taniguchi of YCU, created a technique called self-condensation cell culture.

The team tested it with donated human organ cells, mouse organ cells and induced pluripotent stem cells, combining each of these cell types with progenitor cells called mesenchymal stem cells and human umbilical vascular endothelial cells. They also added genetic and biochemical material that triggered the formation of pancreatic islets. Cultured in an endothelial cell growth medium, the "ingredients condensed and self-organized" into pancreatic islets.

"The self-condensation of human and mouse islets with endothelial cells not only promoted functionalization in culture but also massively improved post-transplant engraftment," they wrote in the study. The transplant treated mouse models of Type 1 diabetes more effectively than did a conventional approach, they reported.

While the study is promising, Takebe warned that more work is in store before it can be used in humans. Transplanting donor cells might provoke a rejection from the recipient's immune system, while a stem cell-based approach carries the risk of tumors that can arise from residual immature cells.

In fact, multiple companies and academic teams are working to lessen those sorts of risks by finding new ways to encapsulate stem cell-based therapies. Eli Lilly, for one, recently handed over $63 million up front to license Sigilon's islet cell encapsulation technology, while Semma Therapeutics raised $114 million last fall to move its encapsulated therapy into the clinic.

And there is widespread interest in academia in converting patients' own cells into diabetes treatments, which could eliminate the risk of immune rejection. In February, researchers from the University of Miami Miller School of Medicine's Diabetes Research Institute confirmed the existence of progenitor cells that can become insulin-producing beta cells in the pancreas, and a Stanford team is working on converting pancreatic alpha cells to beta cells.

Takebe hopes to further develop his team's vascularized tissues and examine their potential as a transplantable treatment for diabetes. "This is a life-threatening disease that never goes away, so developing effective and possibly permanent therapeutic approaches would help millions of children and adults around the world," he said.