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Researchers develop oxygen-generating biomaterial

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Scientists at the Diabetes Research Institute have developed a revolutionary technique to provide critical oxygen for maintaining the survival of insulin-producing cells. This is the first time that scientists have been able to successfully deliver oxygen locally to beta cells using a biomaterial. The results of the study, which represents a major step toward the goal of developing an alternative site to house insulin-producing cells, were just published in the prestigious journal *Proceedings of the National Academy of Sciences* (*PNAS*).

One of the major problems with the transplantation of cells, particularly beta cells, is meeting the high nutrient demand of these cells following transplantation. During the initial days of implantation, these cells do not have a functioning vascular network feeding oxygen to the cells, thus cells become starved and large cell loss occurs.

The DRI team, led by Dr. Cherie Stabler, developed a novel oxygen-generating material (termed PDMS-CaO2), which has the capacity to generate this critical element when exposed to water. This spontaneous generation of oxygen creates a nutrient-rich environment with sustained oxygen supplementation for more than six weeks. With this unique biomaterial system, the duration and amount of oxygen generated can be elegantly controlled, thereby providing the ideal environment for the cells. The potential of this technique to enhance beta cell survival with the use of this material was illustrated by incubating beta cells and islets in conditions that mimic the native pancreas.

"We have been working to create an optimal environment for housing transplanted islets that mimics the native pancreas, akin to a 'mini organ,' and this study represents a significant step toward that goal," says Dr. Cherie Stabler. "This oxygen-generating biomaterial provides the supplemental oxygen needed by the islets and serves as a bridge until the vascular bed (blood vessels) is formed, providing natural oxygen delivery to the insulin-producing cells."

In the study, the researchers also used a 3D model, similar to the bioengineered scaffold, to demonstrate that the oxygen-generating material was able to prevent cell death due to inadequate oxygen levels. With these promising results, future studies are focused on translating these studies to implanted grafts, with the end goal of preserving islet viability during the precarious engraftment period.

"This novel method for sustained oxygen delivery within the microenvironment of tissue-engineered sites, could be critically important to improve the survival of transplanted cellular products. The new platform technology could be particularly useful during the delicate post-implantation phase, in which new blood vessels are growing to provide full nutritional and oxygen support to the transplanted tissue," said Dr. Camillo Ricordi, DRI scientific director.

"We are very encouraged by the outcome of this study and its implications toward our goal of translating these findings to the millions of people living with diabetes," added Dr. Stabler.

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