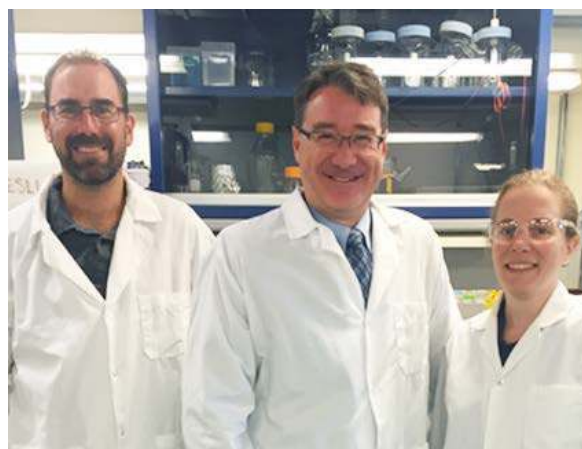


3D-printed bioartificial pancreas: From science fiction to science fact



Researcher Richard Leask; Dave Prowten, president and CEO at JDRF Canada; and lead researcher Dr. Corinne Hoesli from McGill University

Type 1 diabetes (T1D) is an autoimmune disease that occurs when the body's immune system attacks and destroys the cells in the pancreas that make insulin. Unlike type 2 diabetes, T1D is not linked to being overweight, lack of exercise or other lifestyle factors. It is not preventable and its cause is unknown.

Pioneering research could make insulin injections a thing of the past.

A 3D-printed, fully transplantable bioartificial pancreas that requires no maintenance? It may sound like science fiction, but it's definitely not – it's science fact. Thanks to a JDRF grant, a multidisciplinary team from McGill University, McGill University Health Centre and Laval University is actually building this 3D-printed bioartificial pancreas. This bioartificial pancreas is designed to become a permanent part of the body and function as independently as a normal pancreas, with no patient intervention required.

"It would be very similar to a bypass surgery," explains Dr. Corinne Hoesli, who is leading the pioneering research at McGill.

In 2000, a team of scientists in Edmonton, Alberta, reported that people with type 1 diabetes (T1D) who received islet cell transplantation could avoid insulin injections for up to five years. Their research became known as the "Edmonton Protocol". This was undeniably an important breakthrough in diabetes research, but one of the downsides of the approach is rejection of the newly transplanted islets by the body's immune system, notes Dr. Hoesli. In addition, the donated islet cells do not receive enough blood and oxygen to ensure long-term insulin production and cell survival.

Dr. Hoesli and her team (André Bégin-Drolet, Steven Paraskevas, Richard Leask and Jean Ruel) are working to advance this research by creating a protective pouch that's about half the size of a teacup (50 to 100 mL) to house the insulin-producing beta cells. The design of the protective pouch aims to allow the cells to survive and thrive for many years.

"Our end goal is to provide a long-term solution for T1D patients by protecting the cells from the immune system – ultimately making the procedure accessible to more patients," says Dr. Hoesli.

In September 2016, the Food and Drug Administration approved the first artificial pancreas for use in the US. The system includes a sensor that is attached under the skin and continuously measures glucose levels. Then, an external insulin pump that is

connected to an infusion patch delivers insulin through a catheter. However, while the device automatically adjusts insulin levels, patients still need to manually adjust insulin doses around mealtimes.

While the FDA-approved artificial pancreas is a major boon for T1D patients, Dr. Hoesli and her colleagues hope to go one step further and develop a fully transplanted bioartificial pancreas that functions as independently as a normal pancreas, without the need for any intervention by the patient.

However, says Dr. Hoesli, it is very important to note this research is in its infancy. The investigators are currently working to engineer the 3D-printed pancreas, including mapping the artificial organ's blood vessel system and studying how well the donated islet cells survive. The next step will be to conduct transplantation studies in animals to determine whether the procedure will be feasible in human T1D patients.

"Right now, we have a proof-of-principle device, but we still need to check how the cells perform in it. Within the next year-and-a-half, we hope to conduct animal studies to test whether we can flow blood through the apparatus," says Dr. Hoesli.

Although at this early stage it's very difficult to estimate when this device will move into the human testing phase, says Dr. Hoesli, it could one day eliminate the need for insulin injections for millions of people living with T1D.

About JDRF

JDRF is the leading global organization funding type 1 diabetes (T1D) research. Our goal is to raise funds to support the most advanced international T1D research and progressively remove the impact of this disease from people's lives – until we achieve a world without T1D. JDRF collaborates with a wide spectrum of partners and is the only organization with the scientific resources, regulatory influence, and a working plan to better treat, prevent, and eventually cure T1D. JDRF is the largest charitable supporter of T1D research. For more information, please visit jdrf.ca.

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