3D printing technique explored to help treat type 1 diabetes

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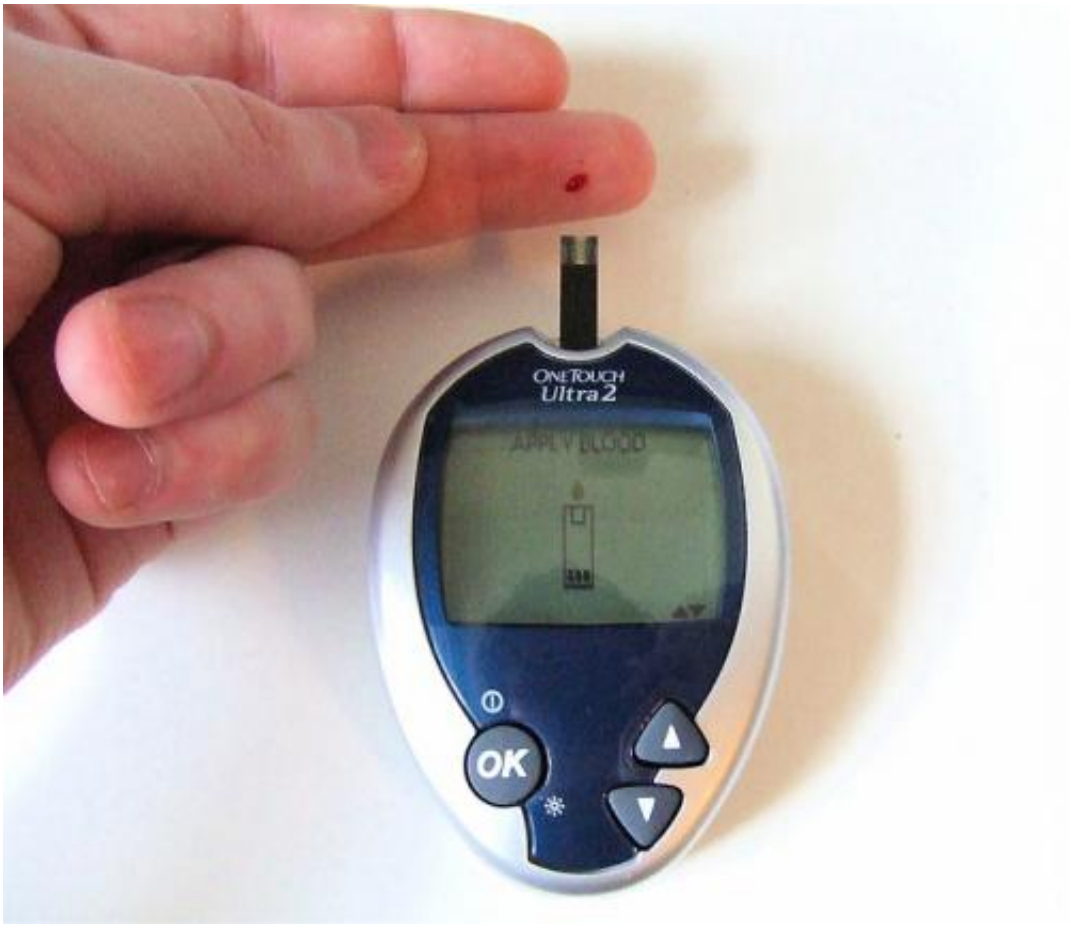

Blood glucose monitoring. Credit: Wikipedia

Researchers from the Netherlands have explored how 3D printing can be used to help treat type 1 diabetes in results presented today, Thursday 28

May, in the journal *Biofabrication*.

The 3D printing technique, known as bioplotting, has taken researchers one step closer to being able to help patients who experience severe hypoglycaemic events, commonly known as 'hypos'- a problem that affects about a third of people with type 1 diabetes according to Diabetes UK.

The paper describes how clusters of specialized cells responsible for the production of insulin and glucagon in the pancreas, called islets of Langerhans, have successfully been 3D printed into a scaffold. It is hoped that the scaffolds can be transplanted into patients with type 1 diabetes to help regulate blood sugar levels and avoid 'hypos'.

In their study, the group of researchers sought to increase the success of islet transplantation by creating bioengineered scaffolds to help deliver the transplanted islet cells into patients, ensuring the cells are protected and fully functioning when placed at the donor site.

The islets were embedded into three-dimensional scaffolds made from an alginate/gelatin mixture with a cross-linked structure and showed full functionality once extracted, meaning that the scaffolds could function as a potential delivery vehicle in future transplantations. The islet cells were included in the liquid hydrogel mixture during printing to create the porous three-dimensional scaffold.

When selecting the material for the scaffold, the researchers had to strike a balance between a liquid mixture that had a high enough viscosity for a strong scaffold to be 3D printed, and a mixture that would not compromise the functionality of the cells when transplanted.

The porous structure of the scaffolds was selected over a bulk material so that it could efficiently facilitate the exchange of glucose and insulin.

At the same time, the scaffold was designed to offer protection to the islet cells from the body's immune system, which would recognise the foreign cells and begin to attack them.

It is for this particular reason that current islet transplantation patients need to undergo a lifelong immunosuppressive therapy to avoid rejection of the transplanted donor tissue.

Co-author of the study Dr A A van Apeldoorn, from the University of Twente, said: "Our results showed that once the islet cells were retrieved from the alginate/gelatin scaffolds in the lab they were able to produce insulin and respond to glucose in the same way as non-printed islet cells, indicating that the procedure had not affected their viability or function at all.

"The macroporous scaffolds also ensured that the islet cells would not migrate uncontrollably through the body once transplanted into the donor site.

"If we are to improve the success of this treatment for type 1 diabetes, we need to create an implant in which islets are embedded, or encapsulated, from a material that allows for very efficient oxygen and nutrient supply, and quick exchange of glucose and insulin, while keeping the host cells out.

"Our future research will look further into recreating an optimal islet microenvironment to provide the donor islets with the best transplantation start possible."

More information: Fabrication of three-dimensional bioplotted hydrogel scaffolds for islets Langerhans transplantations, Marchioli et al 2015 *Biofabrication* 7 025009, iopscience.iop.org/1758-5090/7/2/025009

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