VASCULAR GRAFT TO PROMOTE STEM CELL THERAPY FOR DIABETES AND OTHER DISEASES

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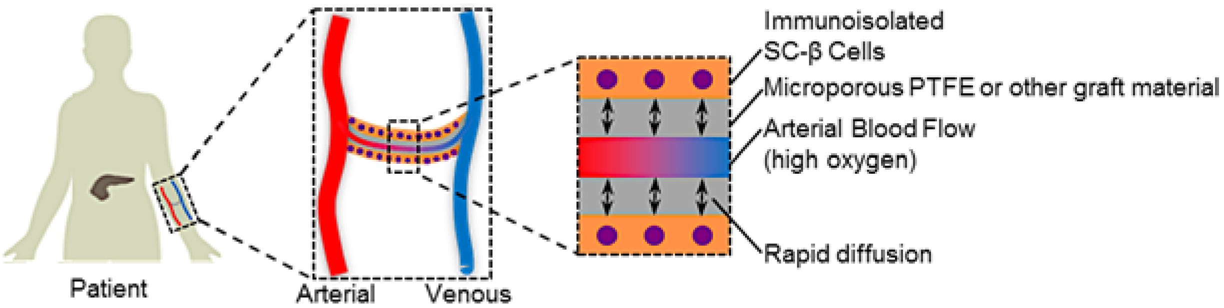
Technology Description

An interdisciplinary team at Washington University in St. Louis has developed a multi-layered arteriovenous graft device that enhances the survival and function of stem cell transplants to treat Type 1 diabetes or other diseases. Artificial organs derived from stem cells could provide long-term, physiologically-regulated enzyme replacement treatment for a variety of conditions. In order to survive, these stem cells must have a sustainable and constant blood supply and they must be protected from attack by host immune system. This new vascular graft achieves those goals: the cells are directly connected to the blood supply to provide oxygen and nutrients for survival; and they are embedded in a hydrogel to protect them from the immune system. Furthermore, because the graft has direct proximity to arterial and venous blood, the transplanted cells can sense metabolites in the blood and secrete enzymes or growth factors in response to physiological conditions. Finally, the graft can be easily inserted, replaced or removed as needed to enhance the treatment or for patient safety.



This device could be used to deliver stem cell-derived insulin-secreting pancreatic beta-cells, which are able to treat Type 1 or Type 2 diabetes via real-time sensing of blood glucose and rapidly delivering intravenous insulin. The same method can also be adapted for thyroid or adrenal gland cells to deliver other cell types, enzymes or growth factors.

Stage of Research

The inventors have built a viable prototype graft that can be implanted with stem cell-derived beta-cell clusters. The inventors have also developed methods for reliable implantation and immune shielding of stem cell-derived beta-cell clusters. In vivo these cells are able sense blood glucose levels and rapidly secrete insulin in real-time. The inventors continue to currently develop and refine the next generation prototypes and implantation methods.

Applications

- **Regenerative medicine device** – graft to deliver biologically active, organ-specific differentiated

stem cells, such as:
  - beta-cells to secrete insulin and treat Type 1 and Type 2 diabetes by normalizing blood glucose
  - Thyroid or adrenal gland cells for enzyme and growth factor-replacement therapy

Key Advantages

- **Enhanced cell/artificial organ survival:**
  - Cells embedded in graft, surrounded by hydrogel to protect them from host immune system
  - Cells have direct access to arterial blood supply to provide oxygen and nutrients
- **Enhanced function/physiological regulation:**
  - For b-cells – cells in graft detect blood glucose fluctuations in real-time and can rapidly deliver insulin for glycemic control
  - For other cells (e.g., thyroid or adrenal) – could detect needed levels of metabolites to secrete other enzymes or growth factors
- **Easy access for removing or replacing –** Graft can be implanted under a patient's skin in an outpatient procedure and accessed percutaneously, allowing access to:
  - Periodically load the graft with new cells
  - Replace the device with a fresh graft
  - Remove the device to ensure patient safety
- **Convenient for patients –** Cell therapy could provide a long-term glycemic control solution for patients with Type 1 and Type 2 diabetes without conventional blood monitoring and insulin injections

Patents

- US 20210290821

Website

- Millman Lab
- Zayed Lab

Publications

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