Bioengineering Islet Cells Using 3D-Bio Printing Technology for the Treatment of Type-1 Diabetes

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Transplantation of isolated human pancreatic islet cells secrete insulin and cures diabetes in patients. Native islets in the pancreas have a rich blood supply and they provide efficient delivery of oxygen and nutrients to islet cells. However, the current islet isolation technique completely severs the vasculature to islets. As such, these islets become avascular and many of them die after transplantation. My hypothesis is, if I create blood vessels around islets, they will survive and reverse diabetes efficiently. So my overall specific aim was to stimulate intra-islet endothelial cells (IIEC) [present inside islet] to form peri-islet vessels (PIV) in culture condition prior to transplantation. I tested my hypothesis and accelerated the formation of PIV to human islets by stimulating the IIEC with the addition of ECGS (Endothelial Cell Growth Supplement) in a 3D-culture system. Human islets cells were isolated from brain-dead donor pancreases (n=18), islet spheroids were prepared using 3D bio-printing technology and the spheroids were cultured with ECGS in a 3D collagen-I gel for 14 days. Confocal microscopy was used to assess islet-derived PIV growth. Human endothelial cell was identified via labeling with UEA-1 staining in bioengineered islets (BEI). To study diabetes reversal, the BEI were implanted in to diabetic nude mice at the subcutaneous site. My results indicated that this approach induced cellular sprouting (blood vessels) from human islets and were positive for endothelial cells (CD31, UEA-1). The BEI maintained >90% cell viability, high insulin secretory capacity when compared to control islets and importantly, BEI reversed diabetes in mice and proved my hypothesis. I can conclude that creating BEI is a novel approach for the treatment of type-I diabetes.

Awards Won:

Second Award of $2,000

American Physiological Society: Second Award of $1,000