A Novel Stem Cell Approach for Curing Diabetes  
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My project centers on finding new ways of generating insulin producing cells from human stem cells. I focus on understanding basic mechanisms of cell to cell communication in stem cells during their development into immature pancreatic cells, and eventually insulin-producing cells.

Type 1 diabetes (T1D) is also referred to as juvenile onset diabetes. It is a devastating disease affecting more than 1 million people in the U.S. and is typically diagnosed during childhood. There are 15,000 children diagnosed with the disease annually and they must learn to tightly regulate and control this disease for the rest of their lives.

T1D patients no longer produce their own insulin, a hormone made in the pancreas that is responsible for maintaining steady levels of blood sugar. In an unaffected person, eating a donut will cause the body to release insulin, which acts as a key to let sugar enter cells in the body where it can be used to produce energy. In a person with T1D, there is no insulin to let sugar enter the body’s cells. Consequently, all of the sugar remains in the bloodstream unable to be used. This high blood sugar can result in a number of short and long term complications including blindness, heart disease, and organ failure, especially in the kidneys. Currently, the only viable option for T1D patients to survive is to take multiple daily injections of insulin to keep their blood sugar levels under strict control.

My research focuses on the development of new cell replacement strategies to restore insulin production in patients with T1D. Specifically, my goal is to turn stem cells into new insulin-producing cells that can one day be used for transplant. This process is already defined but I seek to increase the quantity of pancreatic cells we can generate.

To do this, my experiments aim at understanding and modifying the function of a class of proteins called Connexins which are responsible for connecting cells during their growth and development into different cell types in the body. These proteins function by forming small channels across cells that stick to one another. Think of adjacent cells as rooms in a house, Connexins act as a door between them to let things in and out. These channels are used by stem cells to exchange biochemical information and make collective decisions to either grow and expand, or acquire specific characteristics such as becoming a cell of the brain, heart, skin, or pancreas. These channels act as very selective gates of cell communication that are used by cells to exchange a variety of messages.

In line with this notion, I recently discovered that stem cells treated with a chemical to increase the function of Connexins exhibit a much higher propensity to become insulin-producers compared to untreated stem cells. It appears that promoting cell-to-cell communication during growth of immature pancreatic cells leads to increased numbers of insulin-producing cells. There is a technical bottleneck in generating large numbers of cells that can produce significant levels of insulin. In perspective, although a lab may be able to produce a couple million insulin-producing cells, we would need billions for a viable transplant. My discovery is important because it shows a connection between Connexin function and the ability to derive insulin producing cells.

This discovery of Connexin function relative to stem cell maturation may have a significant impact on the development of innovative new strategies to derive the cells we need for future use in transplantation.
for T1D patients. I am incredibly excited about where these experiments will lead and I am seeking you help in funding the studies. I am confident we can find the way to cell-replacement therapies for T1D.