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Title (English)

Mathematical modeling of insulin response in encapsulated islets of Langerhans

Title (Swedish)

Abstract

Transplantation of the islets of Langerhans is a promising technique for restoring the impaired insulin production in brittle type 1 diabetics. The downside is that the patient will have to take immunosuppressant drugs in order to protect the islet cells from the immune system. Donors are also sparse, making the quest of finding sufficient amounts of islets for transplantation hard. Encapsulation of the islets of Langerhans has been proposed as a means of protecting the cells from the immune system taking away the need for immunosuppresives. The most common encapsulation technique is extravascular capsules, which are categorized into micro- and macrocapsules. The microcapsules hold only one or a small set of islet whereas the macrocapsules hold a large quantity of islets.

This thesis investigates the encapsulation impact on the beta-cells rapid insulin response to rising plasma glucose levels. This was done by simulating the glucose-insulin system in MATLAB with included encapsulation of the islets. Two current macro-encapsulation set ups were used in the model, Beta-Air and ViaCyte devices, and they were compared against a normal case. The results showed that the Beta-Air device would not be able to restore normoglycemia in a T1DM patient but rather showed a delay in insulin response, while the ViaCyte device could mimic the normal case well.

Keywords

Encapsulation, glucose, insulin, secretion, islets, Type 1 diabetes mellitus

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