Abstract

Our research has been focused on a new method of transplantation of islets of Langerhans into the greater omentum. Transplantation of pancreatic islets is an established treatment option for selected patients with unstable diabetes. The liver is almost exclusively used as a site for islet transplantation in the clinical setting. Unfortunately, immediately after graft implantation into the portal circulation, a substantial portion of the islets is lost and graft function in the liver may further deteriorate over time. The fate and location of islets implanted in the liver can only be followed with difficulty by radiological methods or biopsies. All these limitations have led to the search for alternative sites for transplantation.

The greater omentum is easily surgically accessible, meets the demands of a high blood supply and can accommodate large volumes of transplanted tissue. However, the metabolic function of the islet graft itself in the omentum without fixation never achieved satisfactory long-term results in the experiment. Tissue engineering techniques have been used to improve graft attachment and maintain long-term function in the omentum.

In our project, we transplanted islets into the rat omentum using a biocompatible gel consisting of recipient plasma and human thrombin. Transplantation experiments were performed in diabetic rats and the metabolic results of the new transplantation method were compared with the standard liver transplantation method. We confirmed the location and viability of the graft in the omentum by quantitative bioluminescence imaging. In the second part of the experiment, we prepared decellularized pancreatic skeletons suitable for transplantation into the rat omentum. We implanted an iron nanoparticle-labeled graft into the skeletons and mapped these constructs by magnetic resonance imaging after transplantation into the omentum.

Given the success of the experimental model, we developed a protocol for transplanting islets of Langerhans in plasma-thrombin gel into the omentum of patients with type 1 diabetes mellitus with impaired hypoglycemia awareness syndrome. The allogeneic graft was transplanted into the large omentum dispersed in their own plasma and overlaid with human thrombin. The procedure was performed laparoscopically. In our project, the transplantation was successfully performed in 3 persons. Transplantation into the greater omentum resulted in stabilization of the disease, reduction of insulin doses and restoration of hypoglycemia awareness.