MR IMAGING OF THE PANCREAS

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Introduction

Imaging pancreatic islets in their native environment is a daunting challenge but given the potential benefits that would emanate from such a procedure, the notion has become a key objective of diabetes research. To meet this challenge, a successful imaging modality must have the sensitivity and contrast capable of detecting and identifying cell clusters (i.e., islets) that measure 150-200 μm on average in an organ located deep inside the body. One of the imaging modalities with the potential to do so is magnetic resonance (MR). The goal of our research is to acquire high resolution MR images of pancreatic tissue from healthy, islet autoantibody positive and diabetic donors, by utilizing native contrast mechanisms. This represents a dramatic shift in current islet MR imaging research that focuses on the use of exogenous contrast agents such as superparamagnetic iron oxide nanoparticles to enhance detection of the islets. It is our hypothesis that the native MR contrast mechanisms can identify pancreatic islets and detect changes in islet contrast that correlate with an increased risk for type 1 diabetes. Over the past two years we have successfully obtained MR images of isolated islets at isotropic resolution as low as 10 μm without the use of exogenous contrast agents. MR images depict islets as a heterogeneous tissue with significantly different MR properties (i.e., T2, T2*, Apparent Diffusion Coefficient) than acinar cells. These differences have allowed us to distinguish islets from surrounding acinar tissue.

Experimental

To initiate these experiments a mouse pancreas was made available to us and was fixed in formalin. The day before the acquisition of the images the tissue was dialyzed to rehydrate the tissue and replace the fixative. The pancreatic tissue was placed in a 5 mm NMR tube and submerged in PBS. MR images were acquired at 14T using both spin echo and gradient echo sequences. The spin echo images were acquired using a FOV of 0.75x0.5x0.5 (cm), a 160x128x128 matrix, SW=50,000Hz, TR=300ms, TE=5.8ms and 11 averages. The total acquisition time was 15 hours. The gradient echo images were acquired using a FOV of 0.75x0.5x0.5 (cm), a 108x72x72 matrix, SW=50,000Hz, TR=250ms, TE=5.8ms, a 30° flip angle and 16 averages for a total acquisition time of 5 hours and 45 min.

Results and Discussion

Figure 1 shows two slices through the pancreas acquired with a spin echo sequence (the two images on the left) and a gradient echo sequence (the two images on the right). Our images show certain distinct features within the pancreas. For instance the bright spots in the spin echo images are likely attributed to pancreatic ducts, while the dark features in the gradient echo images are likely due to blood present in the vessels. It is also possible that some of these dark spots that do not continue from slice to slice are due to islets. This sample was sent for histologic cross-sectioning to correlate with the MR images.

Conclusions

MR images of fixed excised pancreas demonstrate that anatomic features of the pancreas including ducts and vessels are detectable. It is also encouraging that islets may be detected as well. Since the detection of islets is our ultimate objective, the current data are very encouraging.

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