MR-guided Biopsy Targeting Transplanted MR-Visible Magnetocapsules (MCs) containing Human Islets

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Purpose: Assessment of in vivo transplanted islet cells is vital to assess the status engraftment and to monitor for rejection. Currently, transplanted islet cells are not visible. To further address this issue, magnetic resonance (MR)-trackable magnetocapsules (MCs) were created to simultaneously immunoprotect pancreatic beta cells and non-invasively monitor, in real-time, portal vein delivery and engraftment using MR imaging (MRI). The purpose of this study was to demonstrate the feasibility of MR-guided, targeted biopsy of MCs containing human islets in order to assess not only their viability and function, but also the host vs. graft tissue response.

Methods: MR imaging was performed using a dedicated interventional MRI/X-ray suite equipped with a Siemens Espree MRI scanner and AXIOM Artis dFC. Four weeks prior to biopsy, four swine underwent islet cell transplantation with human islets (110,000-140,000 MCs)placed in MCs and delivered into the portal vein of swine. Immediately before biopsy, the porcine liver was imaged using a contrast-enhanced, 3D T1-weighted sequence with high resolution isotropic (1x1x1mm) imaging that enables identification of the exact distribution patterns of MCs within the liver. Targeted superficial needle guidance was achieved by moving the operator's finger over the liver, while using a real-time MRI sequence. An MR-compatible 22 Ga FNA needle was placed into the liver under MR guidance to target the MCs. Four core biopsies were obtained using a co-axial biopsy needle system.

Results: MR-guided liver biopsy was successful in all animals with no indication of adverse events. Core biopsies were obtained and placed in formalin for further tissue analysis. Gross observation of the biopsy tissue revealed intact MCs, but detailed histopathology remains to be completed.

Conclusion: MR-guided biopsy of MCs transplanted in the portal venous system is a safe and feasible method for obtaining both encapsulated islets and host liver tissue. This allows histological assessment of islet cell viability and function, as well as the host tissue response towards the grafted material.

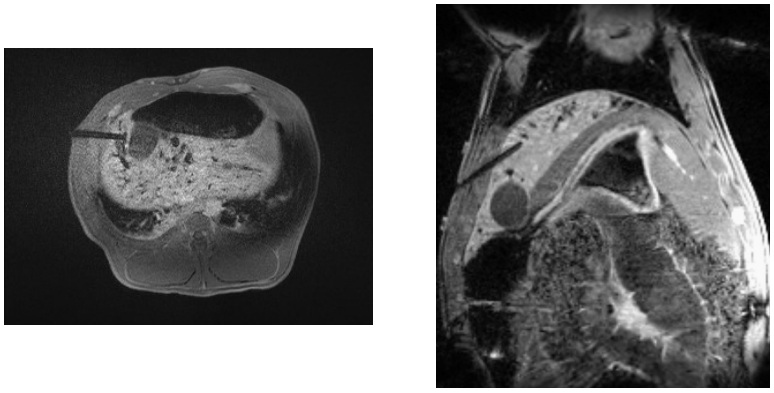

Figure 1. Axial and Coronal T1 post contrast MRI of the liver shows encapsulated islet cells as small areas of signal void. Panel A is an image from MR guided FNA of magnetocapsules. Dark linear signal represents the needle as it is directed towards the MCs in the right anterior lobe. Panel B shows MR guided core biopsy of magnetocapsules in the right posterior lobe.