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MR Imaging of the Human Biliary Tree Using a Flexible Catheter-Mounted Radio-Frequency Detector Microcoil

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Introduction

- Correct classification of biliary strictures as benign or malignant is difficult
- MRI and MRCP are the investigations of choice for bile duct strictures
- A MR system in which a miniature resonant RF detector is very closely apposed to the tissue of interest should improve the resolution of the images obtained
- Our group has developed a resonant microcoil, designed to be passed into the biliary tree via an endoscope to improve tissue conspicuity **(Figs 1 and 2)**

Aim

- To confirm the utility of a prototype MR receiver microcoil
- To image a human liver resection specimen
- To collect signal-to-noise ratio (SNR) and resolution data
- To collect comparable imaging data with the MR body coil

Method

- Two hemihepatectomy specimens were studied: **Specimen 1 (Fig 3) and Specimen 2 (Fig 6)**
- Images were acquired using a 1.5T GE Signa™ scanner
- The microcoil is a 60mm long flexible 2-turn thin film device, tuned and matched at 63.8 MHz and is attached to an 8F biliary catheter. Overall the probe is 2.7mm in diameter and is fully MR compatible
- Imaging data were first acquired using the main body coil for excitation and detection
- Each scan was repeated with the same parameters, but with the prototype microcoil used for detection
- The microcoil was located at the magnet isocentre and arranged parallel to the magnet bore
- Axial images were obtained
- Specimen 1: The microcoil was positioned on the surface of the specimen, parallel to the gallbladder and cystic duct **(Fig 3B)**
- Specimen 2: The microcoil was positioned in the surface of the specimen **(Fig 6, arrow A)** and then in a deep duct **(Fig 6, arrow B)**

Results

- High resolution images were obtained using the body coil **(Fig 4 and Fig 7)** and the catheter-mounted microcoil **(Fig 5, 8 and 9)**
- The microcoil images had a field of view of 15mm radius around the coil
- Resolution was substantially better in the images obtained with the microcoil than those obtained with the gantry receiver coil
- The SNR was 8-fold greater in the microcoil images; 260 vs 30

Conclusion

- **A MR microcoil can produce high quality images of *ex vivo* human liver tissue**
- These images demonstrate interpretable anatomical detail, with sub-millimetre resolution
- Images are superior to those obtained using a standard body coil
- Ongoing work includes:
  - migration to a 3T scanner
  - sequence optimisation
  - collection of MR spectroscopy data
  - development of a clinical study
- This catheter-mounted microcoil has the potential to enhance clinical imaging, as well as a number of exciting research applications

Acknowledgements

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Microcoil design

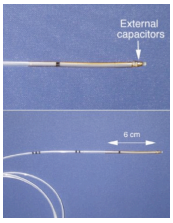

Figure 1: Catheter mounted microcoil

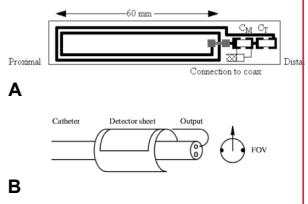

Figure 2 – Microcoil design showing (A) layout of copper track on film and (B) application of film to catheter

Specimen 1

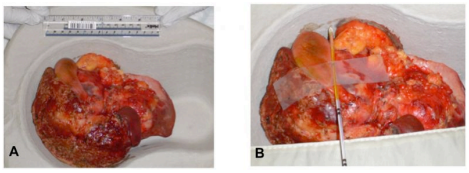

Figure 3 – Arrangement of microcoil catheter on hemihepatectomy specimen

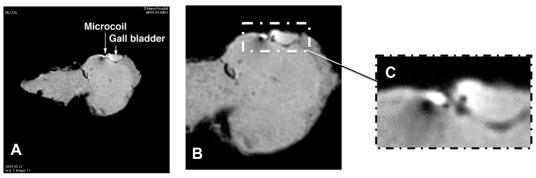

Figure 4 – MR images obtained using standard receiver body coil

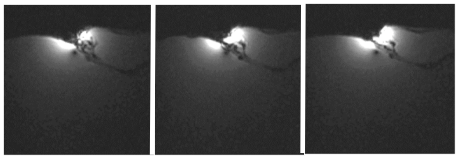

Figure 5 – MR images obtained using microcoil

Specimen 2

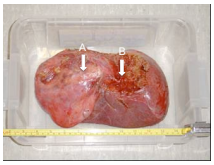

Figure 6 – Specimen 1

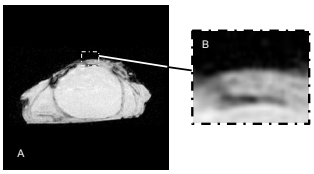

Figure 7 – standard receiver body coil images

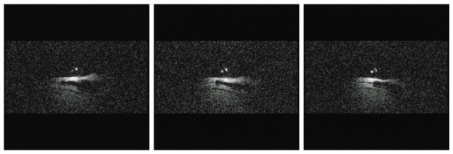

Figure 8 – Images acquired with microcoil on surface of liver (Fig 6, arrow A)

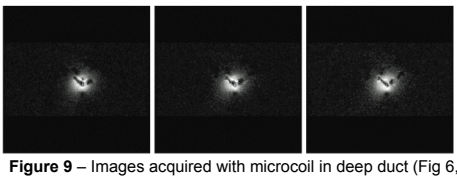

Figure 9 – Images acquired with microcoil in deep duct (Fig 6, arrow B)