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UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN
Laboratory of Comparative Genomics

Development and Initial Application of a Porcine-specific MRI and MRE Protocol for Liver imaging in a Large Animal Cancer Model

F.M. Thomas[1], B. P. Sutton[2,3], T.M. Wszalek[2], M.J. Dailey[1], K.M. Schachtschneider[4], L.B. Schook[1,2,3,4], R.C. Gaba[4]
[1]Department of Animal Sciences, [2]The Beckman Institute, [3]Biomedical Engineering,
University of Illinois, Urbana IL. United States
[4]Department of Radiology, University of Illinois, Chicago IL. United States

Background

- Hepatocellular carcinoma (HCC) spans more than 780,000 new annual diagnoses & causes 750,000 yearly mortalities
- The incidence of HCC is projected to increase given the growing prevalence of chronic liver diseases that increase the risk for carcinogenesis
- Current diagnosis of liver cirrhosis is invasive tissue biopsy, and those at-risk undergo HCC surveillance with ultrasound imaging to survey tumor development
- HCC screening programs center on static radiologic imaging snapshots prescribed at arbitrary intervals based on empiric histologic cirrhosis staging schemes and observational tumor developmental data that neither reflect the transition between normal and diseased states nor biologically relevant disease thresholds
- Magnetic resonance imaging (MRI) and elastography (MRE) may provide a more foundational portrayal of early stages of liver disease and liver oncogenesis that could result in early diagnosis when curative therapies could be employed

Objective

- To develop a clinically translatable MRI/MRE liver imaging protocol in a clinically relevant large animal platform using the Oncopig Cancer Model (OCM), anovel transgenic swine model that recapitulates human HCC through development of site and cell specific tumors after Cre recombinase induced expression of heterozygous *KRAS*^{G12D} and *TP53*^{R167H} transgenes.

Materials & Methods

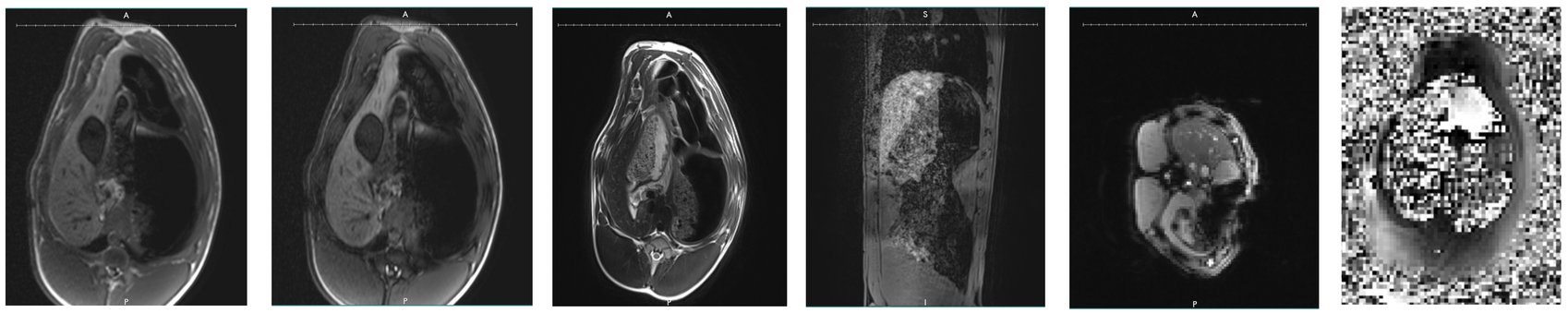
- Three OCM pigs were used in this study. All were female and were 89 days, 151 days, and 312 days old
- Scanning was performed on a Siemens 3T Trio MRI scanner, with animals under general anesthesia

Materials & Methods

- The clinical imaging workflow consists of:
  - T1 Flash in-phase and out of phase
  - T2-HASTE/BLADE acquisitions to provide motion-robust imaging
  - VIBE imaging
  - Diffusion-weighted imaging with IntraVoxel Incoherent Motion (IVIM) for estimating blood flow
  - MRE for quantifying liver stiffness.
- Additional MRI imaging for tumor characterization was also performed, spanning multiphase (arterial, venous, delayed) contrast-enhanced T1-weighted imaging.

Results

T1 Flash in-phase | T1 Flash out-phase | T2-Haste/Blade | VIBE Imaging | Diffusion weighted | MRE



Future Work & Conclusions

- In the future, integration of MRI/MRE, histology, and molecular measures in Oncopigs presenting with liver cirrhosis and HCC may be employed to investigate biomarkers that may define normal versus diseased liver, and may serve as a new approach to identify optimal time points for initiation of disease and treatment for clinical translation.
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