

Syllabus – ISMRM 2013 – Salt Lake City

Title: Functional MRI of the Kidney
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Major Learning Objectives:

1. To understand that there is a toolkit of MRI techniques available to study different biomarkers of kidney function and/or disease.
2. To understand one of these techniques, MR Urography (MRU), to a deeper degree of detail and that MRU is being developed and validated for measuring renal blood flow, perfusion, glomerular filtration, and for assessing post-renal uropathies.
3. To develop an appreciation for clinical applications of functional MRI of the kidney with a focus on chronic kidney disease and kidney transplantation.

Syllabus Abstract:

There is a clinical-healthcare need for improved measures of kidney function, particularly in the setting of Chronic Kidney Disease and transplantation. Current methods clinically available are either too cumbersome, inaccurate, invasive, or simply unable to delineate important biomarkers. MRI has demonstrated the potential to reveal disease biomarkers useful for managing patients and for developing improved therapeutics for CKD.

The healthcare burden from CKD is large, for example, consuming over 15% of the healthcare budget in the United States. Transplantation is considered the therapy for end-stage CKD, while dialysis is palliative. Kidney transplant failures occur almost universally within 15 years, with median transplant kidney survival of 7 years. The ability to prolong transplant organ survival will have a tremendous impact on overall therapy and costs. Most transplant failures occur due to immune-mediated chronic rejection or due to toxicity from the immunosuppressant anti-rejection drugs. New agents are under development, including immunomodulators, however, the ability to monitor the effects of new agents is limited and endpoints of kidney transplant failure requires prohibitively long observation periods.

MRI provides an array of different technical approaches that can be used to explore novel biomarkers of kidney function and disease. These techniques include T2-mapping, blood oxygen level dependent imaging, diffusion weighted imaging, arterial spin-labeling, elastography tissue stiffness measurements and perfusion imaging using injectable gadolinium based chelate agents (GBCA). While investigations and, to different degrees, progress is being made across all of these techniques, perfusion scanning has been of particular interest. Using a technique, referred to as Magnetic Resonance Urography (MRU) or Magnetic Resonance Nephrourography (MRNU), it is possible to derive measures of total renal blood flow, perfusion flow per unit volume of perfused kidney tissue, and glomerular filtration rate (GFR). GFR has been seen as one of the key measures of kidney function useful for longitudinal monitoring of the health of a kidney, native or transplant. However, there are new insights into kidney biomarkers that are being derived through clinical application and observation in the setting of transplantation. These are biomarkers that do not necessarily have correlates in biopsy analysis or other currently available tests. Our observations to date should inspire continued efforts towards the overarching aim of using MRI to improve CKD and kidney transplant outcomes while reducing overall cost-burden.

