Non-Contrast Magnetic Resonance Angiography for Renal Transplant Patients: Current State of the Art

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Synopsis (100 words maximum): In patients at risk for Nephrogenic Systemic Fibrosis the use of Gadolinium based contrast agents (GBCAs) is potentially problematic. The choice of how to image the vascular system becomes a balancing act between using conventional iodinated contrast techniques such as Computed Tomographic angiography (CTA) or Digital Subtraction Angiography (DSA), Magnetic Resonance Angiography (MRA) with GBCAs and Non-Contrast Enhanced MRA. Using the transplant renal artery as our example anatomy for imaging, we present here the current state of the various NCE-MRA methods and how their strengths and weaknesses compare for common post renal transplant pathology.

Purpose: The purpose of this educational exhibit is to review the various methods for Non-Contrast-Enhanced Magnetic Resonance Angiography (NCE-MRA) in the context of renal artery transplant evaluation.[1] We will review an approach that is based on the expected vascular anatomy, pathology and known anatomic variants of the area being studied. The strengths and weaknesses of each of the commonly used NCE-MRA techniques will be shown.

Background: Although relatively rare in occurrence, the possibility for inducing Nephrogenic Systemic Fibrosis (NSF) after the utilization of Gadolinium Based Contrast Agents (GBCA's) in patients with eGFR <30 mg/dl is a clinical concern. Recent evidence indicates that patients with recent surgery, inflammation, infection and decreased renal function are at increased risk for this occasionally fatal disorder.[2] For patients with possible renal transplant artery stenosis, after recent surgery, the imaging options are limited to Doppler ultrasound, NCE-MRA, low dose GBCA MRA and conventional or CO_2 angiography. This presentation reviews the strengths and weaknesses of the currently available NCE-MRA techniques that can be used to safely study the transplant renal artery and vien for this unique group of patients.

Outline of Content:

1. Extent of Problem: Patients at risk for NSF[2]
2. Normal / Abnormal renal transplant arterial anatomy and flow
3. Renal Transplant Venous anatomy and flow direction
4. Vascular Complications of renal transplant
    a. Stenoses of arterial or venous anastomosis
    b. Arteriovenous fistula
    c. Pseudoaneurysm
    d. Venous thrombosis
5. Strengths and weaknesses of NCE-MRA techniques[1.3]
    a. Arterial Spin labeling (ASL)
    b. Steady State Free Precession (SSFP)
    c. Time of Flight (TOF)
    d. Phase Contrast (PC)
    e. ECG-gated 3D Partial Fourier FSE

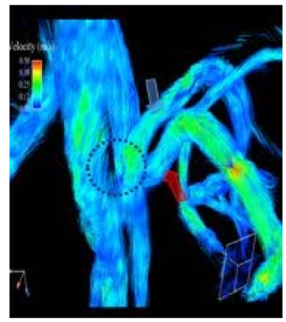

Figure 1-Renal Transplant vein stenosis (circle) shown on a 4D flow-sensitive data PC-MRI set (Transplant artery red arrow)._

Summary: NCE-MRA is an excellent substitute for contrast enhanced MRA in patients with known risk factors for the development of NSF.[3] While there may be no one NCE-MRA technique that answers all the vascular questions posed by a particular clinical situation, through the diligent application of the many pulse sequences available, an answer to the vascular physiology of the targeted vessel in question can usually be obtained.

References: 1. Lee July 2008 Radiology, 248, 20-43
2. Sadowski April 2007 Radiology, 243, 148-157
3. Bley ISMRM 2010 Book of Abstracts #3768

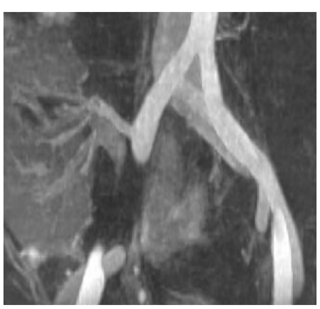

Figure 2 – Coronal thick slab MIP of fat-suppressed 3D SSFP right renal transplant artery. There is some venous flow which can help in cases of suspected venous thrombosis.

Figure 3 – Coronal thick slab MIP of inflow enhanced 3D SSFP in same patient as 1. Note lack of venous signal intensity

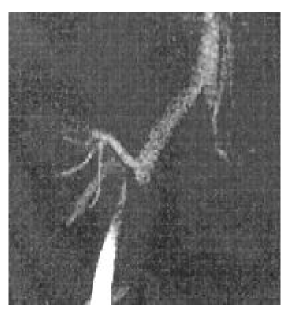

Figure 4 – Coronal thick Slab MIP of 3D PC MRA of same patient as 1 and 2.Note venous inflow from the external iliac vein.

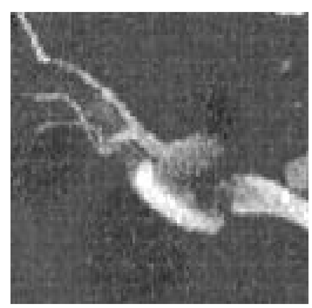

Figure 5 – Axial thick Slab MIP of 3D PC MRA of same patient as 1 and 2.Note venous inflow from the external iliac vein.