MR Venography of the central veins: Comparison of Direct contrast-enhanced 2D MR fluoroscopic venography with 3D MRV

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Introduction
Because of susceptibility induced signal drop-off within the subclavian and upper extremity veins on the side of the contrast agent injection, MR venograms cannot be acquired by injection of commercial strength gadolinium into a vein on a first pass. Because of this two fundamentally different methods exist for evaluating the great thoracic veins with MR. The first of these, indirect MRV relies on imaging during re-circulation of contrast agent by which time the blood concentration of gadolinium will have diminished sufficiently to eliminate susceptibility effect. The second method, direct MRV allows first pass imaging to be performed by significantly diluting the contrast agent with saline to overcome susceptibility effect. Several authors have validated 3D CE-MRV using this technique. In this paper we describe direct 2D MRV, which offers several advantages over the 3D technique. This approach is almost identical in philosophy to an X-ray venogram acquired during injection of iodinated contrast into each arm.

Methods
10 patients (6F/4M, 19-58 years, mean 31yrs) with suspected central venous occlusion underwent both 2D and 3D CE-MRV during injection of a 6% solution of a gadolinium chelate (Magnevist, Schering, UK) and saline. Images were acquired at 1.5T (ACS Gryoscan 1.5 NT, PowerTrak 6000 gradients, Philips Medical Systems, Best, NL). Scan parameters were as follows:

### 2D CE-MRV
- TR/TE/flip 5msec/1.5msec/40degrees
- Scan matrix 512 x ~200, 2mm thick slices with zero-interpolation
- FOV 400-420mm, RFOV 75-100% with centric k-space filling order
- Acquisition time 15-20 seconds

### 3D CE-MRV
- TR/TE/flip 5.2msec/1.4msec/40degrees
- Scan matrix 256 x 192, FOV 400-420mm, slice thickness 75-100mm, with linear k-space filling order
- Acquisition time 1 second per slice

Injection protocol
1. **Injection of dilute contrast agent into an upper limb vein eliminates T2* induced susceptibility effect and allows acquisition of high quality direct MR Venograms during first-pass of contrast through the veins.**
2. **2D MRV showed identical accuracy to 3D MRV in the present study.**
3. **Advantages of 2D over 3D MRV include elimination of the need for bolus timing and post-processing (the scan is time resolved and uses a single slice acquisition) and use of a lower contrast dose (0.9cc per side compared to 3cc per side for 3D).**
4. **Additionally, the scan time is shorter making the technique more attractive in patients with limited breath-holding capability, and the total examination time is shorter.**
5. **2D studies do not necessarily rely on fast gradients and can be potentially be performed on old slower systems. Images are virtually identical to those acquired with X-ray venography.**

In conclusion, acquisition of direct MR venograms can be performed using either a 2D or 3D approach. The 2D approach offers several potential advantages over the 3D approach.

### References