

Contrasted Enhanced Magnetic Resonance Venography with Gadofosveset Trisodium

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Introduction

Magnetic Resonance Venography(MRV) is a noninvasive imaging technique increasingly utilized for the workup of cryptogenic stroke and idiopathic intracranial hypertension. Although various non-contrast and contrast-enhanced(CE) MRV techniques are available in these applications(1), a more extensive mapping of the venous system in the evaluation of the venous insufficiency theory in multiple sclerosis has proven challenging for these established approaches. A potential solution is CE MRV using the intravascular agent gadofosveset trisodium, which has the advantage of a prolonged intravascular half-life due to serum albumin binding compared to the extracellular gadolinium agents. The goal of this study is to evaluate the utility of CE MRV using a single-dose peripheral intravenous injection of gadofosveset trisodium in the comprehensive evaluation of the cranial and extracranial venous system.

Methods

The institutional review board approved a HIPPA-compliant CE MRV study of 99 subjects with multiple sclerosis (age=48.1±9.9 years)(males=31, females=68) using single dose of intravenously administered gadofosveset trisodium. All subjects were imaged at 3T utilizing high-resolution 3D T1-weighted fast spoiled-gradient-echo sequences. The CE MRV included the venous system of the cranium, neck, chest, abdomen and pelvis. Identification of venous structures in the intracranial and extracranial circulation and presence of artifacts was qualitatively assessed for all studies. A subset of subjects (n=40) (age=45.1±11.0 years)(males=13, females=28) also underwent conventional venography of the distal internal jugular veins, brachiocephalic veins, superior vena cava, and azygous vein blinded to the results of the CE MRV. Quantification of stenosis was coded on CE MRV and conventional venography per the following criteria: grade 0 ≤ 50%, grade 1 ≥ 51% and ≤ 75%, grade 2 ≥ 76% and ≤ 99% and grade 3=100%.

Results

Visualization of the cranial and extracranial venous system was identified without flow artifacts for all coded venous structures in all subjects. In 40 selected subjects, 73% (29/40) had excellent agreement between conventional venography and CE MRV with matched ≥ grade 1 stenosis in 10%(4/40) and grade 0 stenosis in 63%(25/40). In 27%(11/40) of subjects, conventional venography demonstrated ≥ grade 1 stenosis not present on the CE MRV. Selected CE MRV's of cranium, neck and chest are shown in figures 1-3.

Figure 1. (sagittal, dural sinuses)

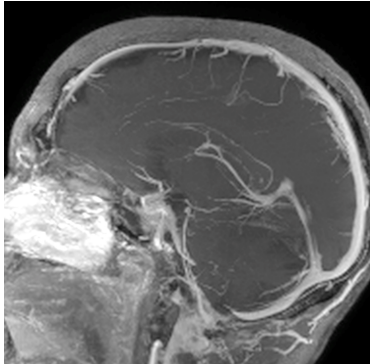
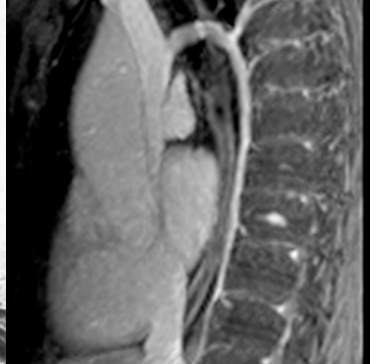


Figure 2. (coronal, internal jugular veins)



Figure 3. (sagittal, azygous vein)



Discussion/Conclusion

Non-contrast MRV utilizing 2D time-of-flight(TOF) technique is inherently limited by in-plane flow saturation and artifacts induced by turbulence(2). In contrast, the T1 shortening of venous blood after the intravenous injection of gadofosveset trisodium minimizes saturation effects and the use of 3D spoiled-gradient sequences with short echo-times further reduces the effects of turbulence. Although, conventional venography can directly measure pressure gradients, it has limited accessibility to all venous structures compared to CE MRV.

CE MRV using a single injection of gadofosveset trisodium can be utilized for rapid comprehensive evaluation of the cranial and extracranial venous system with minimal artifacts. The grade of stenosis identified on CE MRV correlated well with conventional venography in the venous system of the neck and upper chest. In contrast, a high percentage of subjects with ≥ grade 1 stenosis on conventional venography did not match the results with CE MRV potentially indicating a limitation of selective venous contrast injection related to catheter induced vasospasm, flow related apparent narrowing secondary to valves or artifacts due to non-opacified collateral venous flow.

References:

1. Kirchhof K., et al. More reliable noninvasive visualization of the cerebral veins and dural sinuses: comparison of three MR angiographic techniques. *Radiology*. 2002;224(3):804.
2. Rollins N., et al. Cerebral MR venography in children: comparison of 2D time-of-flight and gadolinium-enhanced 3D gradient-echo techniques. *Radiology*. 2005 Jun;235(3):1011-7.