Magnetic resonance venography with a blood pool contrast medium

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Introduction

Non-invasive venography to cover the entire neck and thoracic central venous system in one examination is challenging. MR venography is ideal for coverage but the technique is difficult as the majority of contrast media are extracellular agents that rapidly leave the vascular pool. Time resolved serial acquisition methods have improved but image quality may be suboptimal and they are effectively limited to one body region . This could be overcome using a blood pool agent such as gadofosveset trisodium (Vasovist® , Schering) which can be imaged using both a conventional first pass (FP) technique and then repeatedly in the "steady state" after the redistribution of the agent throughout the vascular system[1,2,3]. The aim of this work was to evaluate the diagnostic performance of the steady-state (SS) images against the conventional first pass time resolved technique for MR venography of the central and upper throracic major veins.

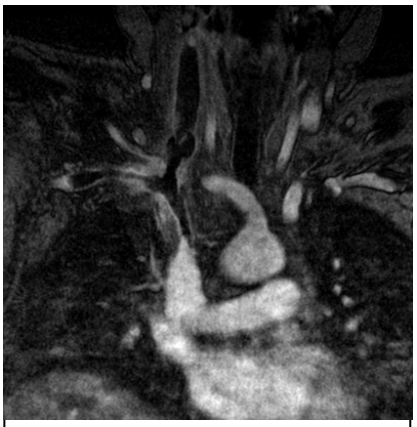

Figure 1: SS imaging shows thrombus within the right brachiocephalic, subclavian and internal jugular veins.

Methods

A prospective ethically approved and Clinical Trial Authorised (2007-002730-11) open-label feasibility study was undertaken from August 2008. Expected final sample size is 30 patients. Patients over 18 years old who have been routinely referred for MRV of central veins were recruited. Informed consent was obtained from all participants. Intravenous Vasovist® 0.12ml/kg body weight (maximum 10mls) is given at 0.8ml/s followed by a saline flush of 20ml at 2ml/s. FP and SS imaging were performed using a 1.5T GE MRI system with an 8 channel cardiac receive array. FP parameters: FOV 40x40cm; slices 42x2.6mm; matrix 418x256x0.75NEX; flip angle 30°;ASSET factor 2; temporal resolution 10sec, 30 phases acquired. SS parameters: FOV 40x40cm; slices 64 x1.6mm;matrix 512x512x2.0 NEX interpolated to 1024 x1024; flip angle 30°; acquisition time 4.25min. Each set of images were assessed independently in randomised fashion. FP images were used as the reference standard for correct diagnosis. Nine venous segments were assessed – superior vena cava (SVC), left and right branches of brachiocephalic, subclavian, internal jugular, and axillary veins. Four parameters were evaluated: 1. image quality in terms of vessel conspicuity using a five-point scale (excellent, good, moderate, poor, very poor); 2. presence of artefacts using a three-point scale (none, mild, major); 3. presence of stenosis using a six-point scale (no: 0%, mild: 1-30%, mild to moderate: 31-50%, moderate: 51-75%, severe: 76-99%, total occlusion); 4. presence of thrombosis using a three-point scale (no, partial, complete). Images were scored by consensus among 3 experienced consultant radiologists.

TABLE 1	No discrepancy	Discrepancies	
		FP superior	SS superior
Image quality	91/144 (63%)	19/53 (36%)	34/53 (64%)
Artefacts	93/144 (65%)	26/51 (51%)	25/51 (49%)

Results

Sixteen participants were recruited at the time of submission. No adverse event was reported. A total of 144 venous segments were assessed in both FP and SS (Figures 1,2), respectively. Table 1 summarises the results on image quality and artefacts. For image quality, discrepancies were found in 37% (53/144) of all cases. Of these, SS shows better quality images in 64% but this trend was not statistically significant (McNemar test: 3.70). Steady state imaging examples are shown in Figures 1 and 2. There were no artefacts in 50% of cases in both FP (72/144) and SS (69/144), respectively. Mild artefacts not affecting diagnostic quality were seen in the remaining 50 % (71/144 in FP and 74/144 in SS). Although differences in the severity of these artefacts were found in 35% (51/144) of all cases, this was not significant. In both sets of images mild motion related artefacts were common in the SVC due to cardiac pulsation. Table 2 summarises the results on detection of stenosis and thrombosis. For detecting stenosis, discrepancies were found in 15% (22/144) of all cases. Of these, 81% and 18% were minor and major discrepancies, respectively. We speculate that the 4 major discrepancies are probably overcall on the FP images. For thrombosis detection, only minor discrepancies were noted between the two techniques.

TABLE 2	Total number of vessels involved	No discrepancy	Discrepancies	
			Major	Minor
Stenosis	49/144 (34%)	27/49 (55%)	4/22 (18%)	18/22 (81%)
Thrombosis	21/144 (15%)	9/21 (43%)	0	12/12 (100%)

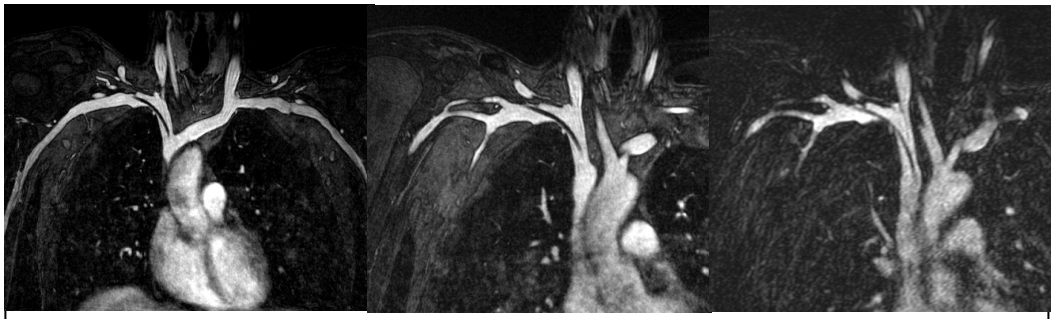

Figure 2: Patient with patent brachiocephalic, subclavian and axillary veins with a right subclavian venous catheter black line) insitu: (LEFT) Curved MIP reformat of the steady state imaging, (MIDDLE) detail from steady state source image, (RIGHT) corresponding detail from the first pass time resolved imaging source image.

Conclusion

Our study (50 % subject recruitment to date) demonstrates feasibility of MR imaging of the central venous system with gadofosveset trisodium. These preliminary results demonstrate that for artefacts, image quality and diagnostic performance SS imaging is comparable to the equivalent first pass technique. Further analysis will take place on completion of the planned recruitment. These results are promising for the imaging of multiple venous regions during a single examination, for example imaging the thoracic and pelvic veins for pre-surgical planning in multi-organ transplant recipients.

Acknowledgements:
Addenbrooke's Charitable Trust, NIHR: Cambridge Biomedical Research Centre, Chris Palmer.

References:

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