A Contrast Dose Reduction Study for 3D High-Spatial Resolution Contrast-Enhanced Cerebral Magnetic Resonance Venography at 3.0 Tesla

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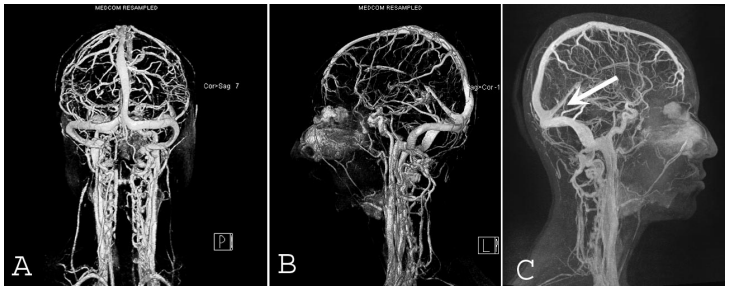
Background and Purpose:
Recent advances in contrast-enhanced MR angiography (CE-MRA) at 3.0T support highly accelerated parallel acquisition for improved pulse sequence performance. In current clinical practice, 0.1-0.2 mmol/kg of gadolinium is utilized for cerebral contrast-enhanced MR venography (1,2). Current evidence suggests that risk of nephrogenic systemic fibrosis (NSF) in renal failure patients, is related to the gadolinium dose (3).
We sought to compare the diagnostic image quality resulting from two contrast dose regimens for 3D high-spatial-resolution contrast-enhanced cerebral MR venography at 3.0 T.

Methods and Materials:
40 consecutive patients were randomized into two equal groups and underwent 3D high-spatial-resolution cerebral CE-MRV at 3.0T (TIM Trio, Siemens) using identical acquisition protocol. A fast spoiled gradient-echo (GRE) sequence with parallel acquisition (GRAPPA x 6) generated 160 partitions (voxel dimensions 0.7 x 0.7 x 0.8 mm^3) in 24 seconds. Contrast injection protocols were 15 mL (0.1 ± 0.01 mmol/kg) and 7.5 mL (0.05 ± 0.008 mmol/kg) of Magnevist (Berlex Laboratories, Wayne, NJ) administered at a rate of 2 ml /sec. Intra-cranial venous structures were divided into 15 large and 17 small segments. Images were assessed for delineation of venous segments, arterial contamination, and venous stenosis by two readers. Analysis was performed using Wilcoxon test and k co-efficient.

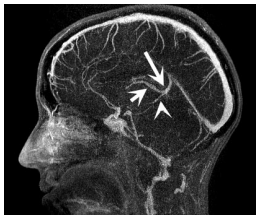
Results:
Reader 1 and 2 identified venous structure delineation as sufficient for diagnosis or excellent for single-dose group in 295 (98.3 %) and 293 (97.7%) large venous segments, and 273 (80.3%) and 281 (82.6%) small venous segments, and for half-dose group in 292 (97.3%) and 290 (96.7%) large venous segments, and 208 (61.2%) and 219 (64.4%) small venous segments, respectively (good inter-observer agreement). Reader 1(2) identified arterial contamination in cavernous sinus in 24 (21) and 15 (11) segments and venous stenosis in 17 (21) and 10 (12) segments, in single- and half-dose groups, respectively (excellent inter-observer agreement). No significant difference existed between the delineation scores for large intra-cranial venous structures for each reader between the two groups ($P>0.05$). Delineation scores of small intra-cranial venous structures were significantly lower on half-dose group ($P<0.01$).

Conclusion:
High-spatial-resolution cerebral CE-MRV performed comparably well with the two contrast dose regimens for evaluation of large intra-cranial venous structures at 3.0T. Adoption of low-dose protocols should diminish the risk for development of dose-dependent complications and result in substantial cost savings.

References:
1. Liang L, et al *AJNR Am J Neuroradiol*. 2002;23:1739-1746 2. Kirchhof K, et al. Radiology 2002;224:804–810.
3. Sadowski EA, et al. Radiology 2007; 243(1):148-57



Single dose: Coronal (A) and sagittal (B) volume rendered images, and full thickness MIP (C) image in a 42 year old patient depict the majority of cerebral veins with high diagnostic quality. Note the high diagnostic quality of basal vein of Rosenthal (C, arrow).



Half dose: Sagittal thin MIP image of gadolinium in a 34 year old female show high diagnostic quality of vein of Galen (large arrow), internal cerebral veins (small arrow), and basal vein of Rorenthal (arrowhead).