Steady state MR Angiography of the carotid arteries: are intravascular agents necessary? A feasibility study to evaluate the potential of gadobenate dimeglumine for combined first pass and high-resolution steady state vascular imaging

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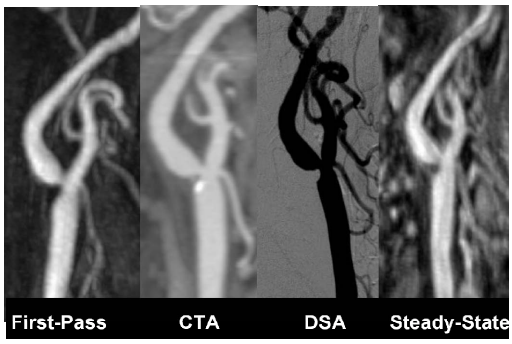
Purpose: The study was designed to prospectively evaluate the potential of gadobenate dimeglumine (MultiHance) for high resolution steady-state (SS) imaging as an adjunct to conventional first-pass (FP) contrast-enhanced MR Angiography (CE-MRA) for the detection of relevant (>70% vessel diameter reduction) steno-occlusive disease of the carotid arteries.

Materials and Methods: The study was performed under a waiver from the institutional review board. Forty patients (22 men, 18 women; age range, 44-90 years) with symptomatic carotid artery disease who were referred for routine diagnostic imaging underwent conventional first-pass CE-MRA with 15 mL gadobenate dimeglumine using a conventional 3D FLASH sequence (TR/TE/FA=3.5ms/1.8ms/30°; voxel size: 1.0×0.8×0.7 mm; 19" acquisition time). Immediately thereafter, steady-state vascular images were obtained using a high resolution coronal 3D FLASH sequence (TR/TE/FA=9.12ms/2.95ms/28°; voxel size: 0.7×0.7×0.7 mm; 3'46'' acquisition time). Two experienced radiologists assessed the quality of both FP and SS acquisitions in terms of vessel conspicuity at the basal portion of the bifurcation using a four-point scale from excellent to poor. Image Quality and related diagnostic utility of the CE-MRA readings (FP, FP+SS) were evaluated using the Spearman correlation coefficient (R(s)). Detected arterial stenoses were quantified and compared (ROC analysis) with findings at digital subtraction angiography (DSA) and Computed Tomographic Angiography (CTA) in all 40 patients. Interobserver variability was assessed with IntraClass Correlation (ICC) for stenoses greater than 70%, and with kappa (κ) statistics for morphology, length and presence of ulcers and tandem lesions.



Results: Vessel conspicuity was rated as good to excellent for 92.5% of vessels on FP images and for 85% of vessels on SS images. Correlation between Image Quality and usefulness of the SS reading was very good (R(s)=0.7; S=0.000). Interobserver agreement was excellent for both FP and SS acquisitions (Intraclass Correlation 0.937 for FP and 0.969 for FP+SS). The sensitivity and specificity of CE-MRA for the detection of significant (>70%) arterial stenoses relative to DSA as the standard of reference were 93% and 100%, respectively, for FP images and 96% and 98%, respectively, for FP+SS images. The accuracy of FP and FP+SS was 0.974 for both modalities with a tendency to underestimation at FP in two cases and a single case of both over- and underestimation at the combined reading. AUC values as well as the comparison of the three curves, using the *chi-squared* test are reported in Table 1.

Conclusion: Although gadobenate dimeglumine is not a dedicated intravascular "blood-pool" contrast agent steady-state imaging of the carotid arteries is nevertheless still feasible. The increased spatial resolution attainable on SS images combined with the elevated contrast enhancement achievable with gadobenate dimeglumine permits improved detection of arterial stenoses, yielding diagnostic performance which is comparable to that of CTA and DSA.

ROC analysis					
	Obs	AUC	Std. Err.	95% Conf.	
FP	80	0.9655	0.0239	0.91859	1.00
FP+SS	80	0.9730	0.0198	0.93408	1.00
CTA	80	0.9828	0.0172	0.94897	1.00
Chi2(2)= 0.35		Prob>chi2 = 0.8387			

Table 1: AUC, standard error, confidence interval and *chi-square* of CTA, FP and FP+SS.