# EFFECT ON IMAGE QUALITY OF CAROTID THREE-DIMENSIONAL MR-ANGIOGRAPHY: 1.0 M GADOBUTROL VERSUS 0.5 M GADOTERATE MEGLUMINE AT 3 TESLA SCANNER

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## INTRODUCTION

One approach to improve the diagnostic quality of contrast enhanced MRA is the introduction of contrast agent with increased T1 relaxivity, which leads to higher vessel signal intensity. Previous studies[1,2,3] showed contradictory results whether 1.0 M gadobutrol could improve image quality over 0.5 M gadolinium-based contrast, possibly because different anatomic regions were examined and study design. Evaluation on the significance of 1.0 M versus 0.5 M gadolinium-based contrast in carotid contrast-enhanced 3D MR angiography is lacking and not confirmed. The purpose of this study was to compare a macrocyclic non-ionic 1.0 M contrast agent (Gadobutrol) with a macrocyclic ionic 0.5 M contrast agent (Gadoterate Meglumine) on the effect of image quality in carotid contrast-enhanced 3D MR angiography.

## SUBJECTS AND METHOD

In an intraindividual comparative study, 10 patients (five women, five men; mean age, 71, range, 37–94 years) with symptomatic of cerebral ischemia underwent 3 Tesla MRI contrast-enhanced 3D MR angiographic examinations performed with parallel imaging technique. At random and in separate sessions, each patient was examined after IV injection of 0.1 mmol/kg body weight 1.0 M macrocyclic non-ionic Gadobutrol and 0.5 M macrocyclic ionic Gadoterate Meglumine at 2cc/sec by a power injector through a cubital or hand vein.

Quantitative analysis included signal-to-noise (SNR) and contrast-to-noise (CNR) values were calculated based on signal intensity (SI) measurements in 3 segments of each carotid artery: Proximal common carotid artery, common carotid artery just proximal to carotid bifurcation and cervical segment of internal carotid artery. SI determinations were performed in ROIs of identical size placed immediately adjacent to the delineated artery in the stationary tissues and were measured on coronal source images. Absolute SI measurements were related to noise, defined as the standard deviation of SI measurements collected in an ROI outside the neck tissue. Based on these data, SNR and CNR values were calculated in the following manner: SNR= SIvessel/noise; CNR = SIvessel – SIadjacent tissue/noise. Student's t test for paired samples was used to compare the 3D CEMRA vessel contrast with the two contrast agents. Significance was considered $p<0.05$.

For qualitative analysis, the overall image quality of each volume data set were rated by 2 experienced radiologists on a 5-point scale: 0, uninterpretable; 1, marginally acceptable quality for diagnosis; 2, acceptable quality for diagnosis; 3, good quality; 4, excellent quality. Wilcoxon's matched-pairs signed-rank tests were used to compare the overall image quality of individual vessel segments with the two contrast agents. Significance was considered $p <0.05$. Kappa values of concordance were computed to compare the two readers' assessments of overall image quality of individual vessels at 3D CEMRA with the two contrast agents. Cohen's kappa values of 0.61–0.80 were considered to indicate substantial agreement, and kappa values greater than 0.81 were considered to indicate almost perfect agreement.

## RESULTS & DISCUSSION

Results of quantitative analysis showed that there were significantly higher SNR and CNR after administration of 1.0 M Gadobutrol compared to 0.5 M Gadoterate Meglumine. The SNR of using 1.0 M Gadobutrol (106.7 ± 27.5) was significantly ($P< 0.05$) higher than that of using 0.5 M Gadoterate Meglumine (88.7 ± 32.1) while the CNR of using Gadobutrol (97.52 ± 28.65) was also significantly ($P< 0.05$) higher than that of using Gadoterate Meglumine (76.9 ± 31.7).

Qualitative analysis rated from 2 experienced radiologists also reflected the higher SNR and CNR of 1.0 M Gadobutrol. The mean score (3.56 ± 0.5) of 1.0 M Gadobutrol group was significantly ($P<0.05$) higher than the mean score (3.13 ± 0.7) of 0.5 M Gadoterate Meglumine group with substantial agreement between readers (Kappa score: 0.67).

Our results concord with the previous studies[1,2] that there is significant advantage of using 1.0 M Gadobutrol versus 0.5 M Gadoterate Meglumine in contrast-enhanced 3D MR angiography. Positive results may be explained by less bolus dispersion of contrast in carotid vessel as suggested by Fink et al[3], when compare to other study with insignificant results which examined more distal anatomical part such as lower limbs[4]. However, our study does has limitation such as relatively small sample size.

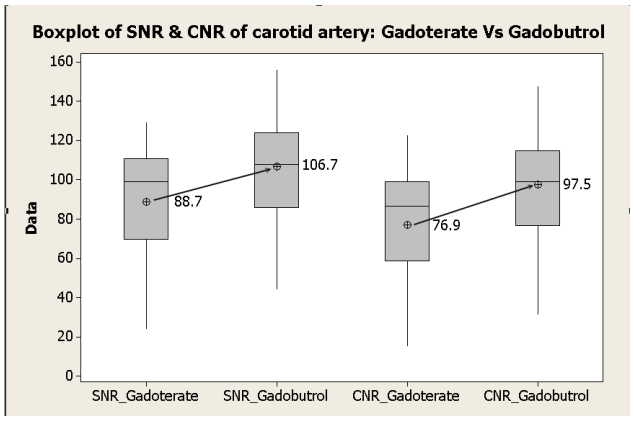


**FIG. 1**. Evaluation of 120 segments of 40 carotid arteries (3 segments in each carotid artery x 10 patients) after administration of 0.5 M Gadoterate Meglumine and 1.0 M Gadobutrol, boxplot shows increased in SNR and CNR after administration of 1.0 M Gadobutrol.


**FIG. 2.** Representative image of carotid MR Angiography. With the administration of 1.0 M Gadobutrol (right side) has higher SNR and CNR with better depiction of small vessels (arrows) compared to 0.5M Gadoterate (left side).

## CONCLUSION

At the dosage of 0.1 mmol/kg of 1.0 M Gadobutrol versus 0.5 M Gadoterate Meglumine, administration of 1.0 M Gadobutrol resulted in better quality of carotid contrast-enhanced 3D MR angiography.

## REFERENCES

[1]Goyen et al. 0.5 M Gd chelate (Magnevist) versus 1.0 M Gd chelate (Gadovist): Dose-independent effect on image quality of pelvic three-dimensional MR-angiography. J Magn Reson Imaging 2001; 14:602 – 607. [2] Herborn et al.. Intraindividual comparison of gadopentetate dimeglumine, gadobenate dimeglumine, and gadobutrol for pelvic 3D magnetic resonance angiography. Invest Radiol 2003; 38:27 – 33. [3] Fink et al. Intraindividual comparison of 1.0 M gadobutrol and 0.5 M gadopentetate dimeglumine for time resolved contrast-enhanced three-dimensional magnetic resonance angiography of the upper torso. J Magn Reson Imaging 2005;22:286 – 290. [4] Zsolt et al. 1.0-M Gadobutrol Versus 0.5-M Gadoterate for Peripheral Magnetic Resonance Angiography: A Prospective Randomized Controlled Clinical Trial. J. Magn. Reson. Imaging 2008;27:1399 – 1405.