

REDUCED GADOLINIUM DOSE IN CAROTID CEMRA USING GADOBUTROL AT 3T

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INTRODUCTION

In recent years, contrast-enhanced magnetic resonance angiography (CEMRA) of the carotid arteries has been used as a reliable diagnostic tool for patients with known or suspected carotid artery disease.

With the rise in concern of Nephrogenic Systemic Fibrosis (NSF)[1] in the high risk or renal compromised patient, it is of greater importance for us, as technologists to make a conscious effort to help reduce this risk and continue to provide high quality, diagnostic examinations.

The standard dose of Gadobutrol for CEMRA (1 FOV) is 7.5cc for body weight below 75 kg, 10cc for body weight of 75 kg and higher; (corresponding to 0.1 - 0.15 mmol/kg of body weight).

The purpose of this study was to investigate whether a significant difference exists in image quality and diagnostic information when using a reduced dose (5cc) as opposed to our standard dose (10cc) of Gadobutrol (Bayer Shering AG), for carotid CEMRA imaging.

METHODS

Patients were scanned for routine clinical examinations on a Philips 3T magnet, using the 16 channel neuro vascular array coil.

A coronal 3DT1W volume of the carotid arteries was acquired after injection of either 5cc or 10cc of Gadobutrol.

The quality of the CEMRA is governed by the timing of the contrast injection and data acquisition. Thus, by identifying and adjusting specific parameters in our acquisition, we can negate the decreased signal to noise that one would expect when using a decreased dose of gadolinium based contrast medium.

Knowledge of the contrast agent dilution factors and the ultimate resulting relaxation rates, can be used to optimize the imaging parameters to maximize vessel signal relative to the background signal (the contrast to noise ratio) [2].

By decreasing the amount of contrast, the T1 of enhanced blood becomes slightly longer and does not recover as quickly. Thus, by decreasing the flip angle we can avoid saturation effects which in turn translates into increased signal intensity.

For this study, we preserved image quality and diagnostic information of the reduced dose carotid CEMRA by decreasing the flip angle from 30° to 20° with a resultant decrease in Minimum TR from 4.6 to 4.1 msec.

To coincide with sampling the central portion of k-space (approximately 4 seconds), the bolus size was increased by reducing the rate of injection from 1.5cc to 1.0cc per second and the volume of the saline bolus was increased from 20cc to 25cc. All other parameters remained unaltered. Imaging parameters are summarized in Table 1.

Two radiologists performed a blinded, retrospective review of 50 patients who underwent carotid CEMRA, using Gadobutrol (n=25 full dose, n=25 reduced dose).

The source images, reformats and MIP views were reviewed for image quality and diagnostic accuracy. Studies were rated using an analogue scale. Means were compared using a Student's t-test with $p < 0.05$ as significant.

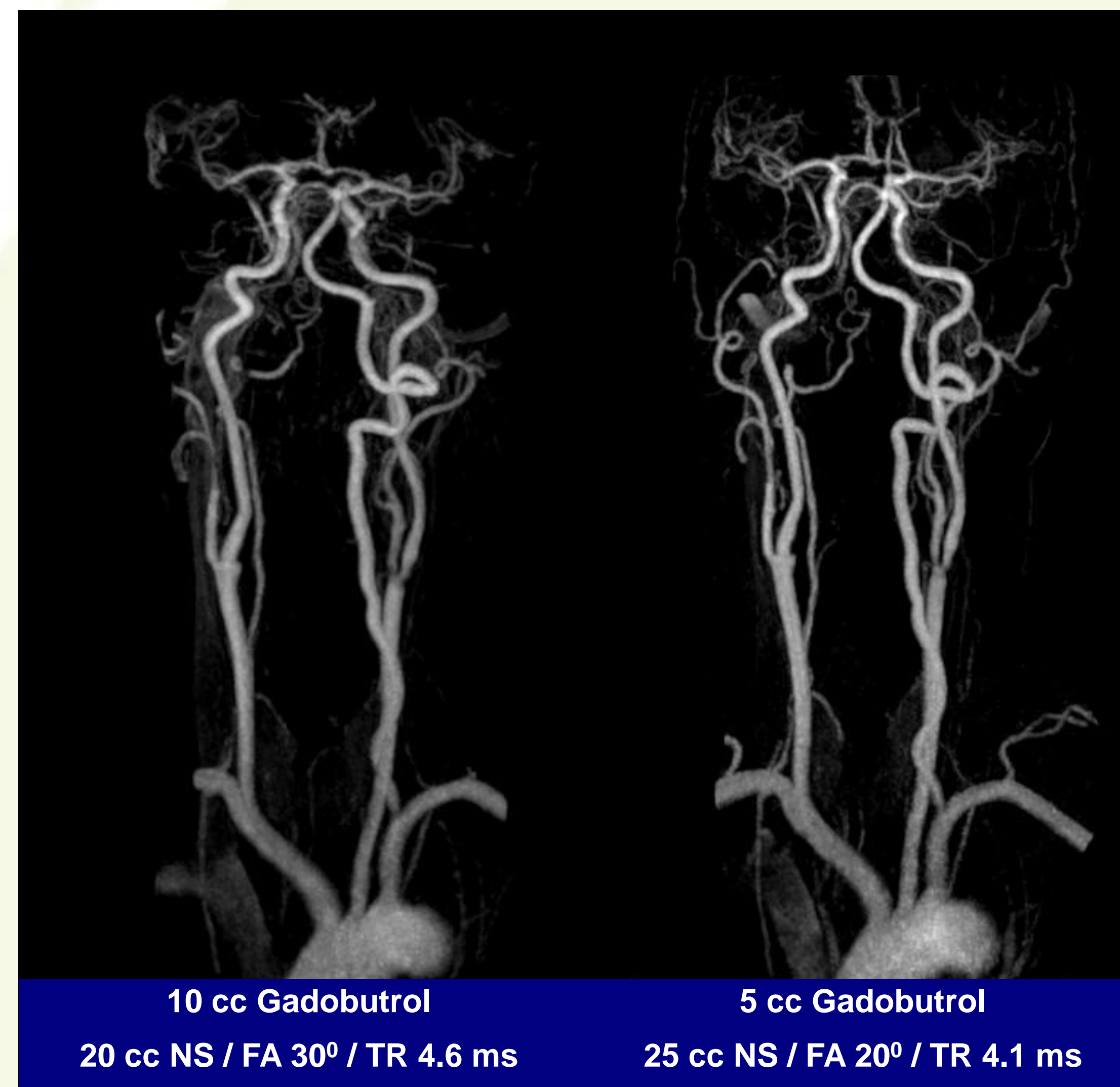


Figure 1

RESULTS

Figure (1) shows a direct comparison of Gadobutrol enhanced carotid CEMRA - MIP view (10cc injection on the left and 5cc injection with specific parameter adjustments, on the right).

The mean rating for images acquired using 10cc vs. 5cc of Gadobutrol was 8.64 and 8.69 respectively, however the difference between the means is non significant ($p=0.87$).

PARAMETER	10 cc VALUES	5 cc VALUES
Scan Plane	Coronal	Coronal
Pulse Sequence	3D FFE	3D FFE
TR	4.6 ms	4.1 ms
TE	1.7 ms	1.7 ms
Flip Angle	30°	20°
FOV	320 X 300	320 X 300
Acquired Voxel	0.6 x 0.6 x 0.5 mm ³	0.6 x 0.6 x 0.5 mm ³
Recon Voxel	0.5 mm ³ Isometric	0.5 mm ³ Isometric
NSA	1	1
Slices	140	140
Sense	P Reduction = 2	P Reduction = 2
CE Profile Order	Centra	Centra
Scan Time	57 sec	57 sec
Normal Saline	20 cc	25 cc

TABLE 1 SCAN PARAMETERS

CONCLUSION

This work demonstrates that there is no significant difference in either image quality or diagnostic information for carotid CEMRA imaging, when using a decreased dose of Gadobutrol and making specific parameter adjustments to our pulse sequence and injection protocol.

This comparison study can provide important documentation for reduced dose, contrast enhanced MRA of the carotid arteries.

The decrease in amount of contrast media given will be beneficial to all patients. As well, there is a direct benefit of cost savings per examination, for the imaging department.

REFERENCES

[1] Cowper S. *NSF...what is it? The International Center for Nephrogenic Systemic Fibrosis Research (ICNSFR)*. 2009. Available at: <http://www.icnfrd.org/> Accessed November 5, 2009.

[2] Haacke EM, Brown RW, Thompson MR, Venkatesan R. *Magnetic Resonance Imaging: Physical Principles and Sequence Design*. 1st ed. Wiley-Liss; 1999