**Intracranial Aneurysms at 3.0T: Time-of-Flight vs Contrast Enhanced MRA vs CTA**

K. Nael[1], P. Villablanca[1], W. Pope[1], A. Nael[1], G. Laub[2], J. P. Finn[1]
[1]Radiology, David Geffen School of Medicine at UCLA, Los Angeles, CA, United States, [2]Siemens, Los Angeles, CA, United States

**Background:** MR angiography (MRA) and CT angiography (CTA) have been used frequently for evaluation of the intracranial aneurysms. Advances in multi-slice technology have dramatically increased the speed and image quality of modern CTA studies, setting a high standard for alternative imaging techniques. Introduction of 3.0T and increased available SNR can significantly enhance the performance of MRA, in terms of speed, spatial resolution, and more efficient use of parallel imaging, rivaling multi-slice CTA.

**Purpose:** To evaluate a high spatial resolution 3.0T MR angiography protocol including both time-of-flight (TOF) and contrast-enhanced MRA for visualization and characterization of intracranial aneurysms, and to compare the results with multi-slice CTA.

**Materials and Methods:** A total of 46 consecutive patients (19M, 27F, 22-64 y/o) with suspected intracranial aneurysm underwent MR angiography on a 3.0T MR system (Magnetom Trio, Siemens Medical Solutions), including both three-dimensional (3D) TOF of the intracranial vessels and 3D contrast-enhanced MRA (CE-MRA) of the entire carotid circulation. Imaging parameters for TOF were: TR/TE: 23/3.7 ms, FA 20º, BW: 188 Hz/pixel, 512 matrix on a 200 mm field of view, GRAPPA x 2, generating 0.7 x 0.4 x 1 mm³ voxels in 6 minutes. Subsequently, after intravenous injection of 25 ml Gadodiamide, high spatial resolution CE-MRA of entire supra-aortic arteries was acquired: TR/TE: 3/1.2 ms, FA 21º, BW: 720 Hz/pixel, 576 matrix, 390 mm field of view, and GRAPPA x 4, generating 3D data with 0.7 x 0.7 x 0.9 mm³ voxels in 20 seconds. Both TOF and CE-MRA were assessed independently by 2 neuroradiologists for: image quality of arterial segments (based on 1-4 scoring scale), the presence of aneurysm, aneurysmal shape, and relationship of the aneurysm and neighboring branches. Based on the MRA, a subset of patients underwent CTA on a 64-slice CT scanner (voxel size: 0.35 x 0.35 x 0.7 mm³ in 17s). CTA images were evaluated by both observers by consensus, and served as the standard of reference. The aneurysm dimensions, including maximum diameter and neck size was measured by one experienced observer using the source data in all 3 modalities. Statistical analysis was performed by calculating the ANOVA test, kappa (κ) coefficient and correlation coefficient (Rs).

**Results:** Both TOF and CE-MRA resulted in diagnostic image quality for all arterial segments, with excellent interobserver agreement ($\kappa$ =0.83; 95% CI: 0.78, 0.86). A total of 22 and 23 aneurysms were identified in 17 patients, with TOF and CE-MRA respectively ($\kappa$ =1). CTA in a total of 14 patients with aneurysms had confirmed the MRA findings with excellent correlation for aneurysm characterization, shape, and relationship to neighboring branch vessels (Rs =1). There was no statistical significant difference for the aneurysm measurements among the three modalities ($p$ =0.30). The correlation coefficient for the aneurysm diameter measurements was 0.89 (TOF and CE-MRA), 0.83 (CTA and CE-MRA), and 0.78 (TOF and CTA).

**Conclusion:** MRA at 3.0T including both TOF and CE-MRA is accurate for evaluation of intracranial aneurysms. The more aggressive use of parallel acquisition can be used to improve spatial resolution and coverage, generating sub-millimeter voxels (0.44 mm³ in CE-MRA and 0.28 mm³ in TOF) with high intravascular contrast, rivaling the still superior spatial resolution of multi-slice CT (0.12 mm³).


Sagittal oblique thin MIPs (upper row), and coronal oblique volume-rendered (bottom row) from three different modalities, show a bilobed aneurysm at the junction of the left cavernous internal carotid artery and posterior communicating artery.