

Imaging of Saccular Intracranial Aneurysms with T1W-VISTA Black-Blood Sequence

Haikun Qi¹, Peng Liu², Hansen Li¹, and Huijun Chen¹

¹Department of Biomedical Engineering, School of Medicine, Tsinghua University, Beijing, Beijing, China, ²Department of Neurosurgical, Beijing Neurosurgical Institute and Beijing Tiantan Hospital, Beijing, China

Target Audience: Clinicians and Scientists interested in black blood imaging of saccular intracranial aneurysms.

Introduction: Subarachnoid hemorrhage from ruptured intracranial aneurysms (IAs) and prophylactic IA treatments before rupture are both associated with significant morbidity and mortality^[1], making the IA rupture risk stratification critical. Clinically, IA size and size ratio^[2] are usually used to identify the aneurysm risk. Besides morphological characters, several studies^[3,4] have shown that inflammation may be a driver of aneurysm pathology. Assumed that an inflamed endothelial lining permits seepage of gadolinium into the vessel wall, contrast-enhanced IA wall imaging should be valuable in depicting IA wall inflammation. Therefore, post-contrast high-resolution MR black blood vessel wall imaging is potential for saccular IA risk assessment because of its ability to measure IA size and evaluate the inflammation of aneurysm wall. However, the size measurement by black blood MRI has not been validated yet. In this study, we imaged the walls of unruptured saccular IAs using a 3D T1-Weighted Volumetric ISotropic TSE Acquisition (T1-W VISTA) sequence^[5] after contrast enhancement. The accuracy of morphological measurements by VISTA images were tested by comparing with CTA. Moreover, the IA wall enhancement in post-contrast images were evaluated.

Methods: After obtaining written informed consent, 15 patients (5 males, mean age 59.8 years) with unruptured saccular cerebral aneurysms based on proceeding CTA were recruited. CTA imaging was performed on a 64-row CT scanner (GE Discovery CT750 HD). Scanning parameters were: 0.5 pitch, 1.25mm collimation, 580 mA, 100 kVp, 0.625mm slice thickness, 0.4mm reconstruction interval, 25cm FOV, and 65-85mL of iodinated contrast material injection. The MR imaging was performed on a 3.0T MR scanner (Achieva TX, Philips, Best, The Netherlands) with a 32-channel head coil. The 3D TOF-MRA sequence was first performed to localize the IA. Then the IA wall was imaged by 3D black blood T1W-VISTA sequence before contrast injection and at about 6 minutes after administration of Gd-DTPA (Magnevist; Bayer Schering Pharma, Berlin, Germany; 0.1 mmol/Kg). Imaging parameters were: TR/TE, 700/30ms; TSE factor, 49 including 4 startup echoes; sense factor, 2; FOV, 160×160×54mm³; voxel size, 0.6×0.6×0.6mm³. **Image analysis:** As defined in previous study^[2], IA maximum size and parent vessel diameter were measured by two independent blinded observers, one for 3D post-contrast MR VISTA images and one for 3D CTA images. Parent vessel diameter was measured at the nearest region of definable vessel for all vessels that had direct contact with the aneurysm neck. Then the size ratio was calculated by dividing the aneurysm size with its corresponding parent vessel size. One example of IA maximum size measurement and parent vessel diameter measurement on post-contrast VISTA images and the corresponding CTA is shown in **Fig. 1**. The pre- and post-contrast VISTA images were also reviewed by one observer to evaluate the IA wall enhancement. **Statistical analysis:** Pearson correlation analysis was used to determine the relationship of IA size measurements between CTA and MRI. The prevalence of IA wall enhancement was also reported.

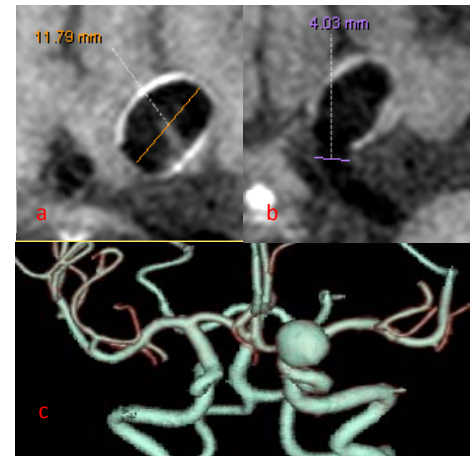


Fig. 1. One example of IA maximum size (a) and parent vessel diameter (b) measurement on post-contrast VISTA images and the corresponding CTA (c).

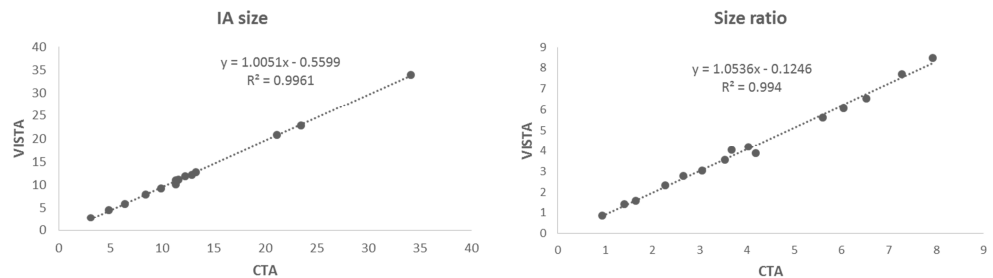


Fig.2. Regression plot for aneurysm size and size ratio.

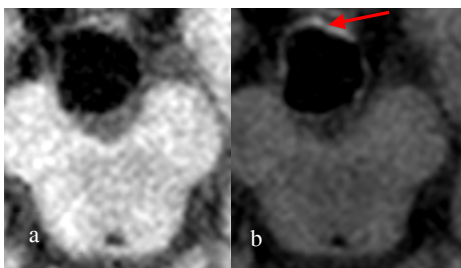


Fig. 3. One case with basilar artery aneurysm wall enhancement. a, b: The pre- and post-contrast VISTA images. The red arrow shows the wall enhancement.

Results: The IA size and size ratio measured by CTA was 13.02 ± 7.89 mm, 4.05 ± 2.19 , and by MRI was 12.53 ± 7.93 mm, 4.14 ± 2.31 . Excellent agreement was found between CTA and MRI in IA measurement: for IA size, $r=0.998$, $p<0.001$; for size ratio, $r=0.997$, $p<0.001$ (**Fig. 2**). Another typical subjects with basilar artery aneurysm is also shown in **Fig. 3**, and the heterogeneous wall enhancement can be seen. Prevalence of IA wall enhancement in this population was 60%.

Discussion and Conclusions: In measurement of IA maximum size and size ratio, post-contrast black blood MRI, T1W-VISTA, showed excellent agreement with CTA. Different from CTA, pre- and post-contrast VISTA images can also be used to depict IA wall enhancement, which may reflect the aneurysm wall inflammation progression and can be used to evaluate aneurysm rupture risk.

References: [1] Wiebers D, et al. N Engl J Med. 1998;339:1725-1733. [2] Rahman M, et al. Stroke. 2010;41:916-920. [3] Chalouhi N, et al. J. Cereb. Blood Flow Metab. 2012;32:1659-1676. [4] Tulamo R, et al. J Neurointerv Surg. 2010;2:120-130. [5] Qiao Y, et al. JMIR. 2011;34:22-30.