Imaging small **cerebral** aneurysms using non-invasive **MR angiography**

3.0T MRA without contrast agent demonstrates high performance in cerebral aneurysm imaging

The Sixth Affiliated People's Hospital, Shanghai Jiao Tong University (China), uses time-of-flight MR angiography (TOF MRA) to visualize cerebral aneurysms. The team has high confidence in their 3D TOF MRA method when imaging patients with small aneurysms.

“3D TOF is easy to use and the background signal suppression is very good. We use SENSE to shorten the scan duration”

Yuehua Li, MD, PhD, Professor of Radiology at The Sixth Affiliated People’s Hospital, Shanghai Jiao Tong University, China.

Visualizing small aneurysms

“Visualization of small cerebral aneurysms is relevant because detection of unruptured aneurysms can influence patient care,” notes Yuehua Li, MD, PhD, professor of the radiology department. “After follow-up examinations, patients with high-risk aneurysms can receive therapeutic interventions to decrease the risk of rupture.”

“Our team highly appreciates the capabilities of MRI for non-invasive visualization of aneurysms smaller than 5 mm. Both MR and CT can be used to image aneurysms, but MR angiography can be performed without contrast agent, and without ionizing radiation it is not influenced by skull bones.”

High resolution and high SNR are essential

Dr. Li uses a protocol based on 3D time-of-flight (TOF) MRA. “High resolution and high SNR are the most important factors when visualizing small aneurysms. In order to achieve that, scan duration is the trade-off,” Dr. Li says. “To shorten the scan duration we use SENSE.”

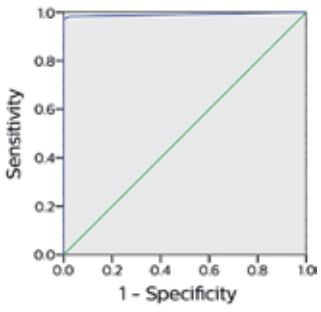
“The 3D TOF MR angiograms are obtained by using 3D T1-weighted FFE sequences (TR 35 ms, TE 7 ms, flip angle 20 degrees, field of view 250 × 190 × 108 mm, matrix 732 × 1024, four slabs, 180 slices of 0.8 mm thickness, acquisition time 8:56 minutes). On our Achieva 3.0T MRI system with an 8-channel head coil, 3D TOF is easy to use and the background signal »

Small aneurysm on 3D TOF MRA and DSA

3D TOF MR angiography non-invasively demonstrates this small cerebral aneurysm that also appears on DSA, which is an invasive procedure.

Achieva 3.0T with an 8-channel head coil, 3D T1W FFE, TR 35 ms, TE 7 ms, flip angle 20 degrees, FOV 250 × 190 × 108 mm, matrix 732 × 1024, 4 slabs, 180 slices of 0.8 mm, scan time 8:56 min. MIP and volume-rendered images are reconstructed. Single-artery highlighting method used to reduce arterial overlay.

Receiver operating characteristics (ROC) curve for aneurysm based evaluation



"We recommend that 3D TOF MRA would be an additional approach for patients with small cerebral aneurysms, due to its non-invasive nature and high degree of accuracy and sensitivity" [2]

MR angiography of multiple cerebral aneurysms

3D TOF MRA demonstrates bilateral aneurysms arising from C5 and C6 segments.

Achieva 3.0T with an 8-channel head coil, 3D T1W FFE, TR 35 ms, TE 7 ms, flip angle 20 degrees, FOV 250 × 190 × 108 mm, matrix 732 × 1024, 4 slabs, 180 slices of 0.8 mm, scan time 8:56 min. MIP and volume-rendered images are reconstructed. Single-artery highlighting method used to reduce arterial overlay.

5 years MRA follow-up of unruptured aneurysm

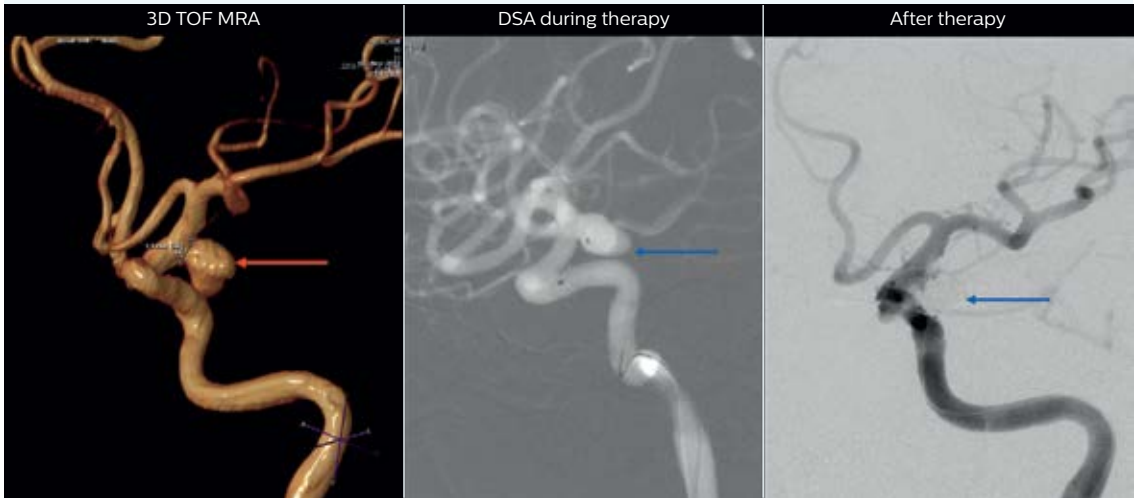
A cerebral aneurysm on the C5 segment in a 57-year-old female was followed over a period of 5 years using 3D TOF MRA. The 5 years follow-up using 3D TOF MRA shows that the aneurysms didn't change much, which indicates that the aneurysm is stable and intervention therapy was not needed.

Achieva 3.0T with an 8-channel head coil, 3D T1W FFE, TR 35 ms, TE 7 ms, flip angle 20 degrees, FOV 250 × 190 × 108 mm, matrix 732 × 1024, 4 slabs, 180 slices of 0.8 mm, scan time 8:56 min. MIP and volume-rendered images are reconstructed. Single-artery highlighting method used to reduce arterial overlay.

MRA of high risk cerebral aneurysm

Volume rendered 3D TOF MRA image visualizes an irregularly shaped cerebral aneurysm arising from the C7 segment. The physician qualified the lesion as instable and interventional therapy was performed. 3D DSA after therapy indicates that the aneurysm has been occluded completely.

Achieva 3.0T with an 8-channel head coil, 3D T1W FFE, TR 35 ms, TE 7 ms, flip angle 20 degrees, FOV 250 × 190 × 108 mm, matrix 732 × 1024, 4 slabs, 180 slices of 0.8 mm, scan time 8:56 min. MIP and volume-rendered images are reconstructed. Single-artery highlighting method used to reduce arterial overlay.



suppression is very good. Maximum intensity projections (MIPs) and volume-rendered images are reconstructed from the data. We use a single-artery highlighting method to reduce arterial overlay. The method can also be used for carotids or other small intracranial vessels."

Study shows high accuracy

"Advances in MR imaging, the high SNR and spatial resolution of 3.0T, increasing observer experience and improved postprocessing techniques have improved the capabilities of MRA over the last decade. We found that 3D TOF MRA provides excellent images for the visualization of small cerebral aneurysms which enables us to accurately diagnose, and this accuracy appears to be similar to that obtained with DSA according to data from a 2014 study," [2] Dr. Li says.

"Aneurysm location can influence how easy it is recognized. Infundibula can mimic aneurysms, adding to the difficulty of interpretation. On MIP images, small aneurysms can also be easily misinterpreted when the aneurysm overlaps with the vessel. This is why in our method we are viewing the images from multiple angles."

"In the hundreds of patients with aneurysms that we scanned, we saw no significant differences in accuracy, sensitivity or specificity among the locations. [2] We think this is the result of technical advances in image acquisition and postprocessing algorithms."

3D TOF MRA chosen for prevalence study

"Our high confidence in the 3D TOF MRA method was the reason to select this method for a study on the prevalence of unruptured cerebral aneurysms in Chinese adults, which involved finding the location and size of unruptured cerebral aneurysms. By the way, that study found a prevalence of 7% and most lesions had a diameter of less than 5 mm," [3] says Dr. Li.

According to Dr. Li, the good performance of MRA makes it a candidate to replace DSA. "We recommend that 3D TOF MR angiography would be an additional approach for patients with small cerebral aneurysms. This is due to its non-invasive nature, ease of use and high degree of accuracy and sensitivity," he concludes. «

References

1. Li MH, Cheng YS, Li YD, Fang C, Chen SW, Wang W, Hu DJ, Xu HW. *Large-cohort comparison between three-dimensional time-of-flight magnetic resonance and rotational digital subtraction angiographies in intracranial aneurysm detection.* Stroke. 2009;40:3127-9.

2. Li Y, et al. *Accurate diagnosis of small cerebral aneurysms ≤5 mm in diameter with 3.0-T MR angiography.* Radiology. 2014;271:553-60.

3. Li Y, et al. *Prevalence of unruptured cerebral aneurysms in Chinese adults aged 35 to 75 years: A cross-sectional study.* Ann Intern Med. 2013;159(8):514-521.