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Image Report

Three tesla magnetic resonance angiography with ultrashort echo time describes the arteries near the cerebral aneurysm with clip and the peripheral cerebral arteries

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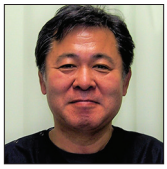

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ABSTRACT

Background: The assessment of the clipped cerebral aneurysm and the cerebral arteries after the treatment of subarachnoid hemorrhage (SAH) is important to find aneurysm regrowth or postoperative cerebral vasospasm. Usually, contrast-enhanced computed tomography angiography is performed for the evaluation of the arteries, but it has side effects of contrast medium. Time-of-flight magnetic resonance angiography (MRA) is a fast and non-invasive method, but clip-induced artifact limits assessment of the artery in the vicinity of the clip. 1.5T MRA with ultrashort echo time (UTE) reduces metal artifact, but the obtained image is too rough to evaluate the aneurysm remnant, and the description range is too narrow to assess the cerebral vasospasm. We routinely use SIGNA Pioneer 3.0T (GE Healthcare Life Sciences, Buckinghamshire, England) and perform SILENT SCAN with UTE-MRA for the postoperative assessment of the clipped aneurysm and cerebral arteries for SAH patients treated by clipping. It has better image quality and describes arteries with a wide description range, so it possesses the potential to overcome the disadvantages of 1.5T UTE-MRA.

Case Description: We presented a representative SAH patient who postoperatively underwent 3.0T UTE-MRA after clipping. The artery near the clipped aneurysm was evaluated in detail, and the cerebral arteries were described from the main trunk to the peripheral parts with a wide description range, which enabled the assessment of cerebral vasospasm.

Conclusion: 3.0T UTE-MRA may be helpful for the usual assessment of the arteries after clipping and cerebral vasospasm in the future.

Keywords: 3 tesla, Cerebral aneurysm, Clipping, Magnetic resonance angiography, Ultrashort echo time

IMAGE REPORT

Background

The assessment of the clipped cerebral aneurysm and the cerebral arteries after the treatment of subarachnoid hemorrhage (SAH) is important to find aneurysm regrowth or postoperative cerebral vasospasm. Of course, non-invasive methods are better for the assessment of the arteries after clipping. Usually, contrast-enhanced computed tomography angiography (CTA) is performed for the evaluation of clipped cerebral aneurysm[14] and the arteries, but it has side effects

of contrast medium. Time-of-flight magnetic resonance angiography (TOF-MRA) is a fast and non-invasive method and used for evaluation of postoperative cerebral vasospasm, but clip-induced artifact limits assessment of the artery in the vicinity of the clip, especially of aneurysm neck remnants.[1] MRA with ultrashort echo time (UTE-MRA) reduces metal artifact,[3,7-9] and its usefulness is reported for the assessment of the internal flow in the intracranial stent,[4,10] moyamoya disease,[12] and arteriovenous malformation.[13] Besides, 1.5T UTE-MRA revealed the artery in the vicinity of a clip,[5] but the obtained image is too rough to evaluate the aneurysm remnant, and its description range is too narrow to assess the cerebral vasospasm especially of the peripheral portion. Therefore, 1.5T UTE-MRA does not yet have the clinically required quality as a usual follow-up after clipping.

3.0T UTE-MRA has a potential to overcome the problem which 1.5T UTE-MRA has because its image is not so rough, and its description range is wider. However, only Takubo *et al*. reported the usefulness of 3.0T UTE-MRA for the assessment of clipped aneurysm,[11] and they mainly investigated characteristic features of the artifacts derived from the clip. Therefore, the clinical usefulness of the 3.0T UTE-MRA, especially for SAH patients, has not been reported. We routinely use SIGNA Pioneer 3.0T (GE Healthcare Life Sciences, Buckinghamshire, England) and perform SILENT SCAN with UTE-MRA for the postoperative assessment of the aneurysm and cerebral arteries for SAH patients treated by clipping. SILENT SCAN can work as quiet as 3 dB and shorten the scan time without severe signal-noise-ratio reduction.[2] We herein presented a representative SAH patient who underwent 3.0T UTE-MRA. The artery near the clipped aneurysm was evaluated in detail, and the cerebral arteries were described from the main trunk to the peripheral parts with a wide description range, which enabled the assessment of cerebral vasospasm.

CASE DESCRIPTION

An 80-year-old woman developed SAH (Hunt and Konik Grade II) due to a ruptured aneurysm at the anterior communicating artery (ACoA). The preoperative CTA revealed the 4.0 mm aneurysm [arrowhead, Figure 1a]

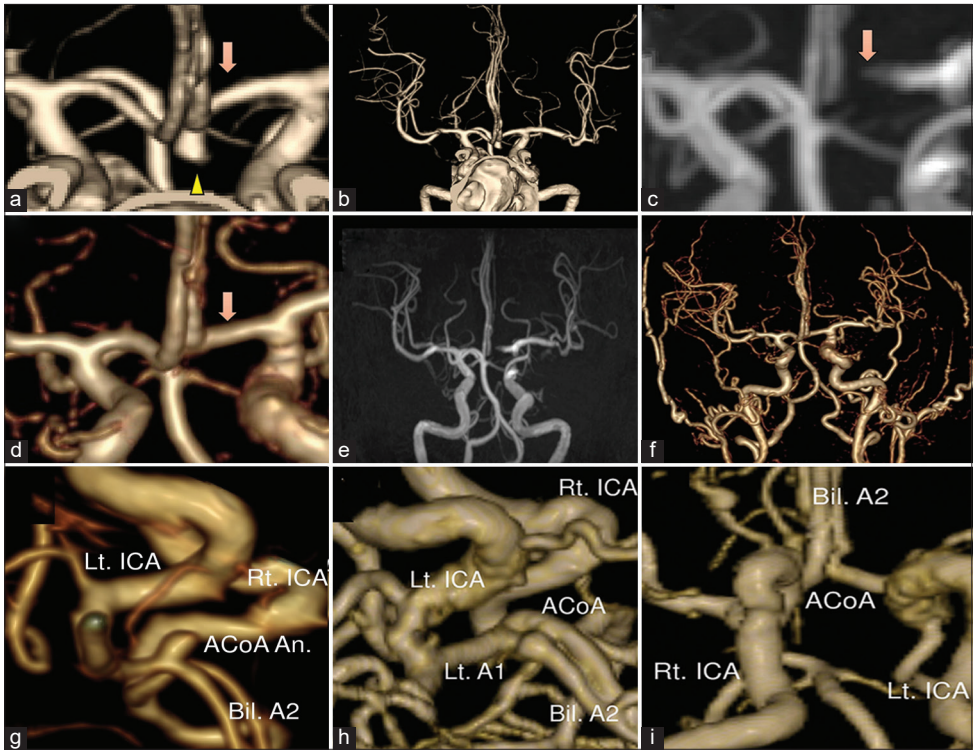

Figure 1: The preoperative computed tomography angiography (CTA) revealed the 4.0 mm aneurysm at the anterior communicating artery (ACoA) (arrowhead, a) and the A1 portion of the anterior cerebral artery (arrow, a) with a wide description range from the main trunk to the peripheral parts (b). On the 5 postoperative day, 3.0T time of flight magnetic resonance angiography (TOF-MRA) did not describe the left A1 (arrow, c), but 3.0T ultrashort echo time MRA (UTE-MRA) described it (arrow, d). Both sequences described the cerebral arteries from the main trunk to the peripheral parts with a wide description range, which enabled the assessment of cerebral vasospasm (e and f). (g) is an operative image reconstructed using the preoperative CTA. (h) is that made by postoperative 3.0T UTE-MRA. (i) is a view from the bottom reconstructed using the postoperative 3.0T UTE-MRA, and it revealed the arteries in the vicinity of the clip, the bilateral A1, A2 portions, and the ACoA, in detail. ACoA: anterior communicating artery, Bil: bilateral, ICA: internal carotid artery.

and the A1 portion of the anterior cerebral artery [arrow, Figure 1a] with a wide description range from the main trunk to the peripheral parts [Figure 1b]. We performed left frontotemporal craniotomy and clipping using the YASARGIL titanium clip (Aesculap, Tuttlingen, Germany). On the 5 postoperative day, 3.0T TOF-MRA did not describe the left A1 [arrow, Figure 1c], but 3.0T UTE-MRA described it [arrow, Figure 1d]. Both sequences described the cerebral arteries from the main trunk to the peripheral parts with a wide description range, which enabled the assessment of cerebral vasospasm [Figure 1e and f]. In addition, compared to the preoperative CTA [Figure 1g], postoperative 3.0T UTE-MRA revealed the arteries in the vicinity of the clip, the bilateral A1, A2 portions, and the ACoA, in detail [Figure 1h and i]. In the postoperative course, we confirmed no aneurysm regrowth nor postoperative cerebral vasospasm using 3.0T UTE-MRA, and the patient was discharged with a modified Rankin Scale score 0 on the 28th postoperative day.

DISCUSSION

This is the first report on the clinical usefulness of 3.0T UTE-MRA for postclipping assessment on the cerebral arteries. Compared to CTA, UTE-MRA is less invasive and fast, but its image quality is not up to the CTA. Compared to TOF-MRA, only UTE-MRA reveals the artery in the vicinity of a clip, but both sequences describe cerebral arteries from the main trunk to the peripheral parts. However, the total required time is longer in UTE-MRA than that in TOF-MRA because UTE-MRA needs arterial spin labeling (ASL) preparation,[8] multiple scans, and subtraction processing.[6] As another problem, the signal in UTE-MRA is weaker than that in TOF-MRA.[3] Furthermore, ASL may not always be performed if there is metal around the neck, such as an intubation tube cuff. Compared to 1.5T UTE-MRA, 3.0T UTE-MRA has the better image quality and wider description range, but the cost and the availability of the 3.0T MRI are problems.[6] In summary, 3.0T UTE-MRA can reduce the time and the invasiveness compared to CTA as well as overcome the disadvantages of 1.5T UTE-MRA, but it also has some disadvantages compared to the other sequences. In addition, the clip-induced metal artifact should be further investigated in 3.0T UTE-MRI,[11] and it should be clarified what kind of aneurysm, clip shape, and surgical procedure, like how to apply the clip, can be applied to 3.0T UTE-MRI. However, 3.0T UTE-MRI is helpful for the usual postoperative and outpatient assessment of the arteries after clipping and cerebral vasospasm in the future.

CONCLUSION

3.0T UTE-MRA may be helpful for the usual assessment of the arteries after clipping and cerebral vasospasm.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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