Follow up on an unruptured intracranial aneurysm treated with a flow diverter

Jiaxu Wei, RT[1]; Xiao Li, MD[1]; Huilin Zhao, MD[1]; Shenghao Ding, MD[2]; Lang Liu, MD[2]; Xi Zhao, MD[3]; Yan Zhou, MD[1]

[1] Department of Radiology, Renji Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, P. R. China
[2] Department of Neurosurgery, Renji Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, P. R. China
[3] Siemens Healthineers, China

History

A 71-year-old female patient, complaining of dizziness for over two months, came to the hospital for a check-up. A native cerebral CT and a CT angiography (CTA) were performed on an energy-integrating detector (EID) CT for assessment.

Diagnosis

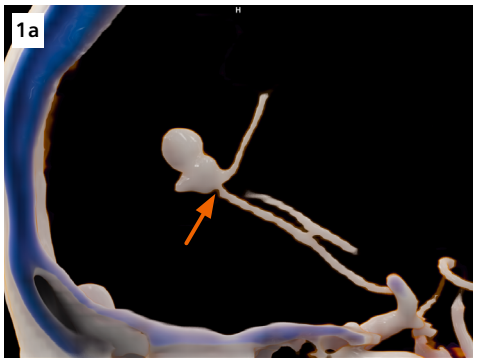
CTA images showed an irregular, saccular aneurysm with a narrow neck, at the A3 segment of the left anterior cerebral artery (ACA), directing forward and upward. The neck-to-dome distance was approximately 12.8 mm and the maximum dome width was 6.3 mm. A severe stenosis in the parent artery, proximal to the neck of the aneurysm, was seen. Native CT images were unremarkable with no signs of subarachnoid hemorrhage.

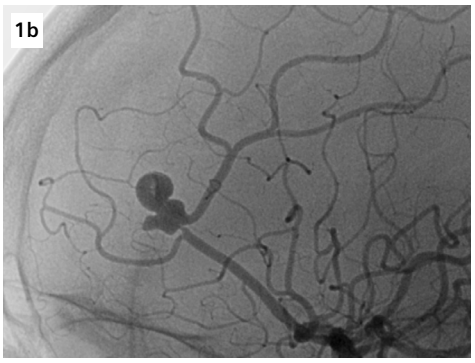
Subsequently, the patient underwent endovascular treatment. The implantation of a flow diverter, as well as a balloon angioplasty, were successfully performed. Post-interventional digital subtraction angiography (DSA) showed retained contrast agent near the neck of the aneurysm. Two days later, this residual filling of contrast agent was also seen in a follow-up CTA performed on a photon-counting detector (PCD) CT, using an ultra-high resolution (UHR) scan mode. The curved segment of the diverter appeared slender. There was no evidence of braid deformation nor of lumen abnormalities of the parent artery.

The patient experienced no complications during her hospital stay and was discharged five days after the intervention. A six-month follow-up CTA was scheduled.

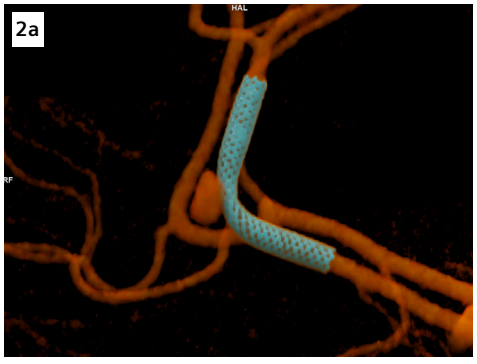
Comments

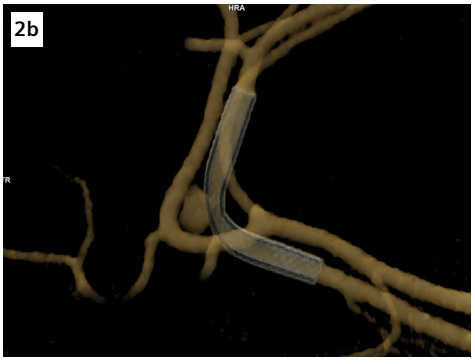
Unruptured intracranial aneurysms (UIAs) are often asymptomatic. When it ruptures, it may bleed into the brain parenchyma or the subarachnoid space, resulting in permanent disability or even death. DSA is considered the gold standard technique for the detection of cerebral aneurysms, offering both dynamic and morphological information on the intracranial circulation. However, it is relatively expensive, not widely available and carries a potential risk of complications. For an appropriate treatment planning, CTA offers valid diagnostic information, such as the location and the form of the aneurysm, the size of its neck and dome, the presence of collateral arteries, or abnormalities of the parent artery. With the introduction of PCD CT, it becomes possible to routinely acquire UHR images with high spatial resolution and reduced image noise at retained radiation dose efficiency. As shown in this case, the UHR images, acquired at 0.2 mm and reconstructed with a sharp kernel of Hv89, can be properly used to create optimal three-dimensional (3D) images, using cinematic volume rendering technique (cVRT). This offers the possibility of visualizing the detailed structures of the vascular anatomy as well as of the flow diverter in both 2D and 3D using the same UHR images. The artifact interference, usually caused by the struts, is not seen. Comparing dose efficiency – the UHR images acquired at 0.2 mm on PCD CT applied a $CTDI_{vol}$ of 24.1 mGy, and the standard images acquired at 1 mm on EID CT applied a $CTDI_{vol}$ of 45.9 mGy. This case shows the potential improvement of the UHR mode with PCD CT in the evaluation on a flow diverter implementation for an intracranial aneurysm, which prompts the primary use of UHR CTA in post-interventional follow-up imaging in clinical routine. ●

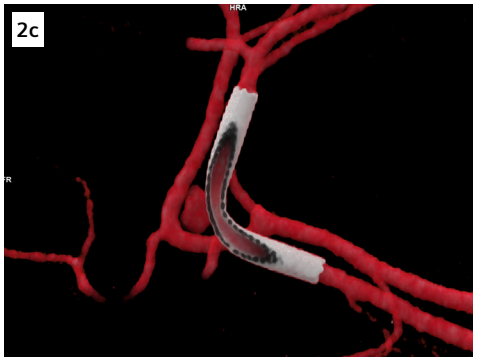


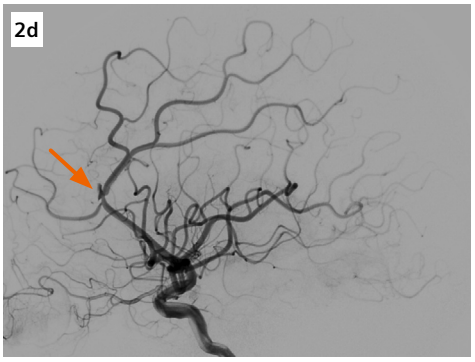


1 A cVRT image (Fig. 1a), created using CTA images acquired on EID CT, shows an irregular, saccular aneurysm, with a narrow neck, at the A3 segment of the left ACA, directing forward and upward. A severe stenosis (arrow) in the parent artery proximal to the neck of the aneurysm is also seen. CT findings are confirmed in the DSA image (Fig. 1b).









2 cVRT images (Fig. 2a – 2c), created using UHR images acquired on PCD CT, show retained contrast agent near the neck of the aneurysm, corresponding to the residual filling of the contrast agent seen in the post-interventional DSA image (Fig. 2d, arrow). The curved segment of the flow diverter appears slender. The structures of the diverter are shown in detail in cVRT images without interference of artifacts caused by the struts.

Examination Protocol

Scanner	NAEOTOM Alpha
Scan area	Brain
Scan mode	UHR mode (Quantum HD)
Scan length	168.6 mm
Scan direction	Caudo-cranial
Scan time	2 s
Tube voltage	140 kV
Effective mAs	99 mAs
IQ level	125
Dose modulation	CARE Dose4D
$CTDI_{vol}$	24.1 mGy
DLP	454 mGy*cm
Rotation time	0.25 s
Pitch	0.85
Slice collimation	120 × 0.2 mm
Slice width	0.2 mm
Reconstruction increment	0.2 mm
Reconstruction kernel	Hv89

Contrast	400 mg/mL
Volume	55 mL + 30 mL saline
Flow rate	4.5 mL/s
Start delay	Bolus tracking triggered at 100 HU in the aortic arch + 4 s