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Case Report

Vascular Compression by a Ventricular Shunt Catheter: Clinical Value of Volume-Rendered CT Angiography

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Summary: One of the strongest advantages of CT angiography (CTA) lies in its unique ability to display simultaneously the anatomy of the vascular system and the topographic relationships existing between the vessels and the neighboring structures. The case we report, a 76-year-old man who underwent an intraventricular shunt placement complicated by a stroke, shows how this topographic assessment also provides important diagnostic information when vascular lesions resulting from an extrinsic compression mechanism are suspected.

Three-dimensional CT angiography (CTA) is a recent development of medical imaging, combining the fast data-acquisition capacity of spiral CT with the graphic-processing capabilities of modern computer workstations. In addition to 3D visualization of vascular structures, this new technique simultaneously offers precise information about the topographic relationships between vessels and the surrounding anatomic landmarks (1). This case report exemplifies the clinical value of 3D CTA for the diagnosis of vascular lesions secondary to extrinsic compression by neighboring structures.

Case Report

We report the case of a 76-year-old man who presented with slowly progressive antegrade amnesia. His medical history was remarkable for normal-pressure hydrocephalus successfully treated by a ventriculoperitoneal shunt 9 years earlier. The neurologic examination was unremarkable, but antegrade amnesia was confirmed by neuropsychological evaluation. The MR images showed a 2.5-cm suprasellar cyst displacing the lamina terminalis posteriorly, displacing the genu of the corpus callosum superiorly, and compressing the fornices bilaterally. The topography of the cyst was felt to be consistent with the clinical presentation, and the cyst was decompressed surgically. Intraoperatively, a second collection of fluid was found behind the lamina terminalis after its fenestration. The fluid was evacuated, and a ventricular shunt catheter was placed in the third ventricle.

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The postoperative period was marked by sudden alteration in the patient's mental status. A brain CT scan was obtained. In addition to the expected postoperative changes, CT revealed a right frontal-lobe infarction (Fig 1A). Since the ventricular catheter was coursing across the basal cisterns, CTA was performed to clarify its topographic relationship with the circle of Willis. The CTA parameters were as follows: collimation of 2 mm, table speed (pitch) of 3 mm/s, reconstruction interval of 1 mm, gantry rotation time of 0.75 s per rotation, contrast rate of 3 mL/s, contrast volume of 120 mL, and a delay of 15 s. Images were reconstructed into both 2D and 3D formats (Fig 1B). Three-dimensional images were created using a volume-rendering technique and displayed in a stereoscopic mode, which requires the use of stereoscopic glasses. However, stereoscopic films were printed as well, allowing 3D viewing without the need for glasses (Fig 1C). CTA revealed the complex course followed by the intraventricular catheter amid the arterial structures of the circle of Willis. In its ventral-to-dorsal progression, the catheter was first crossing the superior aspect of the intradural right internal carotid artery, then passing successively below the proximal third of the A1 segment of the right anterior cerebral artery (ACA) and above the tip of the basilar artery. Although it was stretched over the catheter, the right A1 segment remained patent (Fig 1D). This observation prompted the decision to leave the catheter in place, to avoid further vascular manipulation. Clinical improvement correlated with resolution of the mass effect on a follow-up CT image obtained 10 days later.

Discussion

CTA is the most recent development to come aside MR angiography (MRA) and Doppler sonography in the rapidly evolving field of noninvasive vascular imaging. CTA already has shown its clinical potential in areas such as evaluation of carotid bifurcation and detection of intracranial aneurysm (2). Faster, less expensive, and more widely available than MRA, CTA also is operator-independent and provides better appreciation of regions not easily assessed by sonography, such as the intracranial vasculature. One of the strongest advantages of CTA, however, lies in its unique ability to display simultaneously the anatomy of the vascular system and the topographic relationships between the imaged vessels and their neighboring structures. This capacity has proved to be useful, for instance, in planning surgical access to complex intracranial lesions. The case we report here shows how this topographic assessment also provides important diagnostic information when vascular lesions resulting from an extrinsic compression mechanism are suspected.

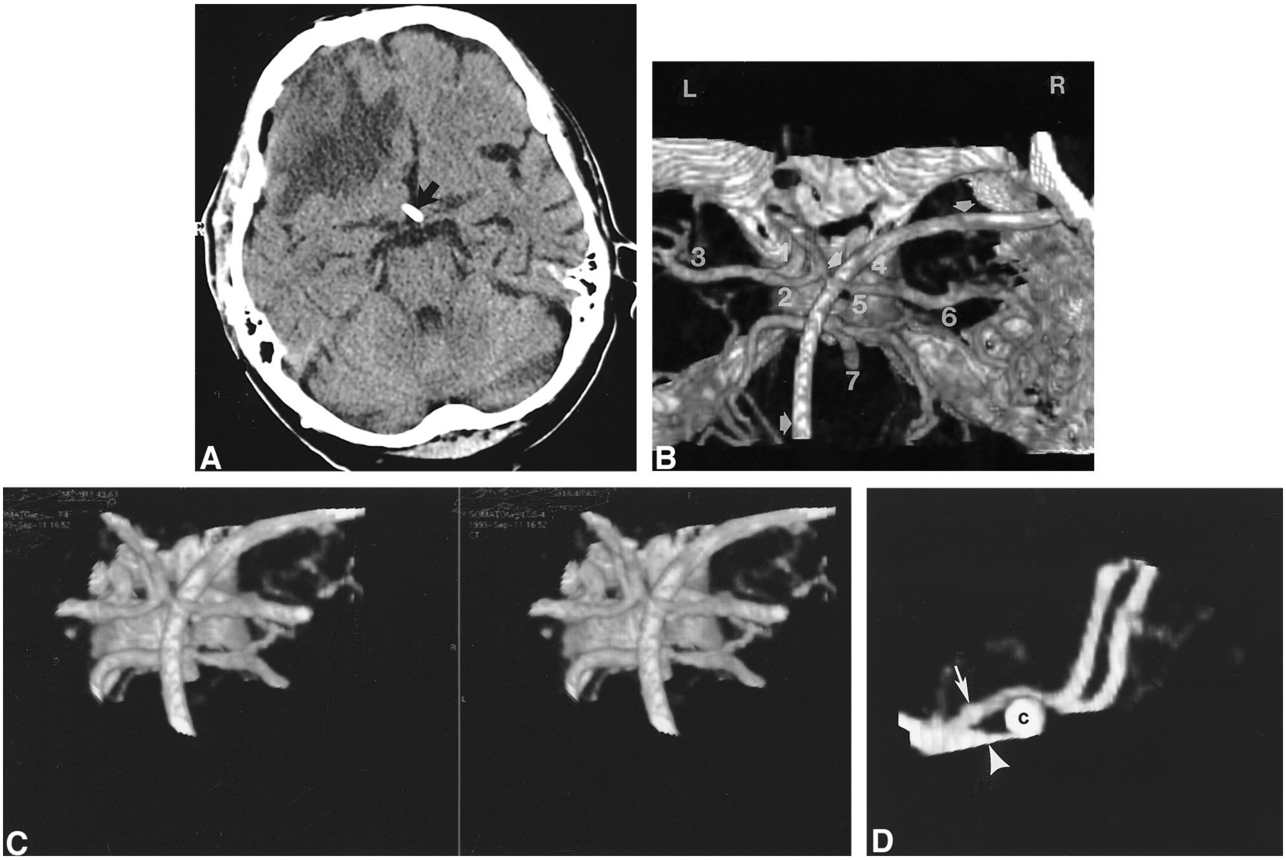

FIG 1. 76-year-old patient with a right frontal stroke after ventricular shunt placement.

A, Nonenhanced axial brain CT scan shows right frontal hypoattenuation associated with subfalcine herniation. Note the ventricular catheter (*arrow*) crossing the suprasellar region.

B, CTA, volume-rendered 3D image, superior view. The ventricular catheter (*arrows*) courses from the right pterion to the suprasellar region, passing above the right anterior clinoid process and distal internal carotid artery, but below the A1 segment of the right ACA. It then proceeds posteriorly over the tip of the basilar artery to end in the posterior aspect of the third ventricle. 1, left internal carotid artery; 2, left anterior cerebral artery (A1 segment); 3, left middle cerebral artery; 4, right internal carotid artery; 5, right anterior cerebral artery (A1 segment); 6, right middle cerebral artery; 7, basilar artery; L, left, R, right.

C, CTA, volume-rendered 3D images, stereoscopic views. The stereoscopic visualization provides precise information about the topographic relationships of the ventricular catheter, the superior aspect of the distal right ICA, the right A1 segment, and the basilar tip. Using the workstation screen and stereoscopic glasses allows real-time 360° rotation and anatomic evaluation. To obtain the stereoscopic effect with printed images, use the cross-eyed viewing technique: first, look at the picture and cross your eyes until the two images become three. Then, try to focus on the central image by slowly varying the viewing distance from the page.

D, CTA, 2D reconstruction in the plane of the right A1 segment. The catheter (C) is coursing between the distal internal carotid artery (*arrowhead*) and the right A1 segment (*arrow*). The latter is stretched over the catheter but its lumen, although narrowed, is still patent.

In our case, the association of a ventricular catheter course neighboring the right aspect of the circle of Willis and the occurrence of a right frontal stroke in the immediate postoperative period suggested a catheter-induced vascular injury. Although they did not provide definitive proof that such a mechanism was involved, the 3D images showing the A1 segment of the right ACA being displaced superiorly and stretched by the catheter supported that hypothesis. The involved arterial segment was, however, patent when the CTA was performed. This finding favors either transient vasospasm induced by the catheter placement or transient vessel occlusion by catheter compression, resulting in both cases in significant hemodynamic imbalance in the right ACA territory. Since the compromised vessel was shown to be patent on CTA, it was decided to leave the shunt in place to avoid the risk of vascular lesions by further manipulations. In the reported case, the additional information provided by 3D CTA assessment of vascular structures and their environment had significant impact on both the diagnostic evaluation and the clinical management of the patient.

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