

Benefit of Conebeam Computed Tomography Angiography in Acute Management of Angiographically Undetectable Ruptured Arteriovenous Malformations

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Introduction

Ruptured arteriovenous malformations (AVMs) are a frequent cause of intracerebral hemorrhage (ICH). In some cases, compression from the associated hematoma in the acute setting can partially or completely occlude an AVM, making it invisible on conventional angiography techniques. We report on the successful use of conebeam computed tomography angiography (CBCT-A) to precisely identify the underlying angioarchitecture of ruptured AVMs invisible on conventional angiography.

Figure 1

5-year-old female presenting with left temporal ICH and IVH (A). MRI demonstrated a possible lesion anterior to the hemorrhage (B) but MRA was negative (C). 2D-DSA showed no vascular lesion (D,E), but CBCT-A clearly showed an AVM nidus (F-H). The hematoma was evacuated and the AVM resected, with follow-up CBCT-A showing complete resection (I).

Methods

Three patients presented with ICH for which they underwent CBCT-A in addition to digital subtraction angiography and other imaging modalities including magnetic resonance angiography (MRA) and computed tomography angiography (CTA). All patients underwent surgical evacuation due to mass effect from the hematoma. Clinical history, radiographic imaging and surgical records were reviewed. Hematoma volumes were calculated.

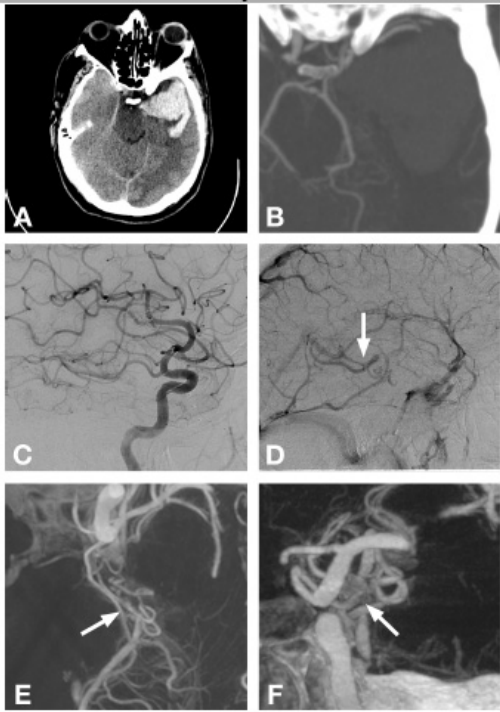
Results

CBCT-A demonstrated detailed anatomy of an AVM in all cases. No lesion or just a suggestion of a draining vein had been seen on other imaging. Magnetic resonance imaging (MRI) demonstrated enhancement in one patient. CTA demonstrated a draining vein in one patient. Two dimensional digital subtraction angiography (2D-DSA) and 3D rotational angiography (3DRA) suggested a draining vein in two cases and no finding in the third. In the two patients in whom CBCT-A was performed prior to surgery, the demonstrated AVM was successfully resected without evidence of residual. In the third patient, CBCT-A allowed precise targeting of the AVM nidus using Gamma Knife radiosurgery.

Conclusions

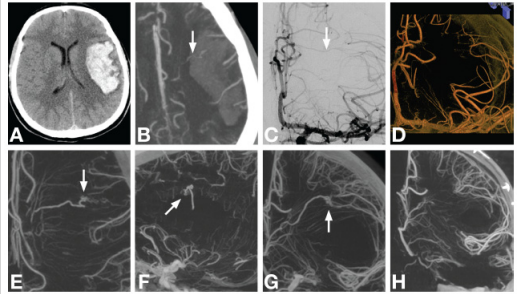
Conebeam computed tomography angiography should be considered in the workup and subsequent treatment of ICH from ruptured AVMs. In cases where the associated hematoma compresses the AVM nidus, it can have higher sensitivity and anatomic accuracy than traditional angiographic modalities including digital subtraction angiography.

Figure 2



57-year-old male with dense right hemiplegia. CT showed left temporal ICH with uncal herniation (A) but CTA showed no vascular malformation (B) The patient underwent emergent hematoma evacuation. Subsequent angiography showed no vascular malformation on arterial phase (C) but venous phase showed an early draining vein near the mesial left temporal lobe (D,arrow). CBCT-A demonstrated an AVM nidus on left ICA injection (arrows, E&F)

Figure 3



31-year-old male with sudden headache, aphasia, and right arm weakness and left frontoparietal ICH (A). CTA showed a possible abnormal draining vein (B, arrow). This was confirmed on catheter angiography (C,D) but no AVM nidus was found. CBCT-A demonstrated a compressed AVM fed by branches of the middle cerebral artery (E-G, arrows). Postoperative coronal CBCT angiogram demonstrating resection of the AVM without evidence of a residual lesion.

Learning Objectives

- 1. Understand the relative utility of using cone-beam CT angiography for detection of angiographically occult AVM
- 2. Be introduced to the novel use of this imaging technology to improve detection of acute ruptured AVM that would otherwise not be detected.

References

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