High-Resolution Magnetic Resonance Vessel Wall Imaging (MR-VWI) in the Evaluation of Ruptured Cranial Dural Arteriovenous Fistulas: A Preliminary Experience

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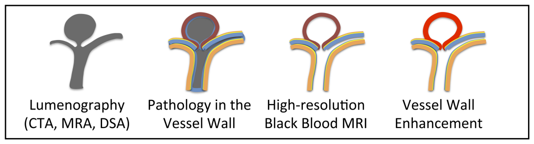
Introduction

High-resolution magnetic resonance vessel wall imaging (MR-VWI) is increasingly being used to characterize intracranial vascular disease. Recent studies support a paradigm of avid vessel wall enhancement in ruptured (but not unruptured) intracranial aneurysms. Here we report our preliminary experience using MR-VWI in the evaluation of ruptured cranial dural arteriovenous fistulas (dAVFs).



Methods

A retrospective review of a prospective intracranial MR-VWI database identified a consecutive series of patients with ruptured cranial dAVFs. All patients underwent standard imaging including non-contrast CT, CT angiography, and digital subtraction angiography (DSA). High-risk angioarchitectural features, e.g., venous-side aneurysms and varices, were identified and a site-of-rupture determined, if possible, using traditional criteria. MR-VWI was used to evaluate high-risk angioarchictectural features for (1) robust enhancement and (2) contiguity to hemorrhagic blood products.

Results

Four of 7 patients with ruptured cranial dAVFs demonstrated at least one high-risk angioarchitectural feature on classical imaging thought to be the site-of-rupture. In all cases, this arterialized venous structure demonstrated robust vessel wall enhancement and was located immediately adjacent to hemorrhagic blood products on MR-VWI. In patients with multiple, high-risk angioarchitectural features, only the feature in contiguity with blood and thought to be the site-of-rupture demonstrated enhancement.

Case Examples With Vessel Wall Enhancement

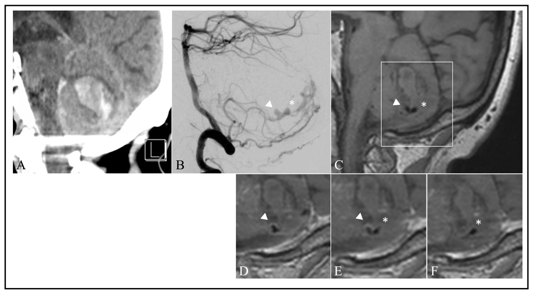


Fig 1. An 87-year-old female presents with a ruptured cranial dAVF. Non-contrast head CT (A) demonstrates a midline cerebellar intraparenchymal hematoma. Diagnostic cerebral angiography (B) reveals a Borden Type III cranial dAVF arising from multiple posterior meningeal artery branches arising from the extracranial left vertebral artery, and draining directly into a midline cerebellar vein with a prominent bilobed venous varix (arrowhead and asterisk). High resolution black blood T1 weighted sagittal MRI (C) clearly resolves the bilobed venous varix (arrowhead and asterisk), demonstrating contiguity with the hematoma. Post contrast images demonstrate circumferential enhancement of the anterior pointing bleb, but NOT the posterior pointing bleb of the venous varix. (D-F are post contrast, serial sagittal slices of the delineated area in C, arrowhead indicates the enhancing anterior bleb, the asterisk indicates the non-enhancing posterior bleb).

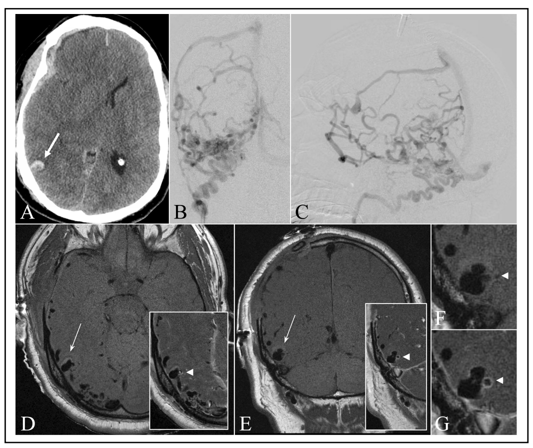


Fig 2. A 54-year-old male presents in extremis with a ruptured cranial dAVF. Pre-operative non-contrast head CT (A) demonstrates a large right SDH connected to a prominent right occipital IPH with central ghosting (arrow) and significant midline shift. Diagnostic cerebral angiography (B, AP projection; C, lateral oblique projection) following emergent decompressive craniotomy and SDH evacuation reveals a Borden Type III cranial dAVF primarily arising from right occipital artery branches with numerous prominent venous varicies along the face of the now evacuated SDH. High-resolution black blood T1 weighted MRI (D, E, F) clearly resolves the large venous varix nestled within the right occipital IPH, demonstrating contiguity with this structure and the hematoma (arrow indicates T1 hyper-intense blood product). Post contrast images demonstrate circumferential enhancement of the medially pointing bleb of this venous varix (arrowhead). Note that F and G are magnified coronal views of the venous varix seen in E.

Case Example Without Vessel Wall Enhancement

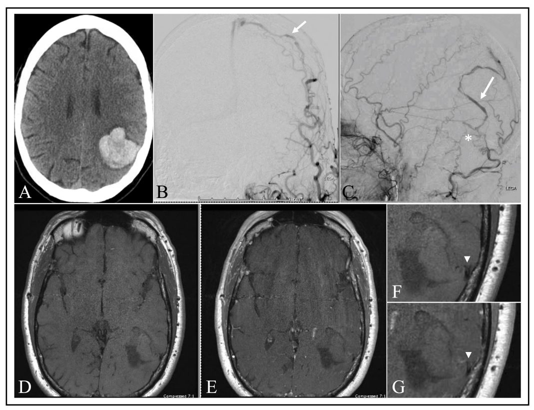


Fig 3. A 59-year-old man with a ruptured cranial DAVF. A, Head CT head demonstrates a left parietal intraparenchymal hemorrhage extending to the cortical surface. B and C, DSA of the left external carotid demonstrated a Borden type III cranial DAVF supplied by trans-osseous branches of the occipital artery and posteriorly-directed branches of the middle meningeal artery, with exclusive drainage to the superior sagittal sinus. D and E low magnification, F and G high magnification, High-resolution black blood T1WI before (D, F) and after (E,G) the administration of gadolinium demonstrates a prominent cortical vein adjacent to the hematoma but without overt wall enhancement.

Conclusions

MR-VWI may be useful in the evaluation of ruptured cranial dAVFs. In particular, it may aid in site-of-rupture identification. These findings support an emerging paradigm that spontaneously ruptured, macrovascular structures, e.g., intracranial aneurysms, demonstrate avid vessel wall enhancement.

References

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