Journal of Neuroradiology (2010) 37, 239—242

Available online at
ScienceDirect
www.sciencedirect.com

Elsevier Masson France
EM|consulte
www.em-consulte.com

CASE REPORT

Perfusion-CT of developmental venous anomalies: typical and atypical hemodynamic patterns

Imagerie tomodensitometrique de perfusion des angiomes veineux: aspects typiques et atypiques

H. Kroll, B.P. Soares, D. Saloner, W.P. Dillon, M. Wintermark*

University of California, San Francisco, Department of Radiology, Neuroradiology Section, 505, Parnassus Avenue, PO Box 0628, San Francisco, California 94143-0628, United States

Available online 2 December 2009

KEYWORDS
Developmental venous anomaly;
DVA;
Venous angioma;
Cavernoma;
Perfusion CT;
PCT;
Typical perfusion patterns;
Atypical perfusion patterns;
CTA

Summary This article reports perfusion-CT patterns that can be observed in patients with DVAs. In atypical DVAs, an abnormal venous congestion pattern with increased CBV, CBF and MTT can be observed in the vicinity of a DVA, and needs to be recognized and differentiated from other entities such as cerebral neoplasms or stroke. This pattern might help to stratify risks of associated complications such as hemorrhage.

Introduction

Developmental venous anomalies (DVA), also known as venous angiomas, are the most common vascular anomaly of the brain [1,2]. They are present in up to 2% of the general population and constitute more than 50% of brain vascular anomalies [3,4]. Standard use of high resolution imaging modalities, namely CT and MRI, in emergency and non-emergency settings (e.g. patients with neurological deficits, seizures, clinical suspicion of stroke) is likely responsible for the increased incidental findings of venous cerebral variants.

Different hypotheses about the pathogenesis of DVAs have been proposed to address whether DVAs are malfunctioning anomalies or congenital variants. Currently, the development of DVAs is thought to be a non-inherited, congenital process that begins in embryogenesis with an arrest in venous development after arterial maturity is complete [5,6]. They are not true vascular malformations and

* Corresponding author. University of Virginia, Neuroradiology Division, Department of Radiology, 1st Floor, Room 1011, PO Box 800170, 1215, Lee Street-New Hospital, Charlottesville 22908-0170, United States.
E-mail address: Max.Wintermark@radiology.ucsf.edu (M. Wintermark).

0150-9861/$ - see front matter © 2009 Elsevier Masson SAS. All rights reserved.
doi:10.1016/j.neurad.2009.09.002

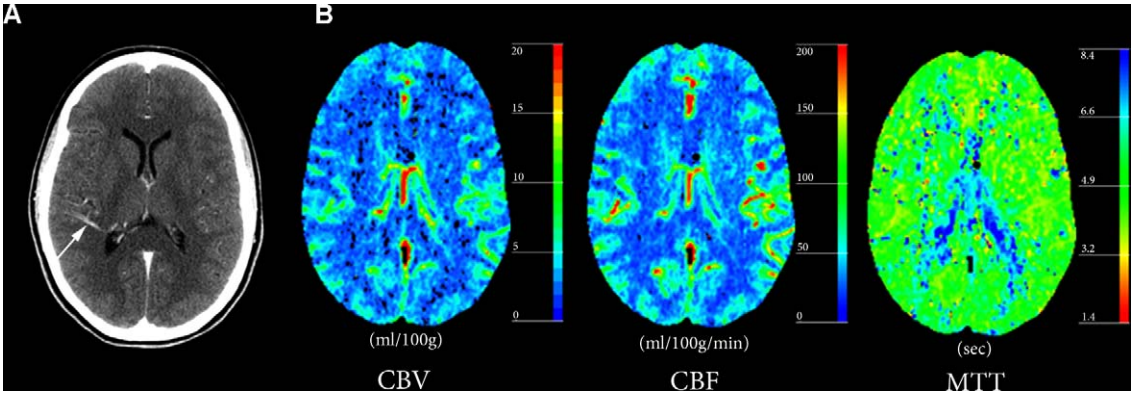

Figure 1 Typical DVA with normal perfusion parameters. A. Post-contrast CT shows a right posterior temporal DVA with centripetal drainage (arrow) into choroidal veins in the atrium of the right lateral ventricle. B. Perfusion-CT maps do not demonstrate abnormalities in the parenchyma surrounding the DVA.

are thought to represent variations of parenchymal venous drainage [3,7]. Their functional role as draining vessels is preserved. Devastating venous infarctions after ligation of a DVA has confirmed the physiological function of a DVA as the only draining vessel for its correlating brain segment [8].

Assessment of DVAs with perfusion-CT (PCT) allows characterization of the hemodynamic properties of DVAs, which may lead to further understanding of the clinical relevance of those lesions. The purpose of this article is to illustrate typical and atypical hemodynamic patterns of DVAs on PCT through case reports.

Case #1: Typical DVA with normal perfusion parameters

A 25-year old female patient with a history of chronic headaches presented to the emergency department with a new episode of headache associated with weakness and dysesthesia in her lower extremities. Physical and neurological examination showed mild spasticity in lower extremities bilaterally, with increased bilateral deep tendon reflexes and extensor plantar responses. A CT study was performed (Fig. 1), consisting of non-contrast enhanced CT, CT angiogram (CTA), perfusion-CT and post-contrast CT. No abnormalities were reported on non-contrast enhanced CT (NCT). Post-contrast CT and CTA showed a right frontoparietal DVA with centripetal drainage to the deep venous system. No adjacent aneurysm or associated vascular malformation was reported. PCT demonstrated normal symmetric blood flow, volume and transit times in the region of interest. Subsequent digital subtraction angiography was performed and confirmed the incidental DVA without evidence of abnormal shunting or aneurysms.

Case #2: Atypical DVA with abnormal perfusion parameters but no complications

A 58-year old male patient with history of back and neck pain presented to the emergency department with acute onset of headache. Physical examination did not show fever, neck stiffness, or focal neurological deficits. A CT study was performed (Fig. 2). No abnormalities were noted on the NCT. Post-contrast CT and CTA demonstrated a DVA in the deep white matter of the right frontal lobe with drainage to ependymal periventricular veins. PCT maps demonstrated a regional increase in cerebral blood volume (CBV) and cerebral blood flow (CBF) with associated prolonged mean transit time (MTT) in the corresponding area. The patient then underwent a lumbar puncture (LP) in which results were negative for SAH. He was discharged the

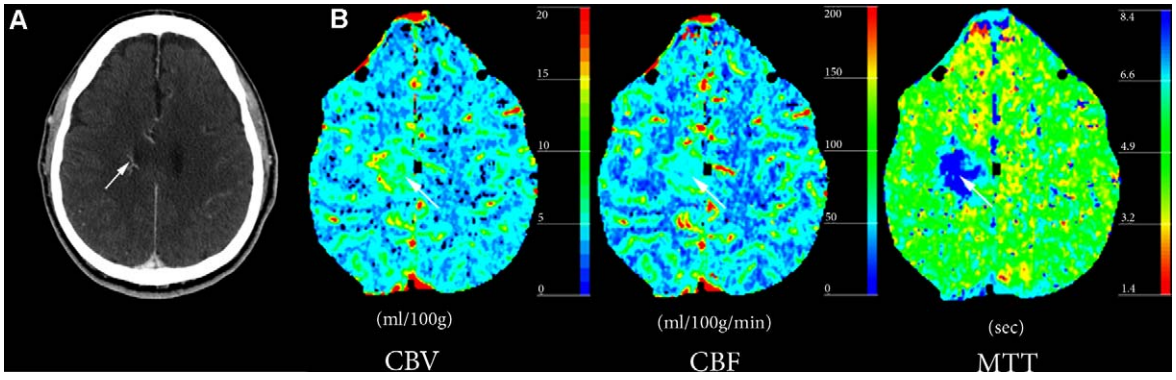

Figure 2 Atypical DVA with abnormal perfusion parameters but no complications. A. Post-contrast CT demonstrates a DVA (arrow) in the deep white matter of the right frontal lobe with drainage into ependymal periventricular veins. B. Perfusion-CT maps demonstrate regional increase in CBV and CBF surrounding the DVA, with prolongation of MTT.