Radiographic Evaluation and Clinical Implications of Venous Connections Between Dural Arteriovenous Fistula of the Cavernous Sinus and Cerebellum and the Pontomedullary Venous System

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■ OBJECTIVE: **The types of cortical venous reflux channels, posterior fossa and pontomesencephalic venous reflux or their connections with the cavernous sinus (CS) are inadequately described in the literature. This study uses angiography, magnetic resonance imaging, and X-ray computed tomography to clarify the possible route of cavernous dural arteriovenous fistulae (CVDAVF) that causes posterior fossa and pontomedullary venous reflux and documents the clinical presentations associated with the reflux.**

■ METHODS: **Eighty-six patients with CSDAVF treated at Ramathibodi Hospital, Bangkok, Thailand, during 2009 to 2013 were studied retrospectively. Sixteen cases with posterior fossa and pontomedullary venous reflux were included for analysis.**

■ RESULTS: **Bridging veins serve as an important pathway for venous reflux from CS to the posterior fossa and brainstem. The uncal vein directly terminates at the CS and has several connecting routes, ranging from the inferior frontal lobes and insula to the posterior fossa through the basal vein of Rosenthal. The petrosal vein was most frequently and easily detected angiographically. It plays a major role in the cerebellar hemispheric venous reflux. Only 1 patient developed brainstem and cerebellar venous congestion, which returned to normal after endovascular treatment.**

■ CONCLUSIONS: **Connections of CS are not limited to intercavernous, ophthalmic veins, sphenoparietal sinuses, and inferior and superior petrosal sinuses. They also occur with complex venous drainages at the base of the frontotemporal lobes, insula, brainstem, and cerebellum. Knowledge of the venous connection of CS is key to understanding the possible locations of venous congestion/hemorrhage and the clinical presentation of patients with CSDAVF.**

INTRODUCTION

Textbooks state that the cavernous sinus (CS) receives venous blood from the tributaries of the superior and inferior ophthalmic veins, the sphenoparietal sinuses, and the superficial middle cerebral veins. Cavernous venous blood exits through the superior and inferior petrosal sinuses, as well as by the skull base emissary veins, mostly the veins of the foramen ovale that connect with the pterygoid venous plexus. In a high-gradient pressure environment, specifically the arteriovenous shunt, the arterialized veins are able to reverse direction of their normal inlet and are potentially able to reflux into the existing venous channels. This reversal of direction is difficult to recognize in most angiographic or imaging studies.

The term bridging vein refers to the vein that links the subarachnoid vein with the dural venous sinus. In the CS, bridging

Key words
- Cavernous dural arteriovenous fistulae
- Endovascular
- Hemorrhagic venous infarction

Abbreviations and Acronyms
BVR: Basal vein of Rosenthal
CS: Cavernous sinus
CSDAVF: Cavernous sinus dural arteriovenous fistulae
CT: Computed tomography
MRI: Magnetic resonance imaging
NBCA: *N*-butyl cyanoacrylate
PV: Petrosal vein
SPS: Superior petrosal sinus
UV: Uncal vein

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Table 1. Clinical Presentation of Patients With CSDAVF With Pontomedullary and Cerebellar Venous Reflux

Patient Number	Red Eye & Proptosis	CN III Palsy	CN IV Palsy	CN VI Palsy	CN			CN VII Palsy	Subjective Bruit	Hemiparesis	Cerebellar Signs
					V1	V2	V3				
1	+	−	−	+	−	−	−	−	+	−	−
2	+	+	+	+	+	+	−	+	+	+	+
3	+	−	−	−	−	−	−	−	−	−	−
4	+	−	−	+	−	−	−	−	+	−	−
5	−	−	−	−	−	−	−	−	+	−	−
6	+	−	−	−	−	−	−	−	+	−	−
7	+	−	−	−	−	−	−	−	+	−	−
8	+	−	−	−	−	−	−	−	−	−	−
9	+	+	−	+	−	−	−	−	+	−	−
10	+	−	−	−	−	−	−	−	+	−	−
11	+	+	+	+	−	−	−	−	+	−	−
12	+	−	−	+	−	−	−	−	−	+	−
13	na	na	na	na	na	na	na	na	na	na	na
14	+	−	−	+	−	−	−	−	−	−	−
15	+	−	−	−	−	−	−	−	−	−	−
16	+	+	+	+	−	−	−	−	+	−	−

+, presence; −, absence; na, not available (the data were lost at the admission to hospital); CN, cranial nerve.