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CASE REPORT

Bilateral Tentorial Sinus Drainage of the Basal Vein (of Rosenthal)

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We report a case of bilateral collateral tentorial venous sinus drainage of the basal vein (of Rosenthal) (BV). The observation was made on a corrosion cast of the cerebral venous system obtained from a fresh cadaver. Radiographic correlation was obtained by performing standard X-ray imaging of the corrosion cast. Embryologic and clinical considerations are discussed. Clin. Anat. 16:264–268, 2003. © 2003 Wiley-Liss, Inc.

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INTRODUCTION

The basal vein (of Rosenthal) (BV) originates below the anterior perforated substance and courses posteriorly between the midbrain and the temporal lobe toward and into the Galenic system of veins. In the adult, the BV is divided into a striate segment (first segment), a peduncular segment (second segment), and a mesencephalic segment (third segment) (Huang and Wolf, 1974; Ono et al., 1984). During fetal development, these segments may not develop fully or at all, or may fail to anastomose longitudinally with each other, resulting in a fragmented BV with various patterns of venous drainage. Portions of the BV may drain: 1) supratentorially and anteriorly toward veins of the middle cranial fossa, the superficial middle cerebral vein, or the dural sinuses of the middle cranial fossa; 2) infratentorially toward the anteromedian and anterolateral pontine and superior petrosal vein via the interpeduncular and lateral mesencephalic veins, respectively; and 3) posteriorly into an internal cerebral vein or the Galenic system of veins.

We report an anatomic observation based on a corrosion cast of the cerebral venous system in which both BVs drained into the ipsilateral transverse sinus via an unnamed tentorial venous sinus. The corrosion cast provided a radiographic correlation to digital subtraction angiography (DSA) imaging.

CASE REPORT

Our anatomy lab received the cadaver of a 84-year-old white female deceased from heart failure and pneumonia, and with no history of cerebrovascular disease or intracranial pathology. A corrosion cast of the cerebral venous system from the non-fixed cadaver was prepared as follows: a mixture of methylmethacrylate (Beracryl, Troller, Switzerland) and barium sulphate powder (HD 200 plus, Lafayette, Anaheim, CA) was injected into the internal jugular vein bilaterally. The head was then immersed in 40% potassium hydroxide solution at 40°C until complete dissolution of the soft and bony tissues was obtained.

The corrosion cast showed excellent bilateral filling of the cerebral venous system. Other than the occurrence of a bilateral tentorial venous sinus drainage of the BV, a tentorial venous sinus drainage of the left medial atrial vein was noted. No other major or infrequent anatomic variations of the cerebral venous system were observed in this specimen.

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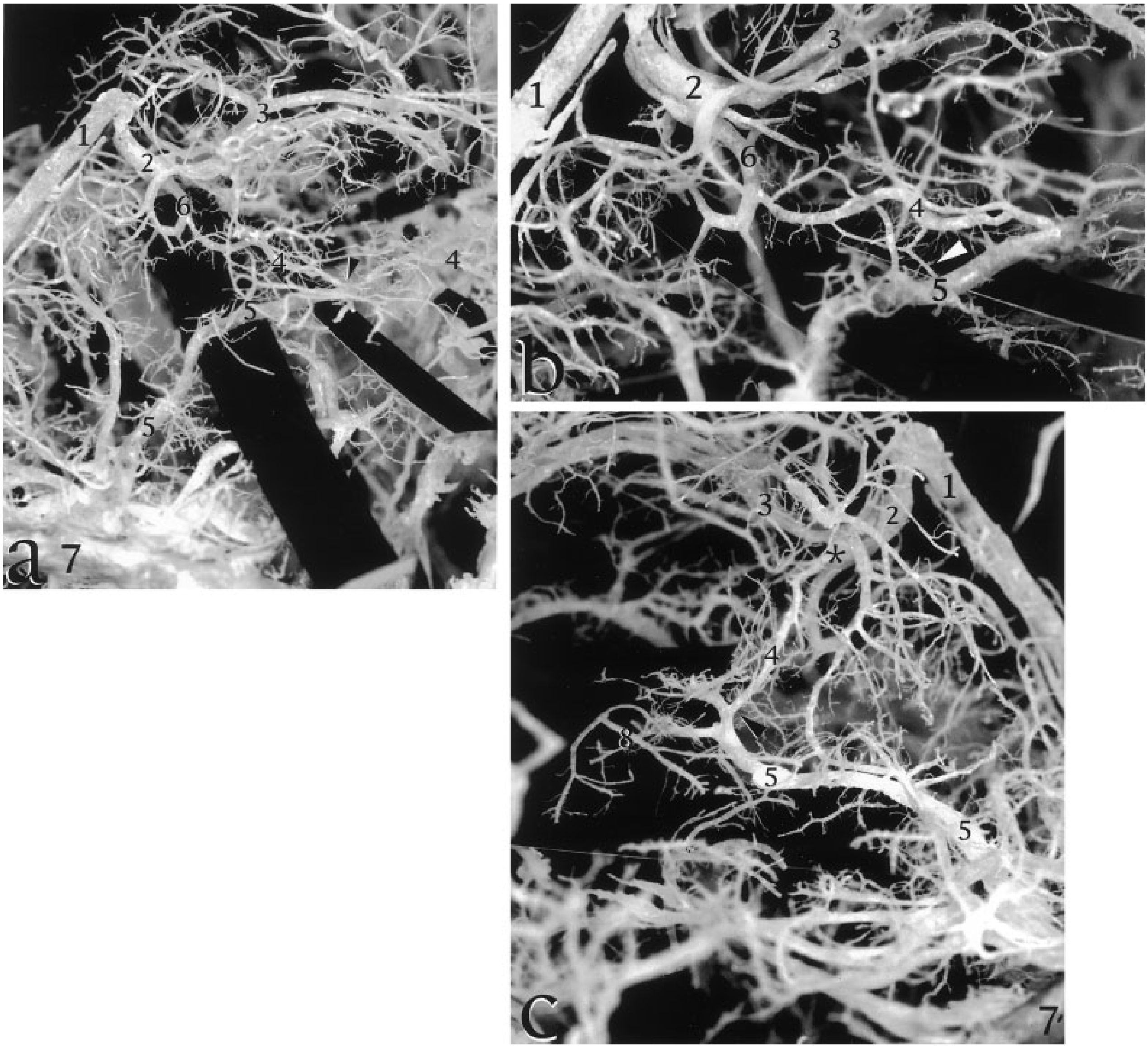

Fig. 1. Corrosion cast of the cerebral venous system obtained from a non-fixed cadaver of an 84-year-old female. Cortical veins have been removed to allow for a good visualization of the deep cerebral venous system. **a:** Right lateral view showing a right tentorial venous sinus draining the right BV. Black arrowhead = point of union between the BV and the right tentorial sinus. **b:** Detail of the posterior portion of the right BV that drains into the superior vermian vein. The lateral mesencephalic vein (white arrowhead) is very thin and constitutes the anatomical limit between the second and third segments of the BV. **c:** Lateral view of left BV. Only the second and third segments are visible. The left BV joins the internal cerebral vein posteriorly (asterisk). Collateral drainage into a tentorial sinus is observed (arrowhead). 1, straight sinus; 2, great cerebral vein (of Galen); 3, internal cerebral veins; 4, basal vein (of Rosenthal) (BV); 5, tentorial sinus draining basal vein; 6, superior vermian vein; 7, transverse sinus; 8, inferior ventricular vein; 9, superior petrosal sinus; 10, superior petrosal vein; 11, cavernous sinus.

Right Basal Vein

The right BV was of the complete form (Fig. 1a,b). The first segment drained anteriorly toward a right laterocavernous sinus (San Millán Ruíz et al., 1998). The third segment was thin and was connected to the great cerebral vein (of Galen) via a right superior vermian vein, and to the right superior petrosal vein (of Dandy) via a thin lateral mesencephalic vein. A few millimeters posterior to its point of junction with the inferior ventricular vein, the right BV connected with a large flattened channel that coursed posterolaterally and inferiorly toward the middle third of the right transverse sinus. The configuration and topography of this venous channel were consistent with a tentorial venous sinus.

Left Basal Vein

The left BV was of the incomplete form (Fig. 1c), the first segment being isolated from the second and third segments. The first segment could be followed up to its termination into the posterosuperior aspect of the cavernous sinus. The third segment joined the distal portion of the left internal cerebral vein. The proximal portion of the second segment was thin and received several presumably medial temporal veins. It coursed posteriorly and connected with a venous confluence formed by the proximal part of the third segment and a large flattened venous channel. This venous channel drained posterolaterally and inferiorly into the middle third of the left transverse sinus, and was also consistent with a tentorial venous sinus. The left inferior ventricular vein was seen to join the proximal portion of this tentorial venous sinus.

Radioanatomic Correlation

The plain films of the corrosion cast obtained in three classic angiographic projections (lateral, anteroposterior, and transfacial) provided radiographic correlation to DSA imaging (Fig. 2a–c). The lateral projection demonstrated the connections between the BV and the deep venous system. The distal portion of the tentorial venous sinuses[1] were difficult to identify, however, due to the superposition of the transverse sinuses in this instance (Fig. 2a). The anteroposterior projection (Fig. 2b) provides an anterosuperior view of the tentorium cerebelli and of the posterior fossa content, and thus allowed for the BV configuration and course to be well depicted. The tentorial venous sinuses appeared as flat venous structures coursing posteriorly and laterally toward the mid-portion of the transverse sinuses. The transfacial projection (Fig. 2c) provided a tangential view of the tentorial venous sinuses, whose courses adopted the slight inferior convexity of the tentorium cerebelli in which they are enclosed.

DISCUSSION

Drainage of the BV through a tentorial venous sinus into the straight sinus, transverse sinus, or confluence of sinuses (torcular of Herophilus) has previously been reported by several authors (Duval et al., 1971; Babin et al., 1973; Huang and Wolf, 1974; Okudera et al., 1984; Ono et al., 1984; Terbrugge et al., 1988; Matsushima et al., 1989). It remains, however, an uncommon finding, with eight cases observed angiographically by Terbrugge et al. (1988) over a 3-year period, two cases out of a series of 150 cerebral angiograms reported by Duval et al. (1971), and one case out of 66 specimen sides examined by Matsushima et al. (1989). In every reported case, the drainage of a BV into a tentorial sinus seemed to be associated with the lack of longitudinal anastomosis between the second and third segments of the BV, or with the absence of its third segment. Unlike these previous observations, the right BV in our specimen was of the complete form, that is, with all three segments present and longitudinally interconnected. On the left side, the second and third segments were interconnected, but disconnected from the first segment (incomplete form). Although the diameter of injected vessels in a corrosion cast may not reflect their actual size, the prominent size of both tentorial venous sinuses in our case strongly suggests that they represented the major drainage pathway of the BV.

From a developmental point of view, drainage of a BV into a tentorial sinus probably represents the persistence of the early drainage pattern of the BV into the primitive tentorial sinus of Padget (PTS) (up to the stage of the 60 mm fetus). The PTS initially drains the various segments that will form the adult BV, that is, the superficial and deep telencephalic veins and the ventral and dorsal diencephalic veins. With the expansion of the cerebral hemispheres, these primitive veins become too distant from the PTS and develop secondary longitudinal anastomoses with each other, thus constituting the definitive BV in its complete form (Padget, 1957). Connections to the PTS generally disappear. Persistence of the PTS in the adult as a paracavernous or a laterocavernous sinus is well known and represents the most frequent drainage pathway of the superficial middle cerebral vein (San Millán Ruíz et al., 1998; Gailloud et al., 2000). Drainage of the BV into a tentorial sinus could, however, represent another form of persistence of a portion of the PTS, in this case, the posterior portion. This particular anatomic configuration, that is, a tentorial venous sinus draining a BV, is probably developmentally distinct from the frequently observed adult tentorial sinuses, which receive cortical tributaries from the inferior aspects of the cerebral hemispheres and the cerebellar hemispheres.

Tentorial venous sinuses are often encountered and ligated during transtentorial approaches to the posterior cranial fossa (Browder, 1975). Because of multiple potential connections with the middle cerebral veins, the infratentorial veins, and the Galenic system of veins, ligating a tentorial sinus that drains a complete form of the BV should be clinically well tolerated. In reviewing the literature, we

[1] Flow is assumed to be centrifugal, thus the “distal portion” refers to the portion close to the transverse sinus.

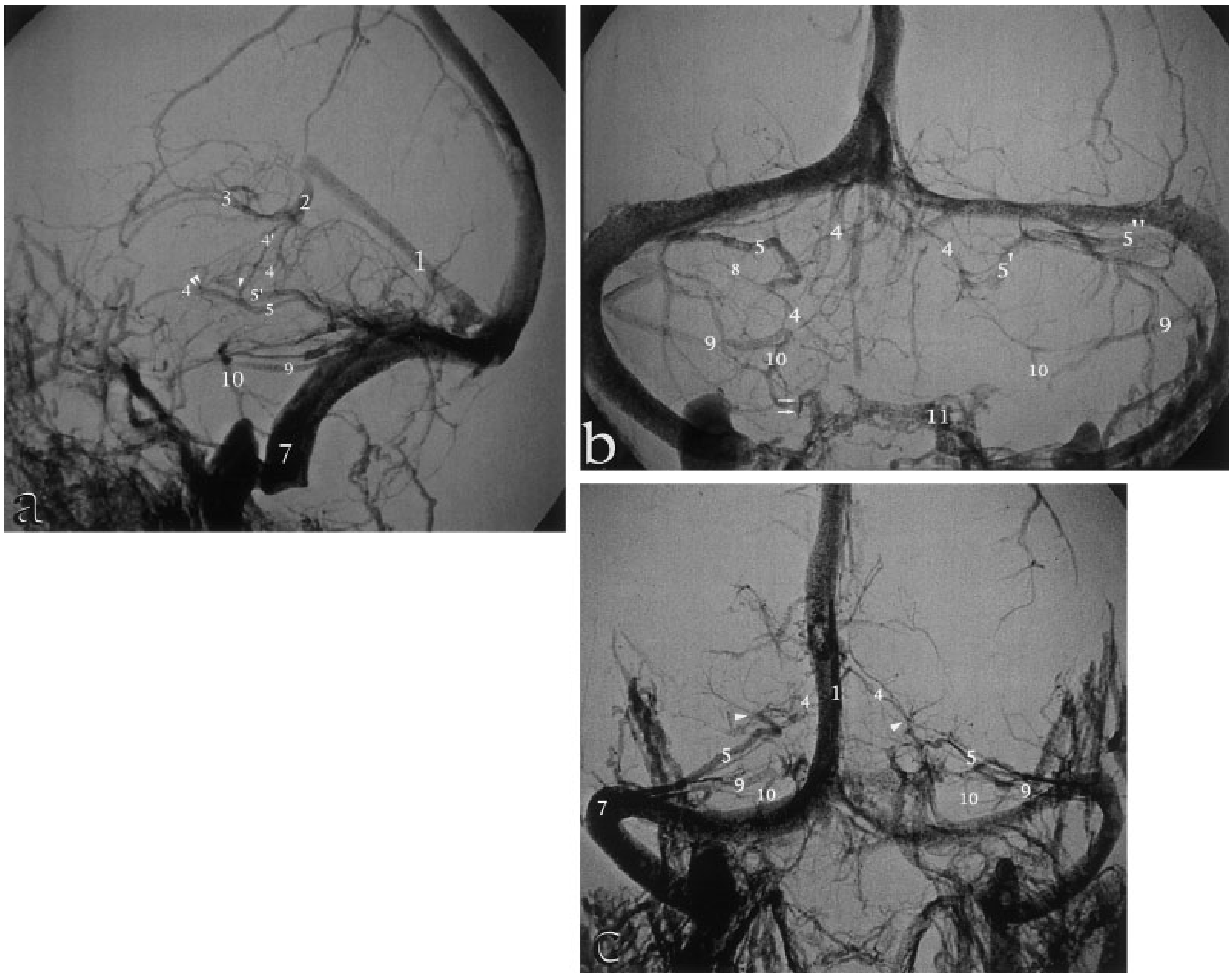

Fig. 2. Plain X-ray of the corrosion cast depicting the angiographic anatomy of the bilateral tentorial sinus drainage of the BV. **a:** Lateral view. The tentorial sinuses draining both BVs (4 and 4′, right and left, respectively) are seen on both sides. Both tentorial venous sinuses (5 and 5′, right and left, respectively) are seen to terminate on the middle third of the transverse sinus. The arrowhead points to the junction between left BV and left tentorial venous sinus. The double arrowhead points at the junction between right BV and right tentorial venous sinus. **b:** Anteroposterior view. Note that the left tentorial venous sinus (5′) that drains the BV seems to enter a larger tentorial sinus (5″). On the corrosion cast, there were two distinct tentorial sinuses at this level that did not connect to each other. The laterocavernous sinus (arrows), which is connected to the first segment of the right BV, is seen with its typical slit-like appearance observed in standard DSA imaging (Gailloud et al., 2000). **c:** Transfacial view. The tentorium cerebelli is clearly delineated by the tentorial sinuses that drain the BVs. The arrowheads point at the junctions between BVs and tentorial venous sinuses. 1, straight sinus; 2, great cerebral vein (of Galen); 3, internal cerebral veins; 4, basal vein (of Rosenthal) (BV); 5, tentorial sinus draining basal vein; 6, superior vermian vein; 7, transverse sinus; 8, inferior ventricular vein; 9, superior petrosal sinus; 10, superior petrosal vein; 11, cavernous sinus.

did not come across any report of complications after the ligation of a BV. Occlusion of a tentorial sinus serving as the major or only outflow pathway of a complete or incomplete BV, however, could potentially lead to devastating ischemic or hemorrhagic complications in the territory drained by the BV segment terminating in the tentorial venous sinus. Non-invasive imaging protocols such as computed tomography venography and magnetic resonance venography could provide useful additional information concerning cerebral venous anatomy, and in particular the existence of tentorial sinus venous drainage of a BV in patients scheduled for a transtentorial approach to the posterior fossa.

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