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CASE REPORT

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A complex dural-venous variation in the posterior cranial fossa: a triplicate falx cerebelli and an aberrant venous sinus

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Variations of the dural folds and the dural venous sinuses are seldom reported in the extant medical literature. Such variations in the posterior cranial fossa may be problematic in various diagnostic and operative procedures of this region. We report our observation of an extremely rare variation of the falx cerebelli and posterior cranial fossa venous sinuses encountered upon dissection of a young male cadaver. In this specimen the falx cerebelli was duplicated with dimensions of 45.3 × 5.1 mm and 49.8 × 5.3 mm for the right and left falces respectively. The distance between the two falces was 3.2, 4.5 and 7.8 mm at their proximal, middle and distal thirds. An accessory small falx (31.8 × 2 mm) was also found approximately 3.4 mm lateral to the right falx cerebelli and blended with the lateral surface of the right falx cerebelli. There was only one occipital venous sinus (diameter, 2.5 mm) and no marginal sinus was detected. At the right floor of the posterior cranial fossa (posterolateral to the foramen magnum) an additional dural venous sinus was found, which connected the terminal portion of the right sigmoid sinus to the occipital and right transverse sinuses via one medial and two lateral branches respectively. We believe that such a complex dural-venous variation in the posterior cranial fossa has not previously been reported. Neurosurgeons and neuroradiologists should be aware of such variations, as these could be potential sources of haemorrhage during suboccipital approaches or may lead to erroneous interpretations of imaging of the posterior cranial fossa.

Key words: accessory, dura, falx cerebelli, occipital sinus, posterior cranial fossa, variation

INTRODUCTION

Variations of the dura mater and its folds are seldom reported in the literature [21]. Among these are duplication of the hemispheric convexity dura [20], duplication of the spinal dural sheath [11], absence or ossification of the falx cerebri [4, 24], presence of an accessory falx cerebri [8], incompetent sellar diaphragm [3] and duplicated, fenestrated or small falx cerebelli [6, 7, 13, 14, 21, 23]. These variations are often asymptomatic and only incidentally found during human dissection. However, they may be part of more complex intracranial abnormalities

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such as agenesis of the corpus callosum [20], holoprosencephaly [4], craniofacial dyssynostosis [3, 5], arachnoid cyst [7], Chiari II malformation [23] and vermian agenesis [13]. The dura mater and its partitions are observed at approximately the 14th gestational week [7, 21]. The developing nervous system induces the formation of the dura mater from surrounding mesenchymal cells [17]. As the formation of the intradural venous sinuses is concurrent with development of the dural folds, any alteration in the morphology of the dural folds may potentially be associated with variations of the venous sinuses. We [21] previously reported a case of duplicated falx cerebelli associated with a duplicated occipital sinus and internal occipital crest [21].

Here we report our observations of an extremely rare variation of the falx cerebelli and posterior cranial fossa venous sinuses encountered upon dissection of a fresh adult male cadaver who had died of a narcotic overdose. To our knowledge, such a complex of dural-venous variation has not yet been reported.

CASE REPORT

After removal of the calvaria and brain, the tentorium cerebelli was carefully cut at its lateral border and turned superiorly. The falx cerebelli was found to be duplicated (Fig. 1). The length of the right falx cerebelli was 45.3 mm and the left was 49.8 mm. The width of the falces, at their attachment to the inferior surface of the tentorium, was 5.1 and 5.3 mm at the right and left sides respectively. The distance between these two falces was 3.2, 4.5 and 7.8 mm at the proximal, middle and distal thirds. A small accessory falx was also found attached to the underside of the tentorium cerebelli 3.4 mm lateral to the base of the right falx cerebelli. Inferiorly, the accessory falx blended with the lateral surface of the right falx cerebelli at its lower third. The length and width of this accessory falx were 31.8 and 2 mm respectively. There was only one occipital venous sinus, which originated near the right posterolateral rim of the foramen magnum. Initially it travelled within the posterior attachment of the right falx cerebelli at its lower third and then coursed between the two falces to enter the confluence of sinuses. The diameter of the occipital sinus was 2.5 mm proximally. No marginal sinus was detected. At the right floor of the posterior cranial fossa (posterolateral to the foramen magnum) an additional dural venous sinus was found. This aberrant sinus was embedded within the dura mater and we termed it a "lateral occipital" venous sinus. While coursing superiorly and posteromedially the lateral occipital venous sinus connected the right sigmoid sinus to the occipital and the right transverse sinuses through

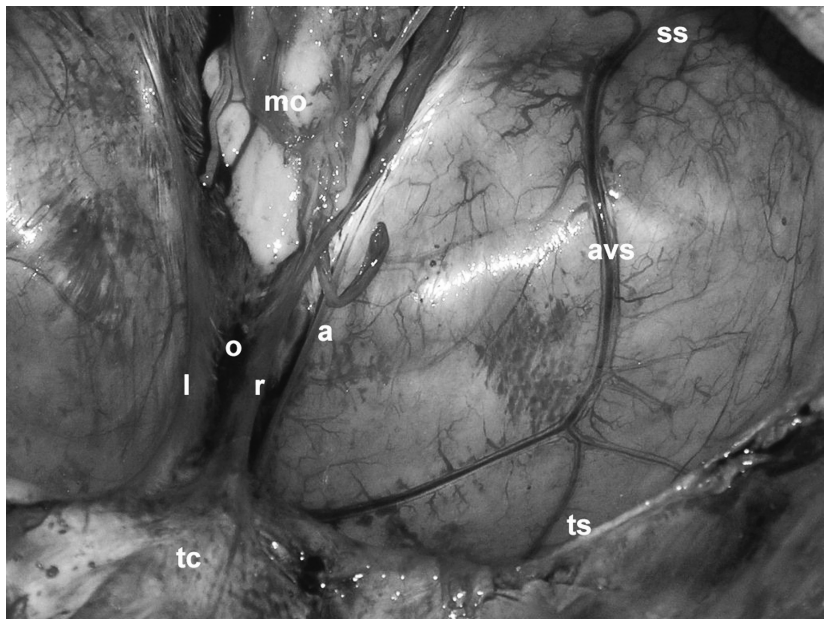

Figure 1. The posterior cranial fossa after reflection of the tentorium cerebelli (tc). Note there are three falx cerebelli; the right (r), left (l) and accessory (a) falces. An additional venous sinus (avs) is seen on the right side connecting the terminal portion of the sigmoid sinus (ss) to the occipital (o) and transverse (ts) sinuses. (mo), medulla oblongata.

one medial and two lateral branches respectively. No gross anomaly was found in the cerebellum or other intracranial structures.

DISCUSSION

The falx cerebelli is a sickle-shaped dural fold that usually harbours a single occipital venous sinus at its posterior attachment [7, 21]. There is usually only one midline-located falx cerebelli, which may be divided inferiorly to create a V-shaped space, the so-called "vermian fossa" [21]. The falx cerebelli is between 2.8 and 4.5 cm in length and is approximately 1–2 mm thick [9, 21]. In the present case, there were two falces cerebelli and a small accessory falx cerebelli. There was one occipital venous sinus. Very few reports of a duplicated falx cerebelli are found in the literature, which includes two previous reports by the present authors. Hassler and Schlenker [7] reported a midline posterior fossa arachnoid cyst with a falx cerebelli on either side. In one case of duplicated falx cerebelli [21] the falces were larger is size, reaching a maximum width of 25 mm (*vs*. 5 mm in the present case) and there were two occipital sinuses draining into the ipsilateral transverse sinus as well as two distinct internal occipital crests. In another case we [22] found a duplicated falx cerebelli associated with a constellation of other intracranial variations such as a Menelfe type 1 accessory middle cerebral artery, a duplicated anterior communicating artery and a persistent intracranial (olfactory) artery.

One of the interesting features of the present case was the presence of an additional (aberrant) dural venous sinus at the posteroinferior floor of the infratentorial space, which connected the terminal portion of the sigmoid sinus to the occipital and ipsilateral transverse sinuses. This venous structure was embedded within the dural layers. Knowledge of such an aberrant venous sinus is important in order to prevent inadvertent injuries during craniotomies of this region [1, 2]. Moreover, this additional venous structure may act as a collateral to drain posterior cranial fossa venous blood in such conditions as transverse or sigmoid sinus thrombosis. Matsushima et al. [12] divided the veins of the posterior fossa into four groups, namely superficial (cortical), deep, brain-stem and bridging veins. However, none of these included our observed variant. In a series of 211 paediatric patients no such venous structure was noted on posterior cranial fossa magnetic resonance venography [19]. Although we found no comparable description in the anatomical literature, a rather similar venous structure is seen in the drawings of the 12th edition of Gray's anatomy [10]. It is said that morphological alterations in the posterior cranial fossa dural sinuses are related to the development of the brain and that postural haemodynamic changes are induced by being erect [16]. Reddy et al. [18] postulated that the aberrant evolution of venous structures in the foetus may affect cerebrovascular, brain or skull development.

Development of the rhombencephalic dural partitions is concomitant with that of the cerebellar vermis [7, 23]. The exact timing of this occurrence is controversial [15]. It has been suggested that a crowded posterior fossa (such as in Chiari II malformation) inhibits the development of the falx cerebelli and internal occipital crest [23]. Formation of the occipital sinus and related veins begin as a venous network that reaches final maturation after birth [19].

We believe that such a complex dural-venous variation in the posterior cranial fossa is reported for the first time here. Neurosurgeons and neuroradiologists should be aware of such variations, as these could be a potential source of haemorrhage during suboccipital approaches or may lead to erroneous interpretation during imaging of the posterior cranial fossa.

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