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CASE REPORT

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A rare variation of the posterior cranial fossa: duplicated falx cerebelli, occipital venous sinus, and internal occipital crest

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Folds of the meningeal layer of the dura mater, the falx cerebri and tentorium cerebelli, traverse the vertebrate intracranial cavity and thus compartmentalise the brain. The falx cerebelli, another dural fold, is found in the posterior cranial fossa and attaches to the inferior aspect of the tentorium cerebelli and to the internal occipital crest. We present a case of a duplicated falx cerebelli, occipital venous sinus and internal occipital crest that was detected upon routine dissection of a male cadaver. Since haemorrhage of a dural venous sinus can be a fatal complication of posterior cranial fossa surgery, knowledge of venous sinus variations in this region may prevent unpredictable complications during intracranial procedures.

Key words: duplication, falx cerebelli, tentorium, anatomical variation

INTRODUCTION

Anatomical variation is a normal flexibility in the morphology of body structures. Variations generally have little effect on body function under normal circumstances, although these may alter patient management [14]. It has been postulated that clinical malpractice is partly attributable to ignorance, in an era of advanced radiology and minimally invasive surgical procedures, of anatomical variations [14]. Indeed, these authors [14] have further stated that "medical progress needs a more accurate knowledge of the variability of the human morphology to improve diagnosis and therapeutic performance".

Folds of the meningeal dura mater traverse and compartmentalise the intracranial cavity and thereby mechanically support various neural elements. The human tentorium cerebelli is a somewhat horizontal dural fold that forms the roof of the posterior cranial fossa and has the largest surface area in relation to body size in mammals [3]. The tentorium cerebelli is continuous with the falx cerebri superiorly and the falx cerebelli inferiorly. The falx cerebelli is a sickle-shaped dural fold that attaches posteroinferiorly to the internal occipital crest. The attached part of the falx cerebelli contains the occipital venous sinus and its anterior margin projects between the two cerebellar hemispheres [1]. 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 [10]. The falx cerebelli is between 2.8 and 4.5 cm in length and is approximately 1–2 mm thick, although thicknesses of up to 13 mm have been described [10, 18]. The current report describes a single cadaver found to have duplication of the falx cerebelli and occipital sinus.

CASE REPORT

During the routine dissection of a 49-year-old male cadaver and following the removal of the brain two

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distinct falces cerebelli were found dividing the infratentorial space into three compartments (Fig. 1, 2). The cause of death had been sudden and of an unknown aetiology. Each falx cerebelli (approximately 2.5 × 3.2 cm) demonstrated a distinct base and apex and possessed a distinct venous sinus on each posteriorly attached border (Fig. 2). These sinuses were noted to drain into to the left and right transverse sinus respectively with no observed connection to the marginal sinus (Fig. 2). Furthermore, after detaching the dura mater from the inner bony surface of the occipital bone, it was noted that there were two distinct internal occipital crests arising inferolaterally to the internal occipital protuberance and diverging inferiorly near the posterolateral borders of the foramen magnum. The distance between the two falces cerebelli was approximately 3 cm.

Figure 1. Schematic drawing of the duplicated falx cerebelli and occipital sinus as seen in the present case report.

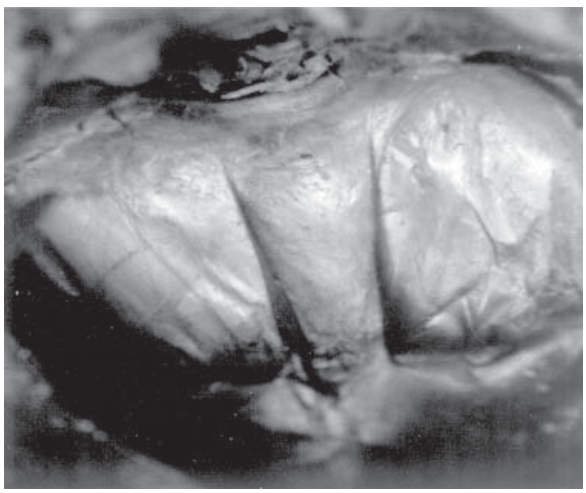

Figure 2. Two distinct falces cerebelli dividing the posterior cranial fossa into three compartments.

The brain from this specimen appeared grossly normal with no defect of the vermis. The external surface of the occipital squama appeared normal as did the remaining anatomy of the craniocervical junction. The lumina of the superior sagittal and straight sinuses were found to be normal in their configuration.

DISCUSSION

Variations in the form of dura mater are apparently rare [17]. Interestingly, Sargon et al. [15] have reported a cadaver with agenesis of the corpus callosum and septum pellucidum that was found to have a five-layered dura mater covering the left cerebral hemisphere. Similarly, Loughenbury et al. [11] reported the duplication of the spinal dural sheath from C2 to L5. Following a literature search, only one other description of a duplicated falx cerebelli was found and this was the report by Haβler and Schlenker [5]. However, their case involved an arachnoid cyst between the two falces cerebelli (not found in our case) and no mention was made of the occipital sinus. These authors [5] regarded the arachnoid cyst found in their case as a cephalic extension of the cisterna magna. Duplicated occipital sinuses have been reported in the literature. Browder et al. [2] have stated that the doubling of occipital sinuses in adults represents the end result of previously existing multi-channelled venous pathways in the midline suboccipital dura mater of the infant. However, no mention was made by these authors of duplication of the falx cerebelli. The dura mater and its partitions associated with the rhombencephalon may be observed at approximately the 14th gestational week, which is the approximate time at which the cerebellar vermis appears as a distinct entity [5]. Lang [10] reported that the occipital sinus may be tripled. It is of note that Knott [9] reported that in 44 cadavers he found no trace of the occipital sinus in two and a doubled sinus in nine cases, one lying on either side of a single internal occipital crest.

We theorise that in the present case the disproportionate growth of the cerebellar vermis and hemispheres with subsequent formation of two deep fossae between them resulted in the formation of two distinct dural folds from differentiation and condensation of the intervening mesodermal tissues. Therefore, the attached borders of the dural folds to the internal cranial surface created increased tension and thus two falces cerebelli. Indeed, Jeffery [8] has shown that the tentorium

cerebelli is rotated inferiorly by disproportionate growth of the cerebrum versus the cerebellum. The mechanical stress of bony tissue has long been known to produce local electrical or electromagnetic currents and that this piezoelectric effect [3] itself enhances osteogenesis via activation of osteoblasts [19]. Henderson et al. [6] have suggested that mechanotransduction of the deeply placed dura mater may regulate the rate of bone deposition in sutures of the cranium.

In cases of holoprosencephaly (maldevelopment of the forebrain) the absence of the interhemispherical fissure is associated with the absence of the falx cerebri [4]. Patients with the Chiari II malformation (hindbrain herniation through the foramen magnum, seen almost exclusively in patients born with a myelomeningocele) may not have a falx cerebelli or internal occipital crest [16]. This may be due to a crowded posterior cranial fossa (with inhibition of the development of these dural folds) in these patients with vermian hindbrain herniation and a small posterior cranial fossa [16]. This notion would support the notion that the development of the brain, either cerebrum or cerebellum, is a precedent event in the formation of dural folds. Michaud et al. [13] have reported a case of agenesis of the vermis in which the falx cerebelli was notably small.

Variations of the dural partitions (such as the falx cerebelli) are rarely reported in the literature. Anatomical variations of the dural venous sinuses in the region of the confluence of the sinuses may present problems with diagnostic and operative procedures [12]. Hollinshead [7] has stated that the occipital sinus is always a potential source of difficulty in posterior approaches to the posterior cranial fossa because of its variability. The clinician who operates intracranially or interprets radiological imaging should be aware of the anatomical variations found within the posterior cranial fossa.

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