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Magnetic Resonance Imaging Evidence of an Occipital-Straight Sinus Dural Arteriovenous Fistula Causing Severe Bilateral Thalamic Oedema: A Case Report

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ABSTRACT

An 81-year-old woman, with a 3-month history of tinnitus and vertigo, presented with a deterioration of symptoms. Magnetic resonance imaging (MRI) of the brain, using fluid attenuated inversion recovery (FLAIR) and T2 weighted (T2WI) images, demonstrated hyperintensity and swelling of the bilateral thalami, medial parietal lobes, occipital lobes, and left cerebellar hemisphere. She was referred to us with the suggestion of a brain tumour that had spread into the bilateral thalami, or encephalitis. A review of the MR images, however, demonstrated dilatation of a vein on the surface of the cerebellar hemisphere on the T2WI image. Susceptibility weighted imaging (SWI) revealed small and multiple hypointense lesions, indicating microhaemorrhages, in the bilateral thalami and left cerebellar hemisphere. The time of flight source imaging demonstrated small hyperintense dots in the wall of the occipital and straight sinus. Finally, a digital subtraction angiogram (DSA) revealed a dural arteriovenous fistula (DAVF) in the occipito-straight sinus with reflux flow into the straight sinus (Borden Type II). A transvenous embolization and trans-arterial embolization were performed, in an emergency setting, for the occipital sinus and dural shunt, respectively, with the aim of preserving the antegrade flow of the straight sinus. The DSA following the endovascular treatment showed the disappearance of shunt flow and recovery of the antegrade flow in the straight sinus. Therefore, this case report highlights that meticulous analysis of MRI scans help diagnose DAVF, which results in quick and radical treatment.

Key words: *dural arteriovenous fistula, magnetic resonance imaging, differential diagnosis*

Dural arteriovenous fistula (DAVF) is an abnormal fistulous connection between the meningeal arteries and dural venous sinuses, meningeal veins, or cortical veins[7, 14, 20)], which account for only 10–15% of all intracranial arteriovenous malformations (AVMs)[1, 7, 13)]. Although a DAVF can arise anywhere within the dura mater, it preferentially occurs in the transverse-sigmoid and cavernous sinuses[1, 7)]. The digital subtraction angiogram (DSA) is the standard diagnostic tool for a DAVF[1, 3, 6, 14, 16)]. However, initial magnetic resonance imaging (MRI) findings of patients with headache, pulsatile tinnitus, or symptoms related to unexplained intracranial hypertension may mislead the diagnosis. Here we present the neuro-radiological findings of a patient with DAVF causing severe bilateral thalamic oedema, which was first suggested to be a malignant brain tumour or encephalitis. Thus, the conscientious analysis of MR images was useful as an initial diagnostic tool for this patient with severe bilateral thalamic oedema due to DAVF.

CASE REPORT

An 81-year-old woman with complaints of tinnitus and vertigo was suspected of having Meniere's disease. She was administered anti-vertigo medication. After 2 months, she developed vomiting and became lethargic. MRI of the brain showed hyperintensity and swelling in the bilateral thala-

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mi and parieto-occipital lobes and left cerebellar hemisphere on a T2 weighted image (T2WI) and fluid attenuation inversion recovery (FLAIR) image (Figure 1A, B). Analysis of the cerebrospinal fluid revealed an elevated protein level of 155 mg/dl. The patient was diagnosed with encephalitis, and treated with steroids. Her level of consciousness, however, did not improve.

She was referred to our hospital 1 week later because she was suspected of having a brain tumour. A meticulous review of MR images demonstrated the dilatation of a vein on the surface of the cerebellar hemisphere on a T2WI (Figure 1C). Susceptibility weighted imaging (SWI) revealed small and multiple hypointense spots indicating micro-bleedings in the bilateral thalami and left cerebellar hemisphere (Figure 2A). A time-of-flight (TOF) source image showed small hyperintense dots adjacent to the wall of the occipital and straight sinus (Figure 2B). The DSA revealed a DAVF in the occipital-straight sinus, with retrograde venous flow in the straight sinus (Borden Type II) (Figure 3A-C).

The occipital sinus was occluded by a trans-venous embolization. Further, a trans-arterial embolization for the dural shunt on a straight sinus was performed in an emergency setting, with the aim of preserving the antegrade flow of the

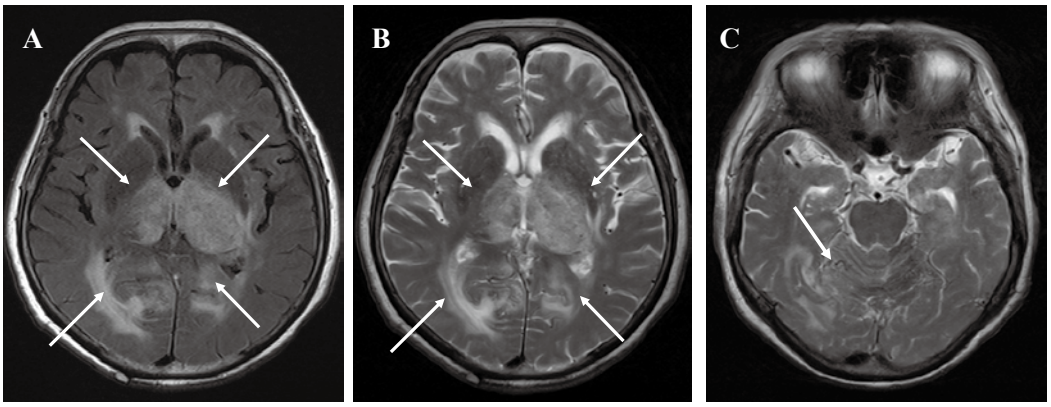

Figure 1: Fluid attenuated inversion recovery (FLAIR) and T2-weighted (T2WI) magnetic resonance imaging (MRI) before treatment
Axial FLAIR (A) and T2WI (B) images showed hyperintensity and swelling in the bilateral thalami, medial parietal lobes, and occipital lobes (white arrows). Another axial T2WI (C) delineated the hypointense tortuous vein on the cerebellar surface (white arrow). These findings suggested the presence of venous congestion, which was caused by fistulous reflux flow into the straight sinus.

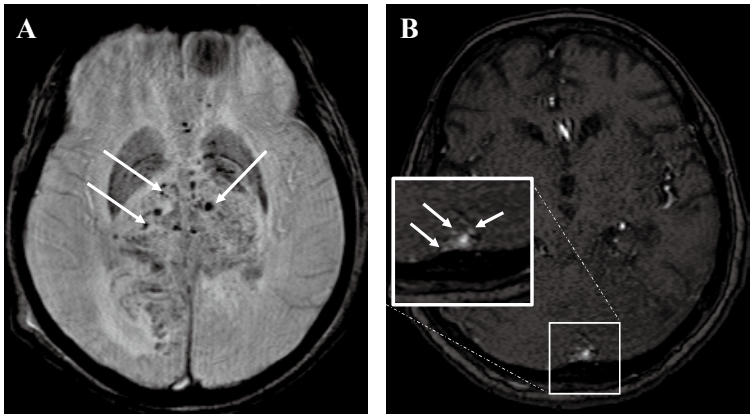

Figure 2: Susceptibility weighted image (SWI) and time-of-flight (TOF) source image before treatment
The SWI (A) revealed multiple small, hypointense dots in the bilateral thalami and right occipital lobe (white arrows). The TOF (B) source image showed multiple nodular hyperintense areas in the sinus wall, which were meningeal branches of feeding arteries and draining venules of the dural arteriovenous fistula (DAVF) (white arrows).

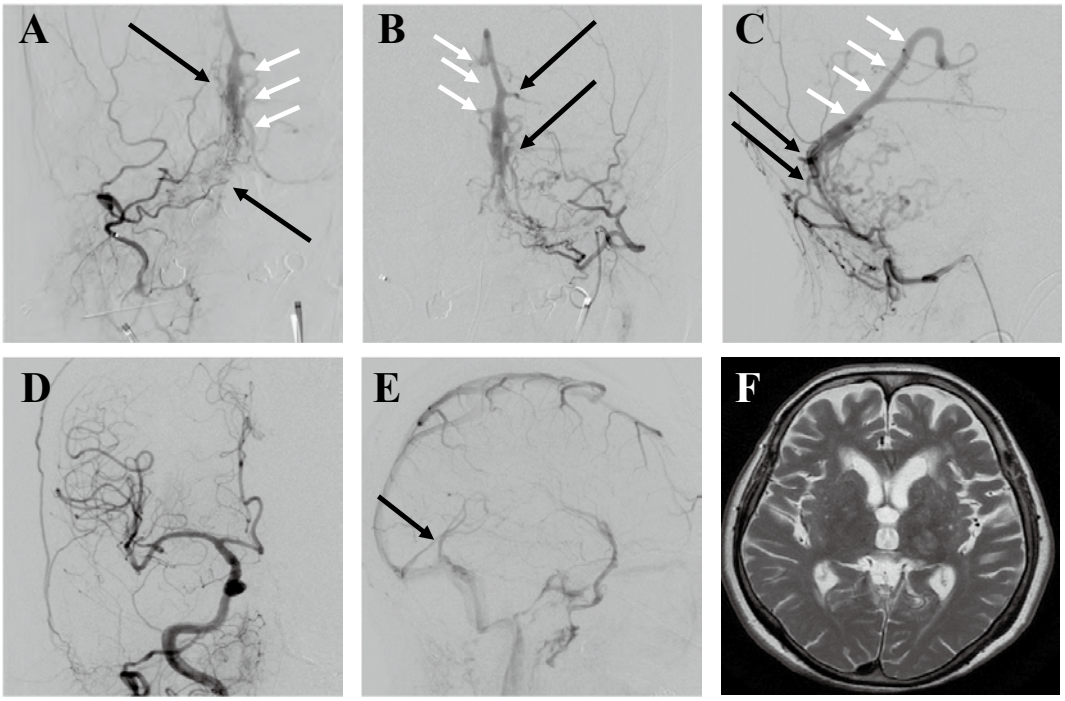

Figure 3: Digital subtraction angiography (DSA) before and after endovascular treatment and post-treatment MRI
The anterior projections of the DSA from the (A) right external carotid artery (ECA), (B) left ECA, and (C) lateral projection of the left ECA showed dural shunts at the occipital sinus and straight sinus (black arrows). These projections also revealed a retrograde venous flow in the occipital-straight sinus and cerebellar cortical vein (white arrows). The patient was diagnosed with a dural arteriovenous fistula (DAVF), classified as Borden Type II.
Following endovascular treatment, the (D) anterior projection of the common carotid artery (CCA) angiogram showed the complete disappearance of dural shunt, and the (E) lateral projection of the CCA angiogram during the venous phase revealed the recovery of the antegrade venous flow of straight sinus (black arrow).
The axial T2-weighted (T2WI) image, taken 3 months after the treatment, showed the disappearance of oedema in the bilateral thalami, medial parietal lobes, and occipital lobes.

straight sinus. A DSA, which was performed after the endovascular treatment, demonstrated the disappearance of shunt flow and recovery of antegrade flow of the straight sinus (Figure 3D, E). T2WI at 3 months after the treatment revealed the disappearance of oedema in the bilateral thalami, medial parietal lobes, occipital lobes, and cerebellar hemisphere (Figure 3F). The patient's level of consciousness gradually improved and she was transferred to a community hospital for rehabilitation.

DISCUSSION

A DAVF can elicit a wide range of signs, symptoms, and clinical manifestations depending on its location and haemodynamic features[10, 16]. Although a DAVF can arise anywhere within the dura mater, during adulthood, it most frequently occurs in the transverse, sigmoid, and cavernous sinuses[1, 7]. An occipital-straight sinus DAVF is very rare; only 5 of 122 cases were reported to occur in the straight sinus by Willinisky et al.[21]. Pulsatile tinnitus is a common symptom caused by increased blood flow in the venous system near the middle ear where a high-velocity shunt flow enters[7, 13]. Patients with a DAVF can also present with more severe symptoms, including intracranial haemorrhage and non-haemorrhagic neurological deficits, such as seizures, cerebellar symptoms, apathy, cranial nerve impairments, and failure to thrive[7]. The wide-range of symptoms occasionally make the clinical diagnosis more difficult.

Symmetrical bilateral thalamic oedema has relatively few differential diagnoses of vascular and non-vascular aetiologies. The most common vascular aetiologies include thromboembolism of the basilar artery and thrombosis of the deep venous system, whereas non-vascular aetiologies are an intrinsic infiltrative tumour and encephalitis[17]. Early MRI features in arterial thromboembolism can be seen immediately after the onset. The loss of flow void is clearly revealed on the TOF-MRA, and the thrombus itself can be seen as a hypoin-

tense mass on the SWI[19]. Hyperintensity in the sinus on the T1WI or FLAIR indicates sinus thrombosis[17]. A thrombosed sinus was clearly shown on MR venography[4]. Infiltrative tumour in bilateral thalami is a rare neoplasm[17]. It is usually a low-grade infiltrative astrocytoma (WHO grade II), which is generally hyperintense on the T2WI and hypointense on the T1WI, without contrast enhancement[15, 17]. MRI images of encephalitis may reveal bilateral hyperintensity on T2WI in the thalami, basal ganglia, or midbrain[8]. In some aetiologies of encephalitis, hyperintensity in the sulci on the T2WI has also been reported, which is suggestive of leptomeningeal inflammation[8, 17]. However, a DAVF involving the deep venous system was also attributed as the aetiology of bilateral thalamic oedema[9, 17]. An MRI is helpful for the diagnosis of DAVF because it can demonstrate dilated vessels, vascular enhancement, and signs of venous hypertension[7, 14, 10]. Suspicion of DAVF, based on MRI findings, can lead to the decision to perform a DSA. The T2WI provides a good anatomical overview, and delineates dilated vessels and oedema resulting from venous hypertension and the passive congestion of the brain[5, 9, 20]. Takada et al.[18] also reported a case with DAVF involving straight sinus in which T2WI showed hyperintensity in the bilateral thalami.

SWI can depict the acute or chronic haemorrhagic complications of DAVF, including previous haemorrhagic events, such as pial hemosiderosis or chronic intraparenchymal hematoma, which may remain occult on images acquired using other imaging modalities or MR sequences[11]. Numerous microhaemorrhages, or microbleeds, appear as hypointense spots, predominantly within the cerebral cortex or near the grey–white junction[12].

Bink et al.[2] demonstrated TOF as an important sequence, which was helpful for the detection of fistulous points in DAVF. The TOF source image revealed multiple high-intensity curvilinear or nodular structures in the sinus wall, indicative of feeding arterioles and draining venules involving the fistula. High-intensity areas in the venous sinus suggestive of arterialized high-velocity flow[10] were also seen in our case.

CONCLUSION

DAVF should be considered as a differential diagnosis in patients with bilateral thalamic oedema on MRI. We recommend careful analysis of MR images, particularly SWI and TOF source images, which helps in providing a quick diagnosis and early treatment of patients with DAVF.

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