CASE REPORT

Recanalisation of the falcine sinus secondary to venous sinus thrombosis

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SUMMARY

The falcine sinus is an ascending midline vein that connects the vein of Galen and sagittal sinus above the level of the confluence of sinuses. It usually involutes after birth. This embryonic vessel is rarely encountered clinically in adults. According to pathogenesis, the falcine sinus can be classified into persistent falcine sinus (PFS) and recanalised falcine sinus (RFS). We present an interest-ing case of an elderly patient with encasement of the internal jugular vein by a thyroid mass, result-ing in secondary cerebral venous thrombosis and recanalisation of the falcine sinus. Following treatment, there is recanalisation of the previously occluded venous sinus pathways with subse-quently reduced enhancement of the falcine sinus. When the falcine sinus is identified on imaging, it is imperative to look for any associated congenital anomalies or causes for the venous sinus ob-struction (e.g., thrombosis or tumours). In this report, we highlight the differences between the two types of falcine sinuses including their pathogenesis and pertinent imaging features.

INTRODUCTION

The falcine sinus is a rare variation of the cerebral venous pathway between the dural layers of the falx cerebri.[1] The sinus can arise from any part of the deep cerebral venous system but most com-monly from the vein of Galen or the straight sinus and drains to the sagittal sinus above the level of the confluence of sinuses.[2] This embryonic vessel normally involutes before or shortly after birth. It is rarely encountered in the adult population. We present an interesting case of an elderly patient with recanalisation of the falcine sinus.

CASE REPORT

An 81-year-old woman with known papillary thyroid carcinoma presented with a worsening head-ache for one month. No neurological deficit was detected on examination. Computed tomography (CT) scans revealed a thyroid mass encasing the right internal jugular vein, resulting in secondary thrombosis of the right internal jugular vein and the sigmoid sinus. CT cerebral venogram con-firmed thrombosis of the right sigmoid sinus and the internal jugular vein (Fig.1). There was re-canalisation of the falcine sinus connecting the vein of Galen to the superior sagittal sinus, with ad-ditional collateral vessels connecting the falcine sinus to the posterior part of the superior sagittal sinus (Fig. 1). There was no evidence of cerebral venous infarction. The patient subsequently un-derwent total thyroidectomy without complication. She has been well and asymptomatic after the surgery. As for the cerebral venous sinus thrombosis, she was prescribed oral anticoagulation thera-py with warfarin for 6 weeks. Two months later, a follow-up CT cerebral venogram showed partial recanalisation of the previously occluded venous sinus drainage pathways with subsequently re-duced enhancement of the falcine sinus (Fig.1d).

DISCUSSION

Falcine sinuses are rarely encountered clinically, only seen in 2.1% of the adult population.[1,3] It usually involutes after birth. There is a variation of the calibre of the falcine sinus ranging from 2 to 17 mm. The morphology of the falcine sinus can vary from an arch-like curved vessel to a straight or branching vessel.[3]

The falcine sinus can be classified into two groups based on the pathogenesis: Persistent falcine sinus (PFS) and recanalised falcine sinus (RFS) which is illustrated in our patient's case.[1]

Persistent falcine sinus: PFS refers to the falcine sinus that does not involute but persists after birth. Figure 2 shows a case example of a 56-year-old woman with PFS. Most PFS are associated with congenital disorders such as malformation of the vein of Galen,[3] absence of the corpus callosum,[4] acrocephalosyndactyly,[4] osteogenesis imperfecta,[3] meningoencephalocele[5] and Chiari II malfor-mation.[1,3] The Manjila classification categorized the PFS based on its relationship with the superior sagittal sinus. It also takes into consideration of associated defects in the brain and other dural ve-nous sinuses (Table 1).[6]

Recanalised Falcine Sinus

The term 'recanalised' in RFS refers to the establishment of flow through a previously involuted falcine sinus.[3] Unlike PFS, which is often associated with other anatomical variants, RFS can be seen in individuals with normal falx and cerebral venous drainage system. RFS is often established following an acquired occlusion of the straight sinus from increased pressure in the cerebral venous system secondary to venous obstruction, e.g., cerebral venous sinus thrombosis (CVST) or tumour compression.[1] The falcine sinus may serve as an alternative venous drainage pathway when throm-bosis or obstruction occurs along the cerebral venous sinus

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Table I: Manjila grading of persistent falcine sinus

Grade	Description
1	Normal falx with PFS disconnected from SSS with or without focal dupli-cation of SSS
2	Hypoplastic falx cerebri posterior to PFS with or without hypoplasia of dis-tal SSS
3	PFS with normal falx; deficient straight sinus with or without dysplastic tentorium cerebelli
4	PFS with hypoplastic falx/SSS associated with deficient straight sinus with or without dysplastic tentorium cerebelli
5	PFS grades 1–4 with additional neurovascular developmental lesions like vein of Galen pathologies and enlarged parietal emissary veins
Subtype A	With atretic parietal/occipital cephalocele
Subtype B	Without atretic parietal/occipital cephalocele

Tenting or peaking of the tentorium can occur in any of the grades. Similarly, an enlarged parietal emissary foramen or a focal duplication of the SSS can appear with or without an atretic parietal/occipital cephalocele. PFS: persistent falcine sinus; SSS: superior sagittal sinus.

Table II: Differences in the imaging features between the persistent falcine sinus (PFS) and the re-canalised falcine sinus (RFS)

Imaging features	Persistent falcine sinus (PFS)	Recanalised falcine sinus (RFS)
Associated with venous sinus disease	No, PFS failed to involute and persisted after birth	Yes, typically associated with intracranial lesion(s) causing venous sinus obstruction including tumours and venous sinus thrombosis secondary to coagulopathy or hypertrophic meningitis
Associated with congenital anomalies of the remaining venous sinuses or other intracranial developmental pathology	Yes, often present (see Table 1 for Manjila grading system of PFS)	Usually absent
Presence of collateral veins around the falcine sinus	Absent	Yes, presence of collateral veins connecting RFS to superior sagittal sinus, depending on the extent of the venous sinus obstruction
Resolution of falcine sinus	No	The RFS may show reduced opacification on CT or MRI venogram following treatment, for example, re-establishment of the normal venous sinus system following anticoagulation therapy or surgical resection of an obstructive intracranial mass

system. When the patient's normal cere-bral venous drainage system is re-establish, the flow through the falcine sinus would be reduced.

Hypertrophic pachymeningitis (HPM) is one of the conditions associated with RFS. It is an un-common condition presenting as chronic inflammation and progressive fibrosis of the dura mater.[6–8] One of the consequences of the inflammatory process in the dura mater is the hypercoagulability state and venous stasis which contributes to CVST.[7,8] HPM can be a secondary manifestation of a number of conditions, including infection (e.g. bacterial meningitis, tuberculous pachymeningitis), neurosarcoidosis, haemodialysis, and mucopolysaccharidoses.[6,8]

Besides CT venogram, the cerebral venous system can be evaluated by magnetic resonance imaging (MRI) which offers a better soft tissue resolution than the CT scan. However, thrombosis of the fal-cine sinus can pose a diagnostic challenge in post-contrast MRI because of the lack of sinus opaci-fication.[3] Traditionally, conventional catheter-based digital subtraction angiography is the preferred modality for the evaluation of the cerebral venous anatomy and drainage pattern.[9] The differences in the imaging features between the PFS and RFS are documented in Table II along with other asso-ciated abnormalities. This may help to guide management.

Clinical Significance of Falcine Sinus

During endovascular or surgical obliteration of the straight sinus, the falcine sinus may assist in ve-nous drainage by establishing an alternative venous sinus pathway.[3] Besides, it is vital in the regula-tion of the intracranial pressure.[3] However, the presence of a falcine sinus could increase the risk of iatrogenic haemorrhage during surgery that involves the falx cerebri.[3] Attention should be paid to the sinus in preoperative planning, especially with tumours that tend to compress the venous sinus.[3] Conversely, the falcine sinus should not be mistaken for a drainage vein of an arteriovenous mal-formation.[3] It is therefore essential to study the cerebral venous sinus system in detail before any endovascular or neurosurgical procedures with attention to the presence of the falcine sinus.

CONCLUSION

The falcine sinus is seldom encountered in the adult population because it usually involutes after birth. Persistent falcine sinus is a variant that persists after birth. Recanalisation of the falcine sinus is often a sequela of acquired venous sinus obstruction leading to increased pressure within the cer-ebral venous system. It is of paramount importance to look for associated congenital disorders or any causes of cerebral venous sinus obstruction when the falcine sinus is identified on imaging.

Declarations of interest
Nothing to declare.
Disclosures: None

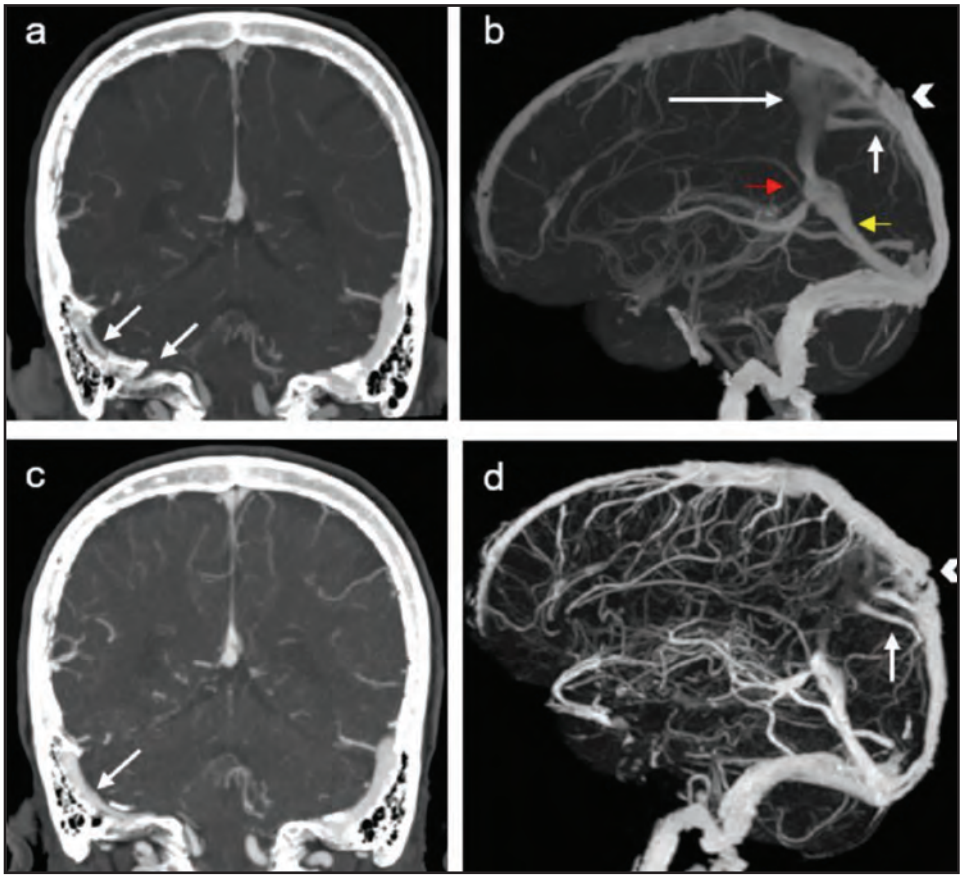

Fig. 1: An 81-year-old woman with known thyroid carcinoma presented with severe headache for 1 month. Coronal CT cerebral venogram image (a) shows filling defects in the right sigmoid sinus and right internal jugular vein (IJV), which is consistent with venous sinus thrombosis (short arrows). Sagittal maximum intensity projection (MIP) CT venogram image (b) shows recanalisation of the falcine sinus (long arrow) connecting the vein of Galen (red arrow) and the straight sinus (yellow arrow) to the superior sagittal sinus. There are two short linear collateral vessels (short arrow) connecting the falcine sinus (long arrow) to the posterior part of the superior sagittal sinus (ar-rowhead). After 6 weeks of anticoagulant therapy, the coronal CT venogram image (c) shows par-tial recanalisation of the right sigmoid sinus and IJV thrombosis. Sagittal MIP CT venogram image (d) shows reduced flow in the falcine sinus. There are persistent short linear collateral vessels (short arrow) connecting the faintly opacified falcine sinus to the posterior part of the superior sagittal si-nus (arrowhead)

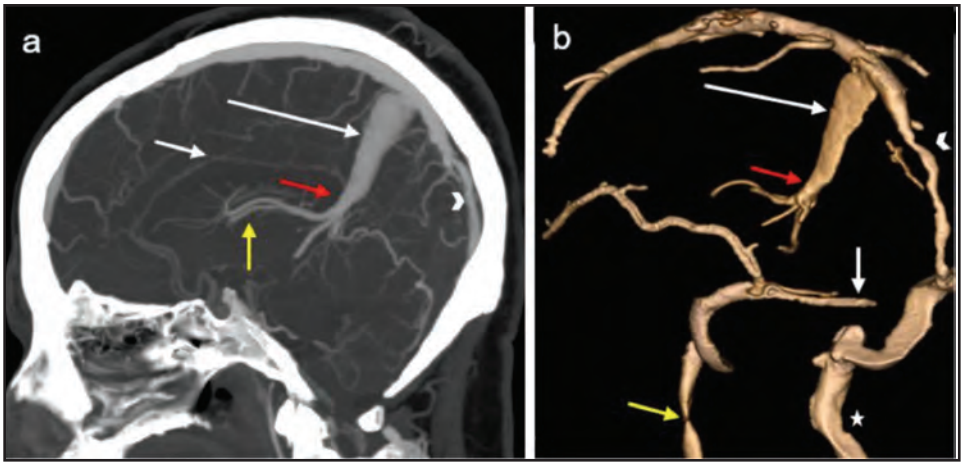

Fig. 2: A 56-year-old woman with a history of Hashimoto's thyroiditis presented with a chronic headache for a few months. Sagittal CT cerebral venogram image (a) reveals a persistent falcine sinus (long arrow) connecting the vein of Galen (red arrow) to the superior sagittal sinus. The paired internal cerebral veins (yellow arrow) fused to form the vein of Galen (red arrow). The inferior sagittal sinus (short white arrow) drains posteriorly into the persistent falcine sinus (long arrow). The posterior third of the superior sagittal sinus is rudimentary (arrowhead). Three-dimensional volume rendering technique (VRT) CT venogram rotated image (b) shows the persistent falcine sinus (long arrow) connecting the vein of Galen (red arrow) to the superior sagittal sinus. There is a rudimentary posterior third of the superior sagittal sinus (arrowhead), and the right transverse sinus is hypoplastic (short white arrow). There is a small calibre right internal jugular vein (IJV) (yellow arrow). As the straight sinus is absent in this case, the venous drainage is preferentially through the persistent falcine sinus (long arrow) and the left transverse and sigmoid sinus into the left IJV (star)

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