

# A vein of the foramen caecum observed on angiography

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## SUMMARY

The foramen caecum is located on the midline between the crista galli and the crest of the frontal bone. The vein of the foramen caecum (VFC) is described as a vein that connects the nasal cavity to the superior sagittal sinus through the foramen caecum.

In the literature, the foramen caecum has been found to be filled with fibrous tissue and is considered that vessels cannot pass through it. Although the VFC is observed in lower mammals, the existence of the VFC in humans is still under debate because the VFC has not been confirmed even in cadavers. In some recent reports, enhanced structures resembling a vascular structure within the foramen caecum on CT and MRI have been reported but not really proven to be the VFC. Here we report a case of a VFC confirmed by digital subtraction angiography. To the best of our knowledge, this is the first VFC confirmed in humans by angiography.

From embryologic and clinical point of view, the VFC is a venous remnant, although rare, we should keep this in mind to avoid some complications when treating lesions around this area.

**Key words:** Vein of the foramen caecum – Foramen caecum – Angiography – Superior sagittal sinus – Nasal cavity

## INTRODUCTION

The vein of the foramen caecum (VFC) is de-

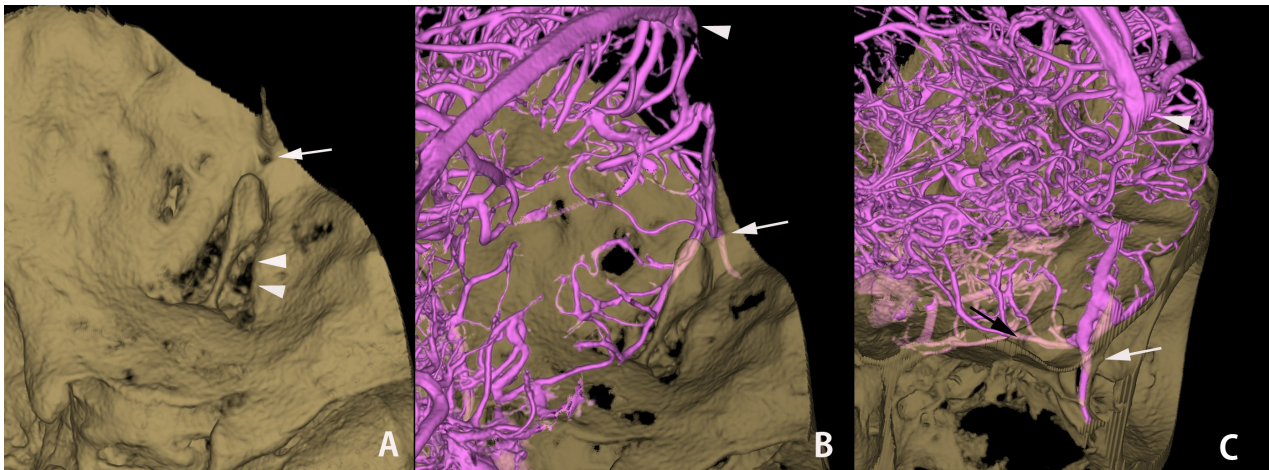
scribed as a vein connecting the nasal cavity to the superior sagittal sinus (SSS) through the foramen caecum, a fine bony canal located anterior to the crista galli. However, the existence of the VFC in humans has not been confirmed (Thewissen, 1989). Herein, we report a case of a VFC demonstrated on digital subtraction angiography (DSA). To the best of our knowledge, this is the first case report of a VFC observed on DSA.

## CASE REPORT

A 32-year-old man with no medical history presented with numbness involving the right side of his face. Computed tomography (CT) showed a small intracerebral hemorrhage in the left frontal lobe. Magnetic resonance imaging (MRI) showed a mixture of high and low-intensity areas corresponding to hemorrhage on T1-weighted images and T2-weighted images. Magnetic resonance angiography (MRA) did not reveal any vascular lesions. DSA was performed to rule out an arteriovenous malformation (AVM). DSA showed no vascular abnormalities related to the intracerebral hemorrhage. Incidentally, a vein connecting the SSS to the nasal cavity was identified. The vein started from the SSS and drained towards the nasal cavity through the foramen located on the midline and anterior to the crista galli or, in other words, the foramen caecum. By definition, this vein is the VFC (Fig. 1). There was no obstruction of the outflow of the SSS. The VFC in this case appeared to be an extension of the SSS. The blood flow was observed to be towards the nasal cavity. There were some cortical veins from the frontal pole joining the most anterior part of the SSS close to the VFC.

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**Fig 1.** Volume-rendering images of rotational angiography in the right posterior oblique view (**A**, **B**) and the right anterior oblique view (**C**) reveal the patency of the foramen caecum (arrow in **A**), with the vein of the foramen caecum (VFC) passing through it (arrow in **B**). Note that the true VFC is not related to the cribriform plate (double arrow heads in **A**). The VFC drains the superior sagittal sinus (SSS) (arrow head in **B**) towards the nasal cavity (**C**). The continuation of the anterior part of the SSS cannot be demonstrated on the 3D images due to the limited field of view of rotational angiography. There are cortical veins from the left frontal lobe joining the most anterior part of the SSS draining into the VFC.

## COMMENTS

The foramen caecum is located on the midline between the crista galli and the crest of the frontal bone. Embryologically, at the eighth week of gestation, there is a transient fontanelle between the inferior frontal bone and nasal bone. A dural diverticulation anterior to the crista galli of the ethmoid bone extends from the anterior skull base inferiorly and posteriorly to the frontal and nasal bones. The foramen caecum is described as an opening of the bone by the remnant of this transient embryologic dural diverticulation. Postnatally, the foramen caecum is filled with fibrous tissue (Hedlund, 2006).

Although VFCs are found in lower mammals, the existence of the VFC in humans is still unclear (Kaplan et al., 1973; San Millán Ruiz et al., 2006; Thewissen, 1989; Tsutsumi et al., 2016; Tutar et al., 2016). The possibility of a venous connection between the intracranial area and the nasal cavity has been discussed in the literature. Boyd et al found that only 3 of 212 dry skull specimens had a connection between the foramen caecum and the nasal cavity, but they did not mention clearly if that path was a vein (Boyd, 1930). Kaplan et al. (1973) reported that the foramen caecum was filled with fibrous tissue, and no VFC was demonstrated in 201 autopsy cases.

San Millán Ruiz et al. (2006) presented two cases with nasal mucosal venous drainage to the SSS on DSA. However, the authors mentioned that these veins actually passed through a slightly paramedian position, suggesting that the course was through the foramen of the cribriform plate rather than the foramen caecum. Although the connecting vein through the cribriform plate and the VFC

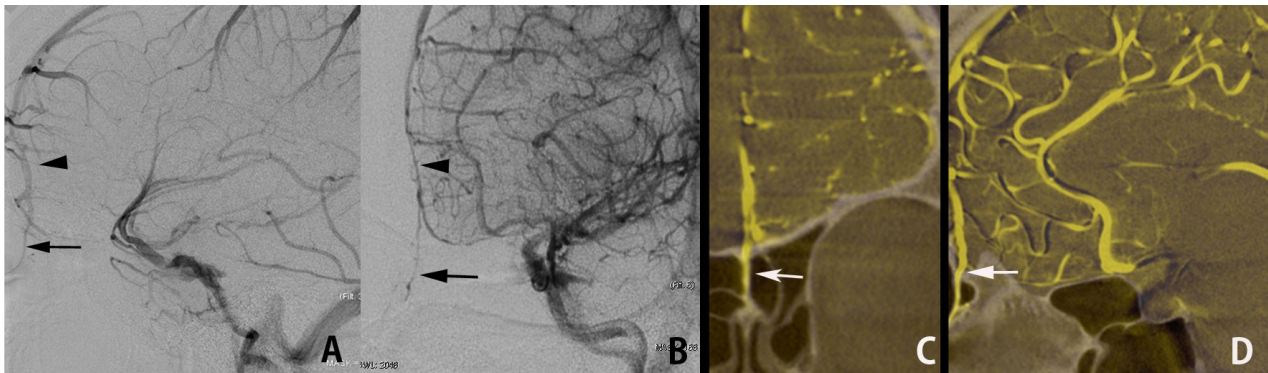
function similarly, we believe that they are embryologically different.

Tutar et al. (2016) demonstrated CT and contrast-enhanced MRI findings of a patient with a vascular structure between the nasal mucosa and the SSS through a patent foramen caecum. Tsutsumi et al. (2016) mentioned that 84% of 101 patients had tubular-shaped venous extensions passing through the foramen caecum on MRI. The venous structures presented in these two reports are suggestive of VFCs. However, these may only refer to any contrast-enhancing structure within a persistent foramen caecum, without necessarily proving it to be a patent venous structure.

Although previous reports based on CT, MRI, and cadaveric studies as mentioned above could not show concrete evidence of the existence of the VFC in humans and the direction of the flow of the VFC, this is the first case showing the VFC on DSA. The VFC in the present case passed through the foramen caecum, and the VFC drained towards the nasal cavity from the SSS (Fig. 2). Thus, it functions as an emissary vein of the cerebral venous system. This case report supports the existence of VFCs in humans, and, at least in this case, the flow was in the extracranial direction.

The VFCs and the emissary veins of the cribriform plate are functionally equivalent, connecting the nasal cavity to the intracranial cavity. Although these veins are not frequently observed, from clinical aspects, we should keep in mind their existence to avoid complications when dealing with lesions around this area.

There has been no report of surgical maneuvers in a case related with the VFC. Because this vein flows towards the nasal cavity functioning as an



**Fig 2.** Venous phase of the left internal carotid artery injection in the lateral view (**A**) and in the oblique view (**B**) showing the VFC (arrow) draining the SSS (arrow head) towards the nasal cavity. Maximum intensity projection (1.13 mm thick) coronal image (**C**) and sagittal image (**D**) show the relationship between the VFC and the cranial base, confirming its path through the foramen caecum (arrow). These images confirm that the VFC is an extracranial extension of the SSS.

emissary vein, it may be disrupted by surgical procedures in this area. As with most emissary veins (e.g. mastoid emissary vein), the risk of venous infarction from the occlusion of the VFC is low. However, if the SSS is occluded by a tumor and the VFC is draining the SSS, the venous outflow may be compromised. Therefore, we should keep in mind the possibility this vein when interpreting images and planning surgical procedures on a lesion around this area.

**Conclusions:** To the best of our knowledge, this is the first case report of a VFC demonstrated on DSA. A patent foramen caecum and the VFC can be considered embryological remnant structures. This case report supports the existence of the VFC in humans. In this specific case, the VFC drained the SSS towards the nasal cavity.

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