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Case Report

Does the superior ophthalmic vein dilate in acute intracranial hypertension due to hemorrhagic stroke?☆,☆☆

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ARTICLE INFO

Article history:
Received 13 March 2023
Revised 15 April 2023
Accepted 26 April 2023

Keywords:
Superior ophthalmic vein (SOV)
Hemorrhagic stroke
SOV dilation
Intracranial hypertension

ABSTRACT

A 65-year-old man presented with coma. The cranial computed tomography (CT) revealed a massive hematoma in the left cerebral hemisphere, accompanied by intraventricular hemorrhage (IVH) and ventriculomegaly. Contrast examination revealed ectatic superior ophthalmic veins (SOVs). The patient underwent emergent hematoma evacuation. Contrast CT performed on postoperative day (POD) 2 showed a remarkable reduction in the diameters of both SOVs. A second patient, a 53-year-old man, presented with consciousness disturbance and right hemiparesis. CT revealed a large hematoma in the left thalamus, accompanied by massive IVH. Contrast CT demonstrated the bold delineation of the SOVs. The patient underwent endoscopic IVH removal. Contrast CT performed on POD 7 showed a remarkable reduction in the diameters of both SOVs. A third patient, a 72-year-old woman, presented with severe headache. CT revealed diffuse subarachnoid hemorrhage and ventriculomegaly. Contrast CT demonstrated a saccular aneurysm on the internal carotid artery-anterior choroidal artery branching site with the bold delineation of the SOVs. The patient underwent microsurgical clipping. Contrast CT performed on POD 68 showed a remarkable reduction in the diameters of both SOVs. The SOVs may function as an alternative venous drainage pathway in the setting of acute intracranial hypertension due to hemorrhagic stroke.

☆ Acknowledgments: None.
☆☆ Competing Interests: The authors have no conflict of interest to declare regarding the materials or methods in this study or the findings presented in this paper.
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https://doi.org/10.1016/j.radcr.2023.04.042

Introduction

The superior ophthalmic vein (SOV) is the largest and most consistent vein of the orbit. The SOVs are thought to possess valve structures and function as emissary veins connecting the cavernous sinus and angular vein lying in the upper medial region of the superficial orbit [1,2]. The veins commonly course lateral to the ophthalmic artery in the orbit with bilateral asymmetry [3]. An examination with routine cerebral angiography delineated the SOVs only in 13.2% of subjects, while they have been documented to be sensitive to magnetic resonance imaging [3–5]. SOV dilation is a rare radiological finding resulting from varying etiologies, most frequently from vascular malformations, represented by dural arteriovenous fistula, followed by venous thrombosis, inflammatory disorder, trauma, lymphoproliferative disease, and infection [6,7]. The SOVs can also dilate in the setting of intracranial hypertension, such as diffuse cerebral swelling, prolonged spinal surgery in the prone position, and during intubation [8–10]. Additionally, intraocular pressure was found to influence the SOV flow [11]. In contrast, the SOVs were documented to collapse in patients with spontaneous intracranial hypotension and lumbar puncture [12,13]. However, to our knowledge, SOV dilation in acute intracranial hypertension due to hemorrhagic stroke has not yet been documented. Here, we present 3 such cases.

Case report

The first patient was a 65-year-old man who presented with coma and was transported to our hospital. His medical history was unremarkable. Cranial computed tomography (CT) scans at the presentation revealed a massive intracerebral hemorrhage in the left cerebral hemisphere, accompanied by intraventricular hemorrhage (IVH) and ventriculomegaly (Fig. 1A). Subsequently, the patient underwent contrast CT examination. During the CT, a total of 75 mL of Iopamiron 370 was infused via the antecubital vein at the injection rate of 4.5 mL/s. The examination revealed ectatic SOVs in both orbits (Figs. 1B and C). The patient underwent an immediate emergent microsurgical hematoma evacuation that resulted in a remarkable release of intracranial hypertension. During surgery, a ventricular catheter for controlling the intracranial pressure was not placed. Contrast CT performed on postoperative day (POD) 2, under the same imaging conditions as with the initial contrast examination, showed a remarkable reduction in SOV diameters (Figs. 1D and E), but the patient died of cardiac arrest on POD 3.

The second patient, a 53-year-old man, presented with consciousness disturbance and right hemiparesis and was transported to our hospital. His medical history was unremarkable. CT at presentation revealed a large hematoma in the left thalamus, accompanied by massive IVH (Fig. 2A). Contrast examination demonstrated bold delineation of the SOVs in both orbits (Figs. 2B and C). The patient underwent an immediate endoscopic IVH removal. During surgery, a ventricular catheter for controlling the intracranial pressure was not placed, and there were no signs of hydrocephalus thereafter. Contrast CT performed on POD 7 showed a remarkable reduction in SOV diameters (Figs. 1D and E). The patient was transferred to a rehabilitation facility on POD 27 with a modified Rankin scale score (mRS) of 4.

The third patient, a 72-year-old woman, presented with severe headache and was transported to our hospital. CT at the presentation revealed diffuse subarachnoid hemorrhage and ventriculomegaly (Fig. 3A). Her medical history was unremarkable. Contrast examination demonstrated a saccular aneurysm on the right internal carotid artery-anterior choroidal artery branching site and bold delineation of the SOVs in both orbits (Figs. 3B and C). The patient underwent an immediate successful microsurgical clipping of the aneurysm. There were no signs of hydrocephalus thereafter and the patient was discharged on POD 30 with an mRS score of 1. Contrast CT performed on POD 68 showed a remarkable reduction in SOV diameters (Figs. 1D and E).

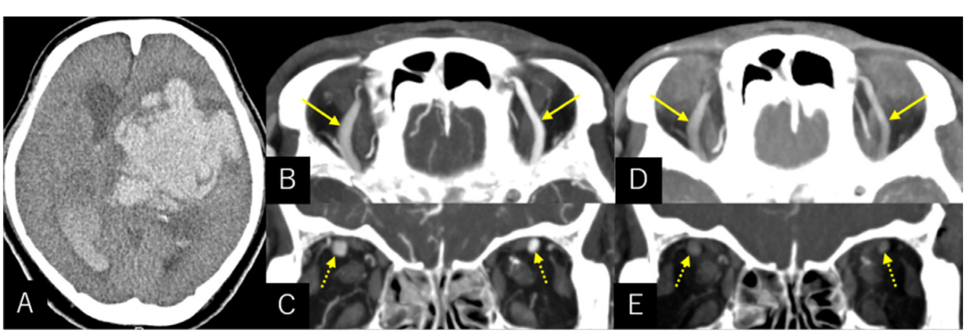

Fig. 1 – Axial computed tomography (CT) scan of a 65-year-old man, showing a massive intracerebral hemorrhage in the left cerebral hemisphere, accompanied by intraventricular hemorrhage and ventriculomegaly (A). Postcontrast axial (B, D) and coronal (C, E) CT images at presentation (B, C) and on postoperative day (POD) 2 (D, E), respectively, showing a remarkable reduction in the diameters of both superior ophthalmic veins on the axial (B and D, arrow) and coronal (C and E, dashed arrow) images.

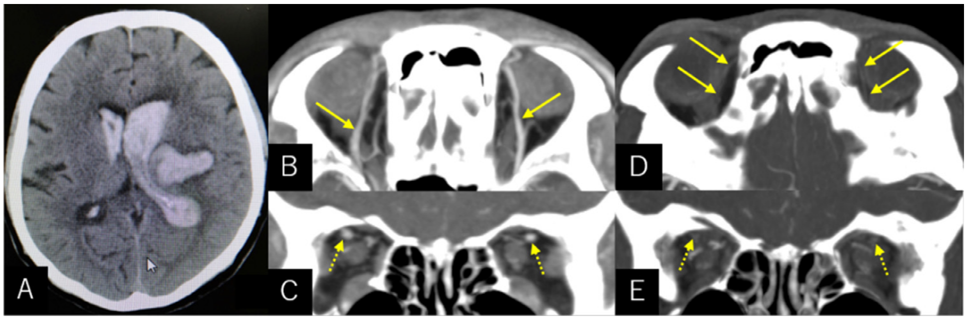

Fig. 2 – Axial computed tomography (CT) scan of a 53-year-old man at showing a left thalamic hemorrhage accompanied by massive intraventricular hemorrhage (A). Postcontrast axial (B, D) and coronal (C, E) CT images at presentation (B, C) and on POD 7 (D, E), respectively, showing a remarkable reduction in the diameters of both superior ophthalmic veins on the axial (B and D, arrow) and coronal (C and E, dashed arrow) images.

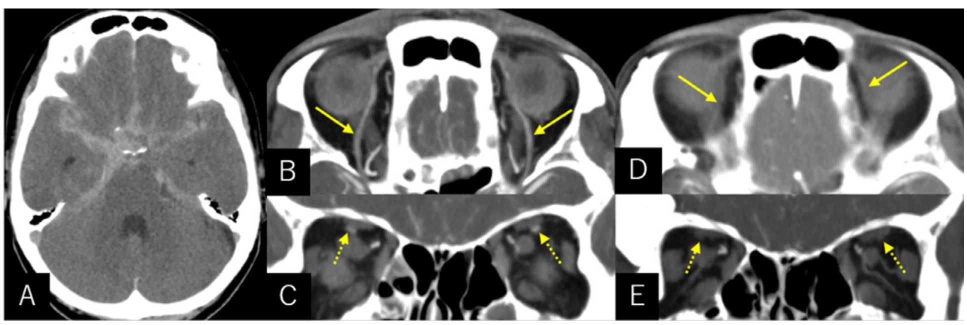

Fig. 3 – Axial computed tomography (CT) scan of a 72-year-old woman showing diffuse subarachnoid hemorrhage (A). Postcontrast axial (B, D) and coronal (C, E) CT images at presentation (B, C) and on POD 68 (D, E), respectively, showing a remarkable reduction in the diameters of both superior ophthalmic veins on the axial (B and D, arrow) and coronal (C and E, dashed arrow) images.

Discussion

The SOVs can dilate in variable pathologic conditions and postural changes [6–10]. The 3 patients presented here showed a massive intracerebral hemorrhage, IVH, ventriculomegaly, or diffuse subarachnoid hemorrhage on initial CT, suggesting acute intracranial hypertension. The SOVs in them were ectatic or bold on initial contrast CT. Furthermore, diameters of these SOVs consistently reduced after surgical intervention that resulted in a release of intracranial hypertension. Therefore, the SOVs were thought to have dilated to compensate as an alternative drainage pathway of intracranial venous flow. This also means that the cranial emissary veins, similar to the SOVs, may function as buffers in the setting of acute intracranial hypertension. Post-treatment reduction of SOV diameters may explain that the SOVs have finished the role as the buffers. Conversely, under the circumstances of intracranial hypotension, these veins may collapse to lessen the extracranial venous drainage [12,13].

There are limitations and weaknesses to such notions. Initially, SOV delineation may not be constant even under the same imaging conditions. Given that the intracranial pressure was different in the 3 patients, some imaging conditions might be optimal for some patients but not applicable for others in visualizing the SOVs. In addition, when the intracranial pressure is considerably high, contrast agents may not reach the intracranial cavity that results in poor delineation of the SOVs. Furthermore, there is no comparison to a control group. The SOV diameters in physiological conditions are considered to be variable in patients presenting with acute hemorrhagic stroke. This would make quantitative, interindividual comparisons of SOV dilation difficult, because potential confounding variables such as age, sex, comorbidities, and other factors that could impact SOV dilation in the context of hemorrhagic stroke. Despite these, we believe that the obtained findings can be a help for aid in understanding the SOVs.

In conclusion, the SOVs may function as an alternative venous drainage pathway in the setting of acute intracranial hypertension due to hemorrhagic stroke.

Author contributions

All the authors contributed equally to this study.

Ethical standards

We declare that the present study has been approved by the institution's guidelines for human research and was performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments.

Patient consent

The authors certify that they obtained the appropriate patient consent to publish this case report.

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