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Case Report

Hyperperfusion and intracranial hemorrhage after burr hole surgery of chronic subdural hematoma

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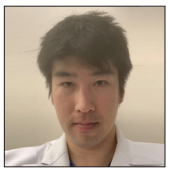

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ABSTRACT

Background: Chronic subdural hematomas (CSDHs) mainly occur in elderly people and usually develop after minor head injuries. CSDH can be cured by a relatively simple burr hole surgery. Rarely reported, hemorrhagic postsurgical complications include subarachnoid, intracerebral, intraventricular, and remote cerebellar hemorrhages. The causes of such uncommon complications are difficult to explain and remain poorly understood.

Case Description: We report the case study of an 89-year-old man with CSDH who presented with the right hemiparesis. He underwent burr hole surgery with a closed-drainage system. A computed tomography (CT) scan conducted the following day demonstrated an acute intraventricular hemorrhage and hyperperfusion of the ipsilateral hemisphere.

Conclusion: This is a rare case of an acute hematoma in the ventricle following drainage of a CSDH. The likely mechanism of this intraventricular hemorrhage could be that the drainage of the hematoma produced a movement of the ventricle and hemisphere accompanied by hyperperfusion.

Keywords: Burr hole surgery, Chronic subdural hematoma, Computed tomography perfusion, Hyperperfusion, Intraventricular hemorrhage, Single-photon emission computed tomography, Vascular dilation

BACKGROUND

Chronic subdural hematoma (CSDH) is a neurological disease that frequently affects the elderly, with a mortality rate of 0.5–4%. Known risk factors include mild head injury, advanced age, alcohol abuse, coagulopathies, and therapeutic anticoagulation.[7] CSDH can be cured by performing a relatively simple burr hole surgery. However, some severe complications, such as intracerebral hematoma and acute subdural or epidural hematoma, have been reported. We report a rare case of an intraventricular hemorrhage (IVH) occurring after burr hole surgery of the CSDH.

CASE PRESENTATION

An 89-year-old man was admitted to our division with the right hemiparesis and decreased cognitive ability. Two weeks before admission, he experienced mild head trauma without neurologic deficit. Computed tomography showed a subdural hematoma compressing the left cerebral hemisphere [Figure 1a].

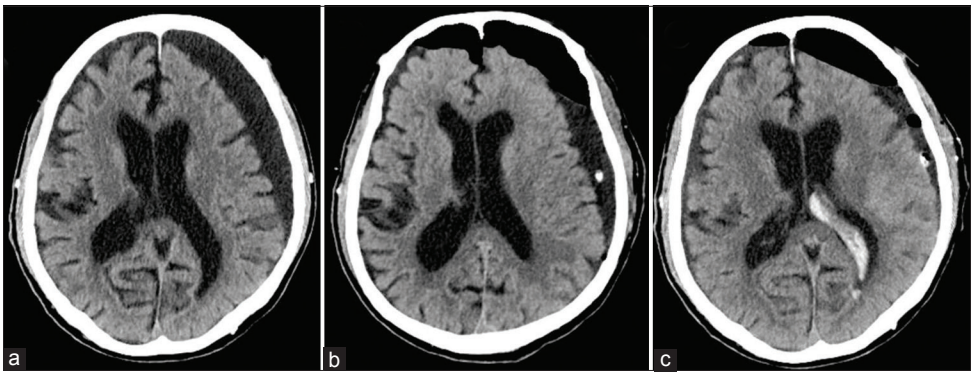

Figure 1: (a) Computed tomography scan showing a left CSDH, (b) Postoperative CT scan showing no obvious findings, (c) CT scan the day after the operation revealing a left intraventricular hemorrhage.

Preoperative coagulation parameters were normal. The patient underwent an operation, in which catheters were inserted through the burr holes made in both sides of the parietal area under local anesthesia. The subdural space was washed with warm 0.9% saline until its return was clear. The patient's vital signs remained stable during the evacuation, and the blood pressure did not increase during the surgery. At the end of the procedure, a subdural frontal closed drainage system was placed. The drainage rate was controlled by gravity and the system was on removed on the second postoperative day. Consciousness and right hemiparesis improved after surgery.

The postoperative CT scan showed bilateral frontal pneumocephalus. No acute bleeding or increase in the left hemispheric hematoma was detected [Figure 1b]. However, the day after the procedure, the patient developed right-sided weakness and confusion. A repeat brain CT scan revealed left intraventricular hemorrhage [Figure 1c]. The patient was admitted to the intensive care unit for close observation and conservative treatment with hemostatic agents and blood pressure monitoring. CT perfusion (CTP) demonstrated hyperperfusion of the MCA territories in the left hemisphere [Figure 2a-d]. Single-photon emission CT (SPECT) also showed hyperperfusion of the left hemisphere [Figure 3a and b]. Furthermore, CT angiography (CTA) showed marked left MCA dilation on the day after surgery [Figure 3c]. After 7 days, the right hemiparesis and unconsciousness gradually improved. CTP and SPECT showed resolution of the left hemisphere hyperperfusion. The patient received repeated rehabilitation therapy, and after 1 month was fully recovered and was discharged.

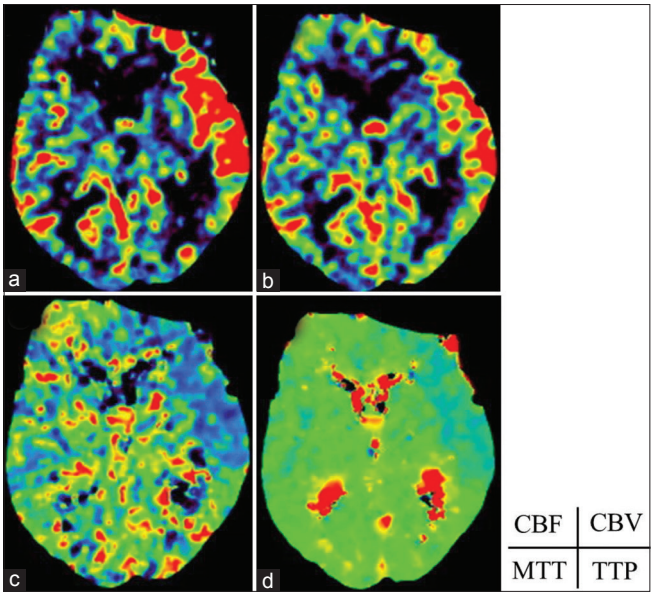

Figure 2: CTP parametric maps, CBF (a), CBV (b), MTT (c), and TTP (d) demonstrate hyperperfusion within the left hemisphere next day after surgery. CBF: Cerebral blood flow, CBV: Cerebral blood volume, MTT: Mean transit time, TTP: Time to peak.

DISCUSSION

Intracranial hemorrhage after burr hole surgery has an incidence of approximately 0.08–0.6%.[16] However, intracranial hemorrhage after burr hole evacuation and drainage of CSDH or subdural hematoma is very uncommon and, therefore, rarely reported.[15] The pathophysiology of such hemorrhages remains unclear. Possible mechanisms include a sudden increase in cerebral blood flow combined with failed autoregulation and damage to the parenchymal vessels secondary to the intraoperative or postoperative shifting of the intracranial content.[2] Ogasawara *et al*. reported that impaired vascular autoregulation was the result of long-term brain compression due to CSDH.[10] Rapid decreases in intracranial pressure and subsequent hemodynamic changes could lead to hyperperfusion and cortical hyperemia.[10] In our case, CTP demonstrated hyperperfusion of the left hemisphere, which might be associated with intraventricular hemorrhage.

On the other hand, it has been previously reported that remote hemorrhage could be the result of intraoperative

and postoperative loss of CSF.[1] The role of intracranial hypotension has been debated in relation to several postcraniotomy complications such as delayed hemorrhage and brain swelling.[17] Van Roost *et al*. reported that the volume depletion that occurs when drainage is carried out after intracranial surgery might generate a negative pressure in the brain.[18] This causes displacement of the ventricle and cerebral hemisphere, which might induce the stretching of cortical veins and venous transmural pressure increase, finally leading to the rupture of small vessels. The drainage of the hematoma that caused movement of the hemisphere and resulted in hyperperfusion with the rupture of a weak subependymal vessels.[8] Elderly patients with physiological aging of the small blood vessels associated with increased fragility may not tolerate a rapid increase in the blood flow.[9]

Sixteen other case studies were retrieved from the literature, amounting to 17 reports, including ours. The clinical and radiological summaries of all the patients are shown in [Table 1].[3-6,8,9,11-14,19,20] Of the total 17 patients, 16 (94%) had favorable outcomes, including good recovery (88%) and moderate disability (6%). Twelve cases (70.5%) presented with intracerebral hemorrhage (ICH), and only 2 presented

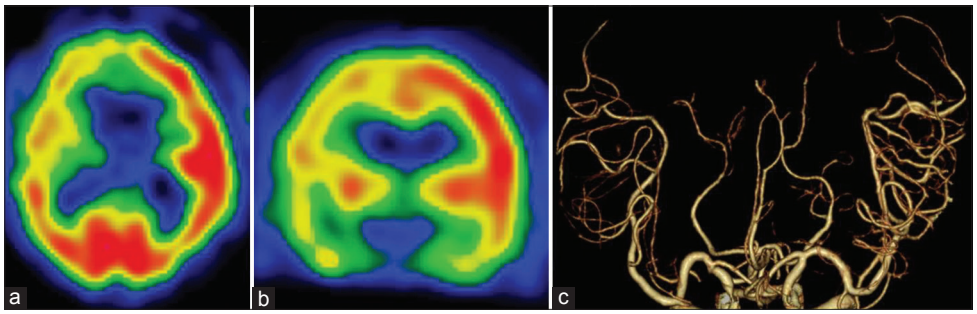

Figure 3: (a and b) Axial section and coronal section of single-photon emission CT showed hyperperfusion of the left hemisphere day after surgery, (c) CT angiography showing marked left MCA dilation the day after surgery.

Table 1: Reported cases of hematomas after burr home surgery for CSDH.

Authors (year)	Age/Sex	Etiology	Side	Surgicaal technique	Closed drainage	Amount of drainage	Anticoagulant or platelet therapy	Bleeding pattern	GOS on discharge
Miyazaki *et al.* (2004)[8]	56/M	N/A	L	Burr hole	+	N/A	Warfarine	SAH	5
Panourias *et al.* (2006)[11]	86/F	N/A	R	Burr hole	+	420	None	EDH	5
Vogels *et al.* (2006)[19]	49/F	None	Bil	Burr hole	+	N/A	None	ICH	5
	73/M	N/A	R	Burr hole	+	N/A	Warfarine	ICH	4
Hyam *et al.* (2007)[5]	79/M	N/A	R	Burr hole	+	N/A	Aspirin	ICH/IVH	1
Dinc *et al.* (2008)[3]	48/F	Trauma	L	Burr hole	+	N/A	None	ICH	5
Park *et al.* (2009)[12]	76/M	None	Bil	Burr hole	+	N/A	None	ICH	4
Muneza *et al.* (2009)[9]	85/M	Trauma	Bil	Burr hole	+	N/A	None	ICH	5
Eom *et al.* (2009)[4]	78/M	Trauma	L	Burr hole	+	N/A	None	EDH	5
Rusconi *et al.* (2015)[13]	62/M	Trauma	R	Burr hole	+	650	None	SAH/ICH	5
	85/M	Trauma	R	Burr hole	+	500	Clopidogrel	SAH/ICH	5
	80/M	Trauma	R	Burr hole	+	600	None	ICH	5
Kim *et al.* (2017)[6]	53/F	Trauma	L	Burr hole	+	N/A	None	SAH/ICH	5
	78/F	N/A	Bil	Burr hole	+	400	None	EDH	5
Seung *et al.* (2017)[14]	77/M	N/A	Bil	Burr hole	+	N/A	None	SAH/ICH	5
Zavatto *et al.* (2019)[20]	65/F	Trauma	R	Burr hole	+	N/A	None	ICH	5
Present case	89/M	Trauma	L	Burr hole	+	350	None	IVH	5

CSDH: Chronic subdural hematomas, SAH: Subarachnoid hemorrhage, EDH: Epidural hematoma, ICH: Intracerebral hemorrhage, IVH: Intraventricular hemorrhage,

IVH. A review of the available literature revealed that IVH after burr hole surgery is very rare. Postoperative hemorrhage occurred more often in patients with large drainage volumes. The drainage volume in our case was 350 ml. The large drainage volume suggested that displacement of the brain and hyperperfusion might have caused the intracranial hemorrhage. It was previously reported that rapid or excessive postoperative drainage should be avoided.[6] To reduce the complication, slow and gradual decompressive drainage of CSDH must be performed carefully.

CONCLUSION

Despite being a rare complication, it is essential to be aware of the development of hyperperfusion and intracranial hematoma after surgery. Sudden decompression should be avoid in the treatment of CSDH and the treatment carefully tailored to the patient's individual condition.

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Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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