Cerebellar hemorrhage after supratentorial burr hole drainage of a chronic subdural hematoma

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Abstract
Cerebellar hemorrhage is an unusual, but increasingly recognized complication after supratentorial surgery. Even rarer are the cases of cerebellar hemorrhage after supratentorial burr-hole drainage of a chronic subdural hematoma (CSDH). The pathophysiology of this rare complication still remains unclear. Hypertension and overdrainage of cerebrospinal fluid seem to be causative factors of postoperative cerebellar hemorrhage. The most important key to minimize this hazardous sequel is to be aware of this potential complication and its pathogenetic mechanisms. We report our case of a 43-year old man who developed cerebellar hemorrhage after burr hole trephination for supratentorial CSDH.


Key words: burr hole drainage; cerebellar hemorrhage; chronic subdural hematoma; supratentorial surgery.

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Cerebellar hemorrhage after supratentorial surgery is the most commonly described pattern of remote intracranial hemorrhage after neurosurgical procedures1. Even rarer are the cases of cerebellar hemorrhage after supratentorial burr-hole drainage of a chronic subdural hematoma (CSDH)2-7. We report a case of a 43-year old man who developed cerebellar hemorrhage after burr hole trephination for supratentorial CSDH and discuss possible etiologic mechanisms.

Case Report
A 43-year old man was admitted to our hospital with head injury after a car accident in good neurological condition. The CT scan revealed a small right frontal subdural hematoma (SDH). Initially, he was treated conservatively, but after 4 days he developed lethargy and ataxia. The new CT scan revealed low density subdural lesions in both frontal regions compatible with chronic bifrontal subdural hematoma with slight decrease of gyral markings (Figure. 1). There was no history of arterial hypertension or hemorrhagic diathesis. Surgery was performed under general anesthesia with the patient in the supine position, without head rotation. Frontal burr holes were drilled on each side and the hematoma was slowly decompressed. His peri-operative blood pressure remained within normal range. At the end of the operation a subdural frontal closed drainage system was placed on each side. Drainage rate was controlled by gravity. The patient was restricted to bed rest in the supine position. One hour postoperatively he developed a strong headache, irritability and nausea.

The level of consciousness, however, was not impaired. The postoperative CT scan demonstrated adequate

Figure 1. CT scan on 16th day after the car accident: subdural low density lesions in both frontal regions, the lesion on the left side being larger. The scan showed a decrease of gyral markings but no shifting of midline structures.
drainage of the subdural hematomas which were replaced by bifrontal pneumocephalus and additionally a new subarachnoid and intraparenchymal hemorrhage within both cerebellar hemispheres (Figure 2). The drainage system was left for 4 days and about 300 ml of chronic subdural hematoma mixed with cerebrospinal fluid (CSF) were totally drained. The patient was treated conservatively with bed rest and hydration and improved gradually within 7 days postoperatively. The CT scan after 17 postoperative days showed complete absorption of the cerebellar hematoma and pneumocephalus. The patient was subsequently discharged without any neurologic deficits.

Discussion
Remote cerebellar hemorrhage (RCH) is a very rare complication of supratentorial surgery, with a reported incidence of 0.08%¹. RCH after burr hole trephinations for CSDH is even rarer, with an incidence of 0.14%².

Pathogenesis of RCH after burr hole drainage of CSDH
The precise mechanism of cerebellar hemorrhage is unknown. The precise mechanism of cerebellar hemorrhage after burr hole drainage of chronic subdural hematoma is not fully understood. It may be due to the direct effect of chronic subdural hematoma on the cerebellar folia, compression of 4th ventricle, or due to the effect of subdural hematoma on the cerebellum (Figure 2).

Table 1: Patient characteristics with cerebellar hemorrhage after burr hole evacuation of chronic subdural hematoma

<table>
<thead>
<tr>
<th>Nr (Ref)</th>
<th>Age/Sex</th>
<th>Coexisting factors</th>
<th>Symptoms on admission</th>
<th>Operating position</th>
<th>Periop BP</th>
<th>Drainage system</th>
<th>Postop symptoms</th>
<th>Estimated amount of CSF lost</th>
<th>Postop BP</th>
<th>Postop CT scan</th>
<th>Treatment</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (2)</td>
<td>74/F</td>
<td>Anticoagulant agent, Hypertension, under medication</td>
<td>Headaches for 4 days</td>
<td>L-SDH</td>
<td>-</td>
<td>-</td>
<td>Normal</td>
<td>Yes</td>
<td>None</td>
<td>500 ml during surgery</td>
<td>-</td>
<td>Hemorrhage within both cerebellar folia</td>
</tr>
<tr>
<td>2 (3)</td>
<td>48/M</td>
<td>None</td>
<td>Headaches for 14 days and pain disorder</td>
<td>Chronic bilateral SDH</td>
<td>-</td>
<td>-</td>
<td>Normal</td>
<td>Yes</td>
<td>60 ml postop</td>
<td>-</td>
<td>Hemorrhage within both cerebellar folia</td>
<td>Conservative</td>
</tr>
<tr>
<td>3 (3)</td>
<td>73/M</td>
<td>Anticoagulation factor, Hypertension, Intracerebral Hemorrhage (ICH)</td>
<td>Impaired consciousness</td>
<td>L-SDH</td>
<td>-</td>
<td>-</td>
<td>Yes</td>
<td>180 ml postop</td>
<td>-</td>
<td>Hemorrhage within both cerebellar folia</td>
<td>Conservative</td>
<td>Complete recovery</td>
</tr>
<tr>
<td>4 (4)</td>
<td>55/M</td>
<td>Diabetes mellitus for 5 years</td>
<td>Bilateral temporal SDH</td>
<td>Chronic bilateral SDH</td>
<td>-</td>
<td>-</td>
<td>Yes</td>
<td>Strong headache, dizziness and vomiting</td>
<td>100 ml</td>
<td>L-cerebellar hemorrhage</td>
<td>Conservative</td>
<td>Complete recovery</td>
</tr>
<tr>
<td>5 (5)</td>
<td>86/M</td>
<td>None</td>
<td>Headaches, dizziness, mild quadriparesis</td>
<td>Chronic bilateral SDH</td>
<td>-</td>
<td>-</td>
<td>Yes</td>
<td>4th day: consciousness deteriorated</td>
<td>30 ml R-side, 5 ml L-side</td>
<td>L-cerebellar hemorrhage</td>
<td>Conservative</td>
<td>Complete recovery</td>
</tr>
<tr>
<td>6 (5)</td>
<td>75/M</td>
<td>None</td>
<td>Headaches for 8 weeks</td>
<td>Bilateral temporal SDH</td>
<td>-</td>
<td>-</td>
<td>Yes</td>
<td>5th day: deterioration of consciousness</td>
<td>100 ml L-side in 4 days</td>
<td>R-cerebellar hemorrhage</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>7 (6)</td>
<td>78/M</td>
<td>Anticoagulation factor</td>
<td>Headaches, dizziness</td>
<td>Bilateral SDH</td>
<td>-</td>
<td>-</td>
<td>The patient was treated</td>
<td>3 days: ventilations</td>
<td>-</td>
<td>Hemorrhage within both cerebellar folia</td>
<td>Conservative</td>
<td>Died</td>
</tr>
<tr>
<td>8 (7)</td>
<td>58/M</td>
<td>Hypertension</td>
<td>Headaches, dizziness, vomiting</td>
<td>Bilateral SDH</td>
<td>-</td>
<td>-</td>
<td>Yes</td>
<td>4th day: consciousness deteriorated</td>
<td>1150 ml CSF</td>
<td>L-cerebellar hemorrhage, obstruction of 4th ventricle</td>
<td>Conservative</td>
<td>Complete recovery</td>
</tr>
</tbody>
</table>

Our case 43/M, None, Lethargy, dizziness, headaches, similar for 12 days | Chronic bilateral SDH | - | - | Yes | Headaches, dizziness, vomiting | 30 ml | R-cerebellar hemorrhage | Conservative | Complete recovery |

following supratentorial burr hole drainage of CSDH is uncertain, but is suspected to be multifactorial. Firstly, a history of previous hypertension and transient hypertensive peaks during the recovery period have been considered to be important factors\(^6\). This idea is based on the fact that arterial hypertension is the most common cause of spontaneous cerebellar hemorrhage. However, only two out of nine patients (22\%), reported in the literature (including ours), had a history of hypertension and in one out of them the preoperative blood pressure was consistently normal with antihypertensive drugs. Moreover all patients had perioperative normal blood pressure and in only two cases an elevation of blood pressure was reported postoperatively (Table 1). In our case, blood pressure remained within normal range perioperatively and postoperatively. Another major cause of spontaneous cerebellar hemorrhages is disturbed blood coagulation, which has been considered as well to be a relevant predisposing factor for postoperative cerebellar hemorrhages\(^8\). According to our literature review, only 3 out of 9 patients (33\%) had disturbed blood coagulation. Another proposed mechanism for the development of RCH is that expansion of CSF spaces after surgical removal of CSDH increases mobility of the intracranial structures. Moreover, CSF overdrainage may lead to a downward displacement of the cerebellum. These above mentioned mechanisms may cause stretching and possible tearing of the superior vermian veins leading to RCH\(^1\). Furthermore, continuous CSF drainage, intraoperatively as well as postoperatively, could even increase the transtentorial pressure gradient leading to rupture of the small supracerebellar veins and capillary bed with venous bleeding as a consequence\(^7\). A massive air reflux into the cranial cavity through the drainage tube may pose an additional risk\(^8\). In our case, the postoperative CT-scan revealed bifrontal pneumocephalus which could be a predisposing factor.

Intra-operative positioning of the patient consists a matter of debate concerning this rare complication. It has been suggested that a head turn in combination with flexion or hyperextension of the neck will cause an obstruction of the venous flow, especially of the ipsilateral jugular vein\(^1\). Nevertheless, the majority of patients, who underwent burr hole drainage, were positioned supine without any rotation of the head at all during surgery and in only two cases\(^3,7\), the patients were positioned with head rotation during surgery.

**Treatment and prognosis**

According to our review, in all cases the hematoma was treated conservatively until it was absorbed. However, in three out of seven cases an external ventricular drainage was administrated in order to relieve postoperative obstructive hydrocephalus syndrome due to the compression of the fourth ventricle from the cerebellar hemorrhage. Furthermore, the prognosis for 8 out of 9 patients with RCH after burr hole evacuation of chronic subdural hematoma was excellent, except one patient died after three burr hole evacuations for recurrent CSDH.

**The mechanism of RCH in our case**

In our case, a large amount of CSF was drained through the subdural drainage system (300 ml) and this progressive but massive loss of CSF may have caused downward displacement of the cerebellum spaces or increased mobility of the intracranial structures due to CSF expansion. Finally, the ingress of the air into the cranial cavity may have played an accessory role in the downward displacement of the cerebellum which in turn may have stretched the superior vermian veins and their tributaries, causing RCH. Taking into account all the above, we consider that cerebellar hemorrhage was a postoperative complication of burr hole drainage.

**Conclusion**

Although a rare complication, it is essential to be aware of the potential development of cerebellar hematoma after supratentorial surgery, even after minimally invasive surgery, such as drainage of a chronic subdural hematoma through burr holes. In order to prevent this complication, we suggest very slow drainage of CSDH during surgical evacuation but also low or no negative pressure in postoperative drainage systems and close neurosurgical examination.

**References**


**Conflict of interest:** The authors declare that they have no conflict of interest.