CASE REPORT

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Remote Cerebellar Hemorrhage after Supratentorial Aneurysmal Surgery : Report of Six Cases

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The case of postoperative hemorrhage occurring apart from the operative site as a complication of intracranial surgery is a rare malady, especially when it involves the cerebellum after supratentorial aneurysm surgery. In a review of the literature, the possible etiologies for cerebellar hemorrhage are: coagulopathy, intraoperative urokinase irrigation, excessive head rotation on positioning, brain shift due to excessive cerebrospinal fluid(CSF) and epidural hemovac drainage. We experienced six cases of cerebellar hemorrhage after supratentorial aneurysm surgery, and all of the patients were improved by instituting conservative medical treatment. The possible mechanism for the remote cerebellar hemorrhages seen in our series is probably a multifactorial effect, such as excessive epidural hemovac and CSF drainage, and jugular venous compression due to the operative position. The purpose of this report is to alert neurosurgeons to the existence of this syndrome and to suggest several ways of minimizing the possibility of their patients developing remote cerebellar hemorrhage.

KEY WORDS : Remote cerebellar hemorrhage · Supratentorial aneurysm surgery.

Introduction

One of the major complications of aneurysm surgery is intracranial hemorrhage[2,8]. Postoperative hemorrhages usually occur at the site of the operation and they may be epidural, subdural, subarachnoid, or intracerebral hemorrhages. Cerebellar hemorrhage following supratentorial aneurysm surgery is a rare event. There have been several reports on this condition, and we now report the etiologies of six such rare cases along with a review of the relevant literature.

Case Report

Case 1

History

This 45-year-old man had a chronic headache.

Examination

We performing computed tomographic angiography(CTA) on the patient's brain and the cerebral angiography demonstrated a 3mm-sized saccular bifurcation aneurysm at the left internal carotid artery(ICA) bifurcation aneurysm (Fig. 1A).

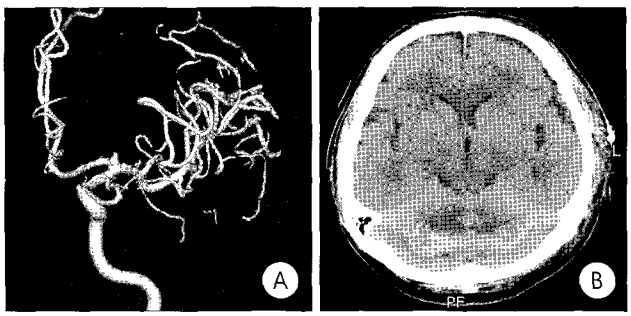

Fig. 1. A : Three-dimentional digital subtraction cerebral angiography demonstrating a 3mm-sized sacular aneurysm at the left internal carotid artery, and it is a bifurcation aneurysm. B : Nonenhanced computed tomography scan at postoperative third day showing the bilateral cerebellar hemispheric and vermian hemorrhage.

There were no other vascular lesion, especially at the infratentorial area. The patient's preoperative laboratory findings were within normal limits.

Operation

On June 2, 2004, while placed supine and with his head turned to the right, the patient underwent a left frontotemporal craniotomy for clipping the aneurysmal neck. Surgery was completed without any intraoperative complication.

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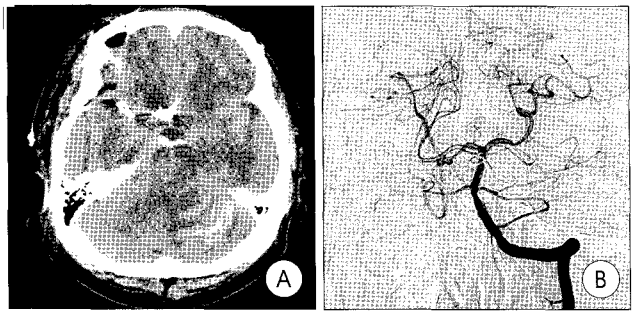

Fig. 2. A : Nonenhanced computed tomography scan at postoperative third day showing a left cerebellar hemispheric and vermian hemorrhage. B : On left vertebral artery angiography, there is no other vascular lesion at the infratentorial region.

Postoperative course

Postoperative neurological status was normal. He showed good progress until postoperative Day 3, when he began to complain of a headache and dizziness. The computed tomography(CT) scan of his head that was, performed on postoperative Day 3, revealed a bilateral cerebellar hemispheric and vermian hemorrhage (Fig. 1B). On the neu-rological examination, the patient displayed had a cerebellar sign. At that time, his blood pressure and laboratory findings were all within normal limits. The hemorrhage was treated nonsurgically, and the patient gradually improved without incurring any other neurological deficits.

Case 2

History

This 59-year-old man had a past history of hypertension, and he suddenly a developed headache while bathing on March 5, 2004. He became drowsy, and then he was quickly brought to our hospital. His blood pressure at that time was 220/110mmHg.

Examination

A CT of the patient's brain showed hemorrhages in both sylvian fissures, the interhemispheric fissure and the basal subarachnoid cistern. The patient's brain CTA revealed an anterior communicating(Acom) artery aneurysm, but there was no evidence of other intracranial vascular lesions. The patient's preoperative laboratory findings were within normal limits.

Operation

On March 5, 2004, while placed supine with his head turned to the left, the patient underwent emergency right orbitofrontotemporal craniotomy for clipping the aneurysmal neck. The lumbar drainage was done before the operation and it was maintained after the operation. The intraoperative blood pressure was in the normal range, and surgery was completed without intraoperative complications.

Postoperative course

The patient's postoperative neurolo-gical status was similar to his the preoperative state. CSF (150cc) was collected daily from the lumbar drain. On postoperative Day 3, a follow-up brain CT scan revealed a left cerebellar hemispheric and vermian hemorrhage (Fig. 2A). On the neurological examination, the patient had left dysmetria. At that time, the laboratory findings were all within the normal limits. However, his mean arterial pressure(MAP) was between 100 and 120mmHg and as this it was slightly high, the lumbar drain was immediately clamped. The hemorrhage was treated nonsurgically, and the patient gradually improved. On March 19, 2004, postoperative cerebral angiography was performed, but there were no other vascular lesions at the infratentorial region (Fig. 2B). At discharge he had mild dysmetria on the left side, but by June 2004, the dysmetria had resolved.

Table 1. Clinical characteristics of six patients with cerebellar hemorrhage after supratentorial aneurysmal clipping

Characteristic	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6
Age and Gender	59, M	45, M	69, F	44, F	21, F	65, F
Operation	Right	Right	Right	Right	Left	Right
Ruptured aneurysm	Incidental	Rupture	Rupture	Rupture	Rupture	Incidental
Coagulopathy	No	No	No	No	No	No
Cerebellar lesion	No	No	No	No	No	No
Hypertension HTN	Yes	No	No	No	No	Yes
Intraoperative HTN	No	No	No	No	No	No
Postoperative HTN	Yes	No	No	No	No	No
Surgical position	Turn left	Turn left	Turn left	Turn left	Turn right	Turn left
Temporary clipping time	No	256 secs	321 secs	No	No	174 secs
Epidural hemovac	Yes	Yes	Yes	Yes	Yes	Yes
CSF drainage	Yes	Yes	No	Yes	Yes	No
Location of hemorrhage	Vermis	Left	Left	Left	Right	Vermis
Time of hemorrhage	POD 3	POD 3	POD 3	POD 2	POD 1	POD 3

Other 4 Cases

The clinical histories of the other 4 cases were similar to the two previous described cases. Remote cerebellar hemorrhage developed in all the cases, but all the patients improved without having to perform surgical intervention. Table 1 displays a summary of the six cases that we have described.

Discussion

Intracerebral hemorrhage occurring apart from the site of craniotomy is a relatively uncommon

neurosurgical complication, and it is often associated with significant morbidity and mortality. Most postcraniotomy hemorrhages commonly occur at the site of surgery and they can usually be attrib-uted to various aspects of inadequate intraoperative hemostasis. However, remote postoperative intracerebral hemorrhage should be distinguished from the other types of iatrogenic intracranial hemorrhages, and especially the cerebellar ones.

Kalfas and Little conducted, a survey of 4,992 intracranial procedures performed over an 11-year period. They found only seven of 40 cases of postoperative hemorrhage in which the hemorrhage occurred in a location apart from the operative site[8]. With the recent developments in imaging modalities, remote cerebellar hemorrhage was noted to occur after approximately from 0.17% to 0.6% of all supratentorial craniotomies[5,6,8]. Thus, it is possible that frequency of detecting this malady will gradually increase.

The precise mechanism is uncertain by which cerebellar hemorrhage occurs following supratentorial craniotomy, and this includes aneurysm surgery. The commonly reported predisposing factors for remote cerebellar hemorrhages are : hypertension, cerebrovascular abnormalities, ant-icoagulation treatment, and coagulopathy[3,4,8,9,11,13,15,19,20]. For example, in the four cases described by Konig, et al., a course of heparin was begun on postoperative Day 1 for thrombosis prophylaxis[11]. At the time that the hemorrhage was discovered, all these patients showed disturbances on their blood coagulation studies.

Other possible factors have been recently mentioned. These include mechanical brain shift that is caused by the excessive loss of cerebrospinal fluid(CSF), epidural negative pressure hemovac drainage, and the venous obstruction from extreme head rotation[2,8,11,12,18,20]. Yoshida, et al., have suggested that excessive CSF drainage during the postoperative periord can lead to a critical increase in the transmural pressures of the veins and venules, and this can lead to possible hemorrhage[20]. Overdrainage via the epidural drain during the postoperative period can easily lead to remote cerebellar hemorrhage[5]. The reason is that overdrainage of the epidural drain with using negative suction may create a subdural dead space. This can lead to a downward displacement of the cerebellum, which can cause stretching and possible tearing of the superior vermian veins and their tributaries[18,20]. Siu, et al., suggested that a transtentorial pressure gradient set up by excessive CSF loss can be held responsible for disrupting the cerebellar venous blood flow, and so this consequently leads to venous hemorrhage[17]. Seoane and Rhoton[16] further implicated positional jugular vein compression by the transverse process of the atlas as a contributor to venous hypertension and remote cerebellar hemorrhage.

In our series, the mechanism for remote cerebellar hemorrhage is probably the result of a mechanical and multifactorial effect, such as excessive epidural hemovac and CSF drainage. However, the remote cerebellar hemorrhages seen in our series were apparently not caused by hypertension and coagulopathy. Four patients had no history of hypertension, and all the patients' systolic blood pressures during the early postoperative periord were maintained below 150mmHg. In general, hemorrhage due to hypertension happens when the systolic pressure is above 190mmHg[14]. So, when the remote hemorrhages developed, all the patients' laboratory findings were within normal limits. Our cases had their heads turned to the side, which, if hyperextended, could have caused a relative obstruction of the ipsilateral jugular vein, leading to a further increase in venous pressure or to venous infarction. The hemorrhages might have eventually occurred during the early postoperative period. Also, the combined excessive epidural hemovac and CSF drainage may have created subdural dead spaces. It is possible that remote hemorrhages are caused by transient vascular or mechanical factors. So, aggressive drainage of the epidural hemovac and CSF during the early postoperative periord may predispose the brain to shifts that could contribute to remote cerebellar hemorrhage. Four cases of remote cerebellar hemorrhage developed in the contralateral cerebellar hemisphere, and two cases developed in the vermis. No remote intracerebral hemorrhage occurred in the ipsilateral cerebellar hemisphere. We thought that the reasons for this malady were multifactorial, such as the head tilt position, hyperextension of the neck, the brain shift due to excessive CSF drainage during the operation, and the excessive epidural he-movac drainage. Finally, we performed arterial temporary clipping within 6 minutes in all six cases. Araki et al., stated that temporary clipping may be harmful to the hemodynamic state, including hyperperfusion, when it performed for more than 20 minutes of total occulusion[1]. Thus, we thought that our cases were not concerned with the temoporary arterial clipping.

Conclusion

Remote cerebellar hemorrhage can complicate performing supratentorial craniotomy including aneurysm clipping, even in the absence of any coagulopathy or other pathological brain parenchymal conditions, including vascular malformation. The purpose of this report is to alert neurosurgeons to the existence of this disease entity and to suggest several ways for minimizing this remote cerebellar hemorrhage. First, the physician should avoid excessive head rotation on the neck. Second, avoid too rapid evacuation of large amounts of cerebrospinal fluid. Third, replace the cerebrospinal fluid with Ringer's solution at the end of the procedure. Fo-

urth, avoid excessive negative hemovac drainage. Finally, and most importantly, be very aware of the possibility of this complication because early detection and action can help achieve in a better outcome.

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Commentary

In this article, the authors reported 6 cases of remote cerebellar hemorrhage(RCH) after supratentorial aneurysmal surgery, and proposed several possible mechanisms such as excessive epidural hemovac drainage, excessive CSF drainage, and jugular venous compression. And they also suggested several ways of minimizing the possibility of RCH.

Remote cerebellar hemorrhage is a rare complication after supratentorial surgery(<5%), and it can occur even after spinal surgery complicated by dural tear and prolonged CSF leakage. According to recent literatures, RCH is often characterized by a typical, streaky bleeding pattern due to blood spreading in the cerebellar sulci, so called *Zebra sign*. The location of upper vermis and cerebellar sulci and usual blilateral pattern indicate involvement of the venous system-stretching of infratentorial cerebellar bridging veins during an upward or downward cerebellar herniation- on the occurrence of RCH. On presentation of the *Zebra sign*, several managements such as discontinuation of drainage(branching off rather than removal), infusion of Ringer solution to replace lost CSF, and early placement of a ventricular drain are recommended to prevent aggravation.

I appreciate the authors' work in this article, and I also hope every neurosurgeons can be aware of the possibility of RCH after supratentorial surgery, and always be ready for early detection and treatment.

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