J Korean Neurosurg Soc 37 : 375-379, 2005

Case Report

Acute Subdural Hematoma Associated with Ruptured Intracranial Aneurysm : Diagnosis and Emergent Aneurysm Clipping

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Rarely, rupture of a cerebral aneurysm causes an acute subdural hematoma(SDH) in addition to subarachnoid hemorrhage(SAH). We report clinical and radiological characteristics of five cases, as well as potential pitfalls in the diagnosis and the treatment of this life-threatening condition. The patients ranged in age from 42 to 76 years. The Hunt-Hess grade on admission was grade III in one patient, grade IV in two, and grade V in two. All five patients underwent one-stage operation (both SDH evacuation and clipping of the aneurysm). The outcome was good recovery in two patients, persistent vegetative state in two, and death in one. Patients with a good outcome had a better Hunt-Hess grade on admission, with less amount of SDH.

KEY WORDS : Acute subdural hematoma · Aneurysm · Outcome.

Introduction

Generally, the rupture of an intracranial aneurysm produces a SAH. The incidence of acute SDH associated with aneurysmal bleeding diagnosed by CT, has been reported to be between 0.5% and 8%[4,9]. This is dangerous, with a poor prognosis. A review of the clinical course of these cases found that the patients were in poor condition on admission and had poor outcomes, even after surgical treatment[8,9]. Nowak et al. proposed that comatose patients require immediate craniotomy for evacuation of the hematoma and later aneurysm clipping[9]. However, Inamasu et al. reported that an emergency one stage operation (SDH evacuation and clipping of the aneurysm) was beneficial for patients with poor prognosis[4]. We report here our experience with five patients who developed SDH from ruptured aneurysms and discuss their management.

Materials and Methods

From May 1998 to December 2003, 249 patients had a verified aneurysm that received either surgical treatment (227patients) or endovascular treatment (27patients). In this series, we reviewed the medical, surgical and radiological records and found SDHs recognized from CT scans in five patients. The clinical characteristics of the patients included gender, age, the grade of subarachnoid hemorrhage on admission, based on the Hunt-Hess grade, treatments received, and outcome. The radiographic evaluation included a check for the presence of SAH or intracerebral hemorrhage, the degree of midline shift, and the maximum thickness of the SDH.

• Received : July 2, 2004 • Accepted : November 8, 2004
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Results

Patients and clinical characteristics

Five patients (two men and three women) with a SDH associated with aneurysmal bleeding underwent removal of the clot and aneurysm clipping. The median age of the patients was 61 years (range 42~76 years). The Hunt-Hess grade at admission was III in one patient, IV in two, and V in two. Two aneurysms were in the distal anterior cerebral artery, one was in the anterior communicating artery, one was in the middle cerebral artery bifurcation, and one involved the junction of the internal carotid artery and posterior communicating artery. On initial CT scans, four patients had both SAH and SDH. One patient (patient 3) showed only an SAH on the initial CT scan. A subsequent CT scan after angiography showed an SDH associated with the SAH. Two patients (patients 2 and 3) presented with rebleeding before surgery.

Radiological characteristics and surgery

CT-angiography was performed in four patients and conventional angiography in three. In two (patients 2 and 5), only CT-angiography was performed because of their poor clinical condition. The thickness of the SDH ranged from 6 to 15mm (median 12mm). The midline shift on CT scans ranged between 8.0 and 14mm (median 10mm). The mechanisms by which a ruptured aneurysm led to a SDH were as follows : in Patients 1 and 2, the aneurysms adhered to the falx cerebri and tentorium and ruptured into the subdural space; in Patient 3, bleeding under high pressure caused the rupture of the arachnoid membrane around the Sylvian fissure, permitting blood to jet directly into the subdural space during angiography ; and in Patients 4 and 5, massive hemorrhages ruptured the cortex and lacerated the arachnoid membrane. All five patients had clipping of the aneurysm carried out at the same time as evacuation of the SDH between three and 48 hours after the first bleeding (Table 1). Three patients underwent extraventricular drainage; three underwent bone flap removal and two received bone flap closure. Two patients received thiopental coma therapy : one for six, and one for seven days.

Outcome

Postoperative complications were meningitis and elevated liver enzymes caused by drugs in patient 2, and status epilepticus and pseudomembranous colitis in patient 1. However, both patients were discharged home after improvement of their complications. The median follow up duration was two months (range 10days to 20months). At the time of the last follow up, the outcomes were Glasgow outcome scale(GOS) 5 in two patients and GOS 2 in two patients. Patient 5 died on the 30th postoperative day from uncontrollable raised intracranial pressure. In the two patients with a preoperative Hunt-Hess grade V, one (Patient 5) died and the other resulted in a persistent ve-getative state (GOS 2). In the two patients with preoperative Hunt-Hess grade IV, one patient showed a GOS of 2 at follow up, the other showed good recovery two months after surgery. One patient with a preoperative Hunt-Hess grade of III showed a good recovery 20months after operation. Two patients with SDHs less than 10mm thick showed good recovery at the last follow up (Table 1).

Table 1. Summary of five patients with acute subdural hematoma secondary to rupture of an intracranial aneurysm

Sex/Age		H-H grade	Duration from ictus to operation (hours)	SDH thickness (mm)	Midline shift (mm)	F/U period (months)	GOS
case1	F/72	3	48	6	8	20	5
case2	M/42	4	3	6.5	10	2	5
case3	F/76	5	18	15	8	0.33(10days)	2
case4	F/53	4	22	12	14	4	2
case5	M/61	5	7	13.5	13.5	1	1

H-H grade : Hunt-Hess grade SDH : subdural hematoma F/U : follow up GOS : Glasgow outcome scale

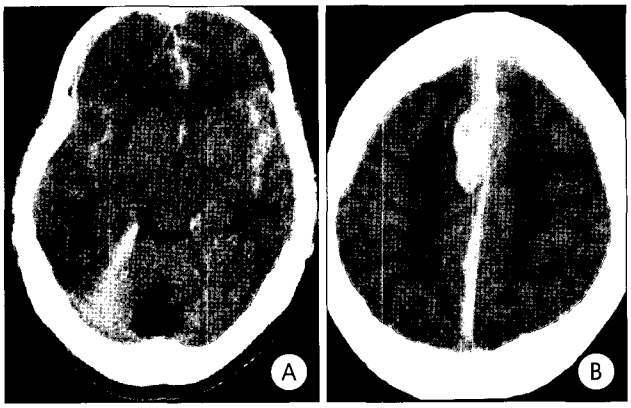

Fig. 1. Computed tomography scan showing an acute subdural hematoma in the convexity and tentorium (A), and subdural hematoma in the interhemispheric subdural space (B).

Case Reports

Patient 1

A 72-year-old woman with no history of head trauma suddenly collapsed after complaining of severe headache, and she was brought to the emergency room. In the emergency room, she showed drowsiness. Her pupils were equal and reactive. A brain CT showed a SDH in the right cerebral hemisphere, interhemispheric fissure, and tentorium (Fig. 1). Angiography showed an aneurysm of the left distal anterior cerebral artery (Fig. 2). She underwent surgery with evacuation of the SDH and successful clipping of the aneurysm on the second day after onset. The dome of the aneurysm adhered tightly to the interhemispheric fissure, and a blood clot was identified on the falx. The patient was discharged from the hospital two months after admission in good condition, with mild but resolving dysphasia and right hemiparesis. Twenty months after the operation, she was in good condition, but with a mild gait disturbance caused by spinal stenosis.

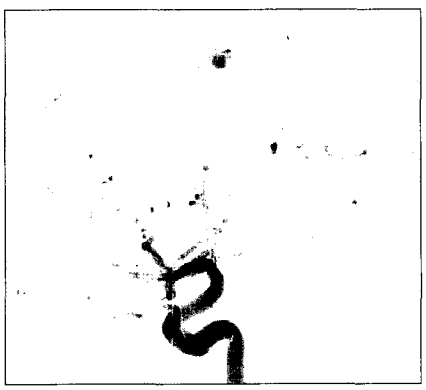

Fig. 2. Left carotid angiogram showing an aneurysm in the distal anterior cerebral artery.

Patient 2

A 42-year-old male developed a severe headache followed by an altered mental state. A CT scan of the head performed at a local hospital revealed a SAH and a small SDH in the left frontal area (Fig. 3). In the emergency room, the patient presented with aphasia and drowsiness. Thirty minutes later, he developed an acute deterioration in mental status and right hemiparesis. Both pupils were fixed : the right was 3mm and the left was 6mm in diameter. CT-angiography showed an increase in the volume of the SAH, and a SDH located in the tentorium and the left cerebral hemisphere (Fig. 4).

Evacuation of the SDH and clipping of the aneurysm was performed immediately. A large frontotemporal craniotomy was performed and the SDH was removed. The brain was swollen when the SDH was removed. The trans Sylvian approach was used to expose the basal cistern. The saccular aneurysm at the junction of the internal carotid artery and the posterior communicating artery was identified. The aneurysm was successfully clipped. Extraventricular drainage and thiopental coma therapy were performed. The patient's postoperative course was complicated by meningitis and elevated liver enzymes caused by drugs. The patient made a good recovery, and two months after the operation he was discharged home with a mild memory disturbance.

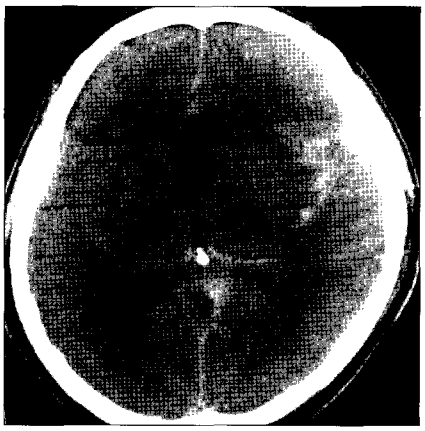

Fig. 3. Computed tomography scan, taken about 30 minutes after the first hemorrhage, showing a subdural hematoma and subarachnoid hemorrhage.

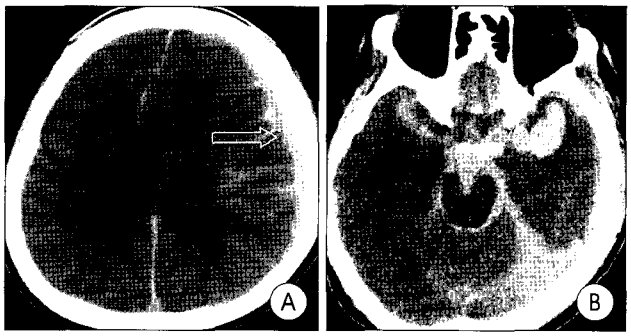

Fig. 4. Computed tomography scan, taken immediately after deterioration of the patient in the emergency department, showing an increased midline shift and increase in volume of the subdural hematoma in the convexity (arrow in A), and subdural hematoma in the tentorium (B).

Discussion

Mechanism of SDH after aneurysm rupture

A number of mechanisms have been proposed to explain the production of an acute SDH after the rupture of a saccular aneurysm. First, an aneurysm adherent to the arachnoid may bleed directly into the subdural space when an arachnoid tear occurs after aneurysm rupture. A previous minor hemorrhage may lead to an adhering aneurysm from local arachnoid adhesions. Second, a hemorrhage under high pressure may also lead to pia-arachnoid rupture and extravasation of blood into an intracerebral or subdural location. Third, rupture of an aneurysm adhering to either the tentorium or falx and located in the subdural space may cause pure SDH[1-8,13,14].

Similar mechanisms might explain the formation of an SDH following the rupture of an aneurysm in these cases. In patients 1 and 2, the aneurysms that adhered to the falx cerebri and tentorium ruptured into the subdural space and resulted in a SAH and a SDH. The CT findings were informative[5,8]. Continuity of the SDH between the convexity and tentorium might indicate an aneurysm in the ruptured internal carotid and posterior communicating arteries, and continuity of the SDH between the convexity and interhemispheric fissure might indicate a ruptured distal anterior cerebral artery aneurysm[5,8]. In our study, the CT scans disclosed convex SDHs with extension along the interhemispheric fissure (patient 1) and tentorium (patient 2). In patient 3, bleeding under high pressure caused the rupture of the arachnoid membrane around the Sylvian fissure, jetting blood directly into the subdural space during angiography and this produced both a SAH and a SDH.

In patient 4, with an aneurysm in the distal anterior cerebral artery, and, in patient 5, with an anterior communicating artery aneurysm, massive hemorrhages ruptured the cortex and lacerated the arachnoid membrane. These caused a SAH, intracerebral hemorrhages, and a SDH. Patient 5 also developed an intraventricular hemorrhage.

Treatment of patients with SDH associated with aneurysm rupture

A SAH associated with acute SDH originating from a ruptured intracranial aneurysm carries a poor prognosis and requires aggressive treatment, including early surgery[4,13]. Thus, patients with a clinically significant SDH have poor outcomes after conservative treatment[5,8,13]. The management of patients with an insignificant quantity of subdural blood

does not pose a dilemma. Many neurosurgeons have encountered small instances of SDH during aneurysm surgery, which are not visible on CT scans. In these patients, the small SDH has little effect on their clinical grade and does not affect management[10]. In our study, initial medical management produced good results for patient 1 with a small SDH treated with a delayed operation (48hours after the initial bleeding). Timely SDH removal and aneurysmal clipping surgery should thus be performed, even for those in poor neurological condition. However, for patients with a massive and rapidly fatal SDH, conservative management may be required. In our study, patient 5 had a SAH, an intracerebral hemorrhage, an intraventricular hemorrhage, SDH, and probable brain stem injury shown by a preoperative CT scan; results after surgery were therefore poor.

The management of patients in comas, i.e. Glasgow Coma Score(GCS) $\leq$ 8, or whose level of consciousness is deteriorating rapidly, is problematical. Some authors have argued that such comatose patients require immediate craniotomy for evacuation of the SDH, and that aneurysmal clipping should be delayed until better clinical conditions can be achieved[9], following angiography. Although these patients showed additional transient neurological recovery after evacuation of the SDH, their condition deteriorated, probably because of rebleeding of their aneurysm while the authors were preparing for cerebral angiography and/or craniotomy. Emergency onestage operation (SDH evacuation and clipping of the aneurysm) has been reported to be beneficial for some grade V patients[4,12,13]. Recent refinement of 3dimensional CT-angiography, allowing it to be performed at the same time as ordinary CT scans and requiring little additional time, may be helpful in localizing a ruptured aneurysm in such an emergency. Cerebral angiography, although essential in localizing ruptu-red aneurysms, is time consuming and may even be hazardous to those patients who are already in poor condition[4]. In this study, two patients (2 and 5) underwent one-stage operations after identifying the location of the aneurysm by CT-angiography. Patient 2 had a good outcome but patient 5 died. Emergency one-stage operation is thus desirable for those with a poor Hunt-Hess grade but who show some neurological recovery after resuscitation. The use of CT-angiography can replace that of angiography in a substantial number of pati-ents with SAH, especially in poor grade patients with SDH[12].

Outcome of patients with SDH associated with aneurysm rupture

Although no statistical analysis could be performed here because of the small number of patients, a worse outcome appeared to be associated with a worse SAH grade on admission, a greater midline shift, and greater SDH volume[4]. The outcomes for the five patients in this study were generally poor : two showed good recovery, two had a persistent vegetative state, and one died. In the patients with a small SDH, this was not the major cause of the poor neurological status and did not affect their management[6,10]. The delay in performing decompressive surgery may be important, because there seems to be a therapeutic window of four hours for evacuation of an acute SDH[11]. In this study, the time between the initial ictus and operation cannot be used to assess outcome, as there were too few patients. However, our experience regarding the importance of an early one-stage operation (SDH removal and aneurysmal clipping) is in general agreement with these findings; thus, patient 2, who presented as semi-comatose but who received surgery within three hours of the initial ictus, showed a good recovery.

Conclusion

An aneurysmal bleeding with SDH is dangerous, with a poor prognosis. Although angiographic verification before aneurysm surgery is preferable, in the moribund patient with SDH, CT-angiography provides sufficient information concerning vascular anatomy to allow emergency craniotomy and aneurysm clipping. Such emergency one-stage operations may be beneficial for those patients with an aneurysmal SDH and who show rapid deterioration.

• Acknowledgement
This work was supported in part by a Seoul Paik Hospital Research Grant. This work was presented as a poster presentation at The Korean Society of Cerebrovascular Surgery Annual Meeting held in Daegu, Korea, on February 2004.

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