CLINICAL ARTICLE

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# Outcomes in the Management of Spontaneous Cerebellar Hemorrhage

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**Objective :** The operative indications on cerebellar hemorrhage have been controversial especially when the patient condition is grave. Therefore we investigated whether it can be justifiable if we perform the surgery in poor clinical grade.

**Methods :** Clinical records and computerized tomography(CT) films of the 89 patients, who were undergone hospital treatment due to spontaneous cerebellar hemorrhage between May 1997 and May 2004, were retrospectively researched.

**Results :** The study population consisted of 36 males and 53 female patients. The mean age was 65years (range 23~89). As a result of treatment, the patients, whose Glasgow coma scale(GCS) score were higher, showed better outcomes (p=0.001). 13 patients (14.6%) were below 5 in GCS score and 10 patients of these were operated. Among 10 patients, 4 patients (40%) showed good outcome and 5 patients (50%) had been dead. 3 patients (60%) of these dead patients had the findings of intraventricular hemorrhage, fourth ventricular obliteration and hydrocephalus in CT scan.

**Conclusion :** This study suggests that operation may be justifiable in clinically poor grade patient with spontaneous intra cerebellar hemorrhage.

**KEY WORDS :** Spontaneous cerebellar hemorrhage · Glasgow coma scale · Glasgow outcome scale · Computerized tomographic finding.

## Introduction

Spontaneous cerebellar hemorrhage accounts for 5~10% of all cases of spontaneous intracerebral hemorrhage. These hemorrhages are associated with high mortality rates of 20 to 75%, because of narrow infratentorial space and direct brain stem compression[2,4,11,15,23].

The operative indications on cerebellar hemorrhage have been variously presented by many authors, and it has been reported that mental deterioration and excessive hemorrhage should be treated by surgical operation and that slight hemorrhage should be treated conservatively[5,7,11,12]. Nevertheless, It has been a lot of controversy that the grave patients showing no respiration or bilateral dilated pupil should be undergone an operation.

We wonder whether it can be justifiable if we perform the surgery in this poor clinical grade patients, i.e. who are comatose, or has bilateral dilated pupils, or has no respiration. In our hospital, we performed emergent surgery as soon as posible even if the patient has no brain stem reflex and self respiration.

This study was performed to contribute to establish a guideline for curing the spontaneous cerebellar hemorrhage patients who show brainstem compression on the basis of the clinical outcomes of spontaneous cerebellar hemorrhage patients analyzed for 7 years.

## Materials and Methods

Clinical records and CT film of the 89 patients, who were undergone hospital treatment due to spontaneous cerebellar hemorrhage between May 1997 and May 2004, were retrospectively researched.

In clinical finding, the prognosis of patients were analyzed

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as to sex, age, blood pressure, GCS score, outcome at discharge and therapeutic method. In brain CT finding, hemorrhagic volume, hematoma location, the compressive degree in the 4th ventricle were comparatively analyzed.

All patients were neurologically examined by a member of our department. The level of consciousness was assessed using the GCS. This allowed a division into three categories : GCS score of 14 and 15, GCS score between 6 and 13, GCS score between 3 and 5

Our surgical indications are disturbance of consciousness, signs of brainstem compression, hematoma with transverse diameter greater than 3cm. Also we operated the grave patients showing no respiration or bilateral dilated pupil.

The GOS(Glasgow outcome scale) score at discharge was used to assess outcome. All patients were divided into two groups, on the basis of GOS scores ; Group 1 (good), good recovery, or moderate disability ; Group 2 (poor), severe disability, persistent vegetative state or dead.

In the statistical analysis, chi-square t-tests were used to assess outcomes. The p value below 0.05 were considered to indicate statistical significance.

# Results

## Patient summary

The study population consisted of 36 males and 53 female patients. The mean age was 65 years (range 23~89). 70 patients (78.6%) had a history of hypertension and 19 patients (21.3%) had a history of previous stroke. A small number of patients had experienced diabetes (4.4%), cancer operation

**Table 1.** Study patients summary

| Clinical characteristics | Number of patients (%) |
|---|---|
| Mean age | 65.1±13.3 (23~89) |
| Male : Female | 36 : 53 (1:1.47) |
| Pre-existing illness | |
| Hypertension | 70 (78.6%) |
| DM | 4 ( 4.4%) |
| Previous stroke | 19 (21.3%) |
| GCS score at admission | |
| GCS ≥ 14 | 52 (58.4%) |
| GCS 6-13 | 24 (27.0%) |
| GCS ≤ 5 | 13 (14.6%) |
| Location of hemorrhage | |
| Vermis | 49 (55%) |
| Hemisphere | 40 (45%) |
| Treatment | |
| Observation | 55 (62%) |
| Surgical management | 34 (38%) |
| EVD | 3 ( 8.8%) |
| Hematoma evacuation | 31 (91.2%) |
| Outcome at discharge | |
| Good recovery | 63 (70%) |
| Moderate disability | 6 ( 7%) |
| Severe disability/vegetative state | 4 ( 5%) |
| Dead | 16 (18%) |

GR : good recovery, MD : moderate disability, SD : severe disability, VS : vegetative state, GCS : Glasgow Coma Scale

**Table 2.** Outcome according to GCS score

| GCS | GOS | | Total |
|---|---|---|---|
| | good | poor | |
| 14~15 | 51( 2) | 1( 0) | 52( 2) |
| 6~13 | 13(13) | 11( 9) | 24(22) |
| 3~5 | 5( 4) | 8( 6) | 13(10) |
| Total | 69(19) | 20(15) | 89(34) |

There was significant difference between outcomes (p=0.001), GCS : Glasgow coma scale, GOS : Glasgow outcome scale, ( ) : number of patient with surgical management

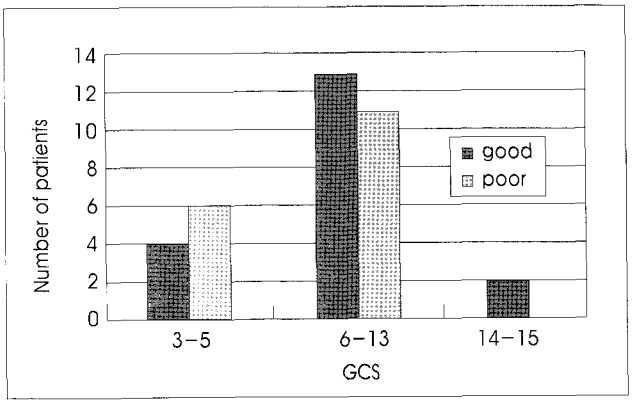


**Fig. 1.** Outcome according to GCS score in operated patients.

**Table 3.** CT finding vs Outcome in all patients

| CT finding | Outcome | | p value |
|---|---|---|---|
| | good | poor | |
| IVH | | | |
| yes | 22 (55) | 18 (45) | 0.000 |
| no | 46 (100) | 0 (0) | |
| Hydrocephalus | | | |
| yes | 9 (42.9) | 12 (57.1) | 0.000 |
| no | 59 (90.8) | 6 (9.2) | |
| Location | | | |
| vermis | 33 (70.2) | 14 (29.8) | 0.034 |
| hemispere | 35 (89.7) | 4 (10.3) | |
| Obliterarion of | | | |
| pre-pontine cistern | | | |
| yes | 10 (40) | 15 (60) | 0.000 |
| no | 58 (95.1) | 3 (4.9) | |
| 4th ventiricle | | | |
| obliteraion | | | |
| yes | 12 (17.6) | 17 (94.4) | 0.000 |
| partial | 14 (20.6) | 0 (0) | |
| no | 42 (61.8) | 1 (5.6) | |
| 0.000 | | | |
| Hematoma size | 2.6±1.1 | 4.1±1.2 | 0.000 |

IVH : intraventricular hemorrhage

**Table 4.** Clinical summary of patients with GCS score of 5 or less

| No | Patient | GCS | Pupil | Stem reflex | Respiration | Time to OP (hrs) from attack | Time to OP (hrs) from ER | Operation name | GOS | Complication |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | M/46 | 4 | normal | yes | yes | 48 | 45 | EVD, DC, shunt | MD | pnemonia |
| 2 | M/52 | 3 | bilat. dilated | no | yes | 3.5 | 0.7 | DC | dead | brain swelling |
| 3 | M/58 | 4 | bilat. dilated | no | yes | 1 | 1 | DC | GR | UGI bleeding |
| 4 | M/30 | 5 | normal | no | yes | 4 | 2 | DC | MD | meningocele |
| 5 | F/55 | 4 | bilat. dilated | no | yes | 2 | 0.8 | DC | dead | brain swelling |
| 6 | M/69 | 3 | bilat. dilated | yes | yes | 2 | 1.5 | DC | dead | brain swelling |
| 7 | M/64 | 3 | normal | no | no | 5 | 1.4 | EVD, DC | dead | brain swelling |
| 8 | M/37 | 4 | bilat. dilated | yes | yes | 4 | 1 | EVD | dead | seizure |
| 9 | M/55 | 3 | normal | no | no | 3 | 0.9 | DC | GR | CSF leakage |
| 10 | M/35 | 4 | normal | no | yes | 5 | 2 | EVD, DC, shunt | SD | infection |
| 11 | F/81 | 5 | normal | yes | yes | – | – | observation | GR | pnemonia |
| 12 | F/56 | 3 | bilat. dilated | no | no | – | – | refused op | dead | brain swelling |
| 13 | M/73 | 3 | normal | yes | yes | – | – | refused op | dead | brain swelling |

GCS : Glasgow coma scale, GOS : Glasgow outcome scale, OP : operation, EVD : extraventricular drainage, DC : decompressive craniectomy and removal of hematoma, MD : moderate disability, GR : good recovery, UGI : upper gastrointestinal, CSF : cerebrospinal fluid

**Table 5.** Radiological summary of patients with GCS score of 5 or less

| No | Patient | ICH location | ICH amount vol (ml) | ICH amount diam (cm) | IVH | 4th ventricle obliteration | Pre-pontine obliteraion | Hydrocep-halus | GOS |
|---|---|---|---|---|---|---|---|---|---|
| 1 | M/46 | vermis | 15 | 3 | yes | yes | no | yes | MD |
| 2 | M/52 | vermis | 25 | 5 | yes | yes | no | no | dead |
| 3 | M/58 | vermis | 12 | 3 | no | yes | no | no | GR |
| 4 | M/30 | vermis | 22 | 7 | yes | yes | yes | no | MD |
| 5 | F/55 | vermis | 20 | 4 | yes | yes | yes | no | dead |
| 6 | M/69 | HS | 22 | 5 | yes | yes | yes | yes | dead |
| 7 | M/64 | vermis | 25 | 4 | yes | yes | yes | yes | dead |
| 8 | M/37 | vermis | 15 | 3.5 | yes | yes | yes | yes | dead |
| 9 | M/55 | vermis | 27 | 5 | no | yes | yes | no | GR |
| 10 | M/35 | vermis | 22 | 4 | yes | yes | no | yes | SD |
| 11 | F/81 | vermis | 7 | 2 | yes | yes | no | no | GR |
| 12 | F/56 | vermis | 30 | 6 | yes | yes | yes | yes | dead |
| 13 | M/73 | HS | 20 | 4 | yes | yes | yes | no | dead |

GCS : Glasgow coma scale, ICH : intracerebral hemorrhage, vol : volume, diam: diameter, IVH : intraventricular hemorrhage, GOS : Glasgow outcome scale, MD : moderate disability, GR : good recovery, SD : severe disability

(2.2%). The GCS score was determined at the time of admission or neurological deterioration. In the 52 cases (58.4%) GCS score was above 14, the 24 patients (27.0%) had GCS score that varied from 6 to 13, in the other 13 patients (14.6%) GCS score was below 5.

In consequence of analyzing the location of cerebellar hemorrhage on brain CT, cerebellar vermis and cerebellar hemisphere were observed in 49 cases (55%) and 40 cases (45%) respectively. The hematoma under 30mm in mean diameter on CT imaging was observed in 60 cases (67.4%) and the 29 cases (32.6%) had bigger hematomas.

Surgical treatment was undertaken in patients with hematomas measuring more than 30mm in mean diameter or hydrocephalus on CT imaging and with a GCS score below 13. 34 cases were undergone operative treatments and 55 cases were undergone conservative treatments. Among them, 3 cases were undergone just extraventricular drainage and in 31 cases hematomas were operatively removed.

In the all patients, 63 cases (70%) showed good recovery, moderate disturbance was observed in 6 cases (7%), severe disturbance was observed in 4 cases (5%), and 16 cases (18%) were dead (Table 1).

## Outcome according to GCS score

All of 51 cases with GCS score above 14 showed good result at the time of discharge, excluding the 1 case who refused to be operated. Craniectomy and removal of hematoma was done in the 21 cases, excluding the 2 cases who refused to be operated, though their GCS was between 6 and 13 at the time of admission, and 1 case was undergone the extraventricular drainage. Among them, the 36.4% (8/22) died and the 59% (13/22) showed good results. Among 13 patients, whose GCS was less than 5 points at the time of admission, 10 patients were undergone operations. The 60% (6/10) died or showed severe disability. But the 40% (4/10) showed good results. As a result, the patients, whose GCS were higher, showed better outcomes (p=0.001) (Table 2), (Fig. 1).

## Outcome according to CT findings

All the patients without intraventricular hemorrhage showed good outcome and patients without hydrocephalus and prepontine cistern obliteration had a better outcome than the other patients (P=0.000). The patients with hematomas in the vermis had a worse outcome than patients with hemispheric lesions (P=0.034). Diameter in patients with good outcome was smaller than patients with poor outcome (P=0.000) (Table 3).

## Patients with GCS score of 5 or less

Among 13 patients with GCS score of 5 or less, 10 patients

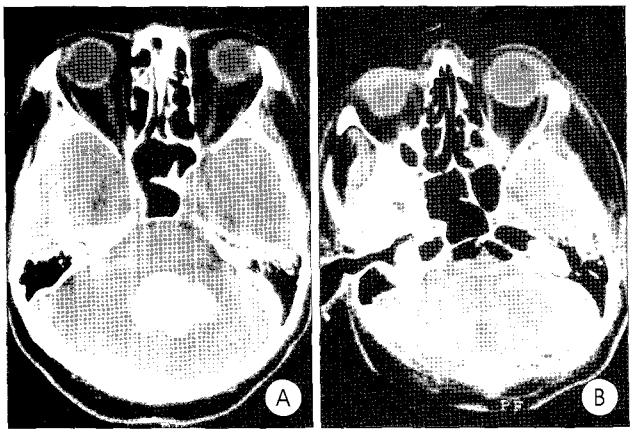

**Fig. 2.** case 3 : computerized tomography scan showing cerebellar hemorrhage (12cm$^3$) with obliteration of the fourth ventricle (A) and postoperative state (B).

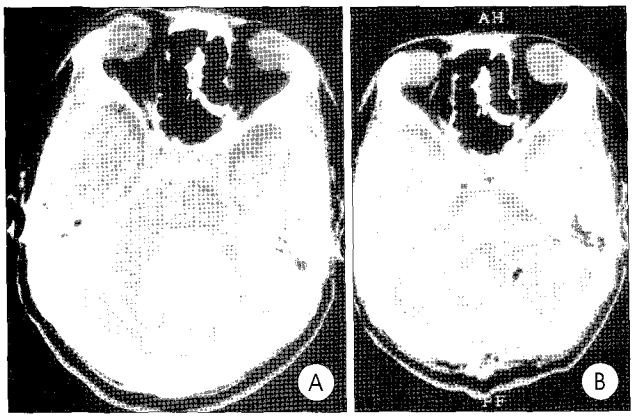

**Fig. 3.** case 9 : computerized tomography scan showing large cerebellar hemorrhage (27cm$^3$) with no hydrocephalus (A) and postoperative state (B).

except one patient with small size hematoma and two patients who refused operation were operated. Among the 6 cases who showed bilateral dilated pupil, the 5 cases' hematomas were operatively removed. In consequence, 4 cases died by cerebral edema and the 1 case, who was operated within one hour due to hemorrhage, showed good result. Of 2 cases who were operated with apnea though mydriasis was not observed, 1 case showed good result (Table. 4), (Fig. 1,3).

All the patients (2 patients) without intraventricular hemorrhage in CT scan showed good recovery. Among the 6 cases who showed pre-pontine cistern obliteration in the operated cases, 2 cases showed good result. Among the 5 cases who showed hydrocephalus, 1 case showed moderate disability. Ultimately 3 cases with all these CT findings showed dead, although operated (Table 5).

## Discussion

Spontaneous cerebellar hemorrhage account for 5~10% of all intracerebral hemorrhage and is a serious diseases with a high mortality rate[2,4,8,11,15]. Most neurosurgeons have emphasized the poor prognosis, being the result of rapid elevation of intracranial pressure, brain stem compression by the local mass effect in the posterior fossa and the concomitant hydrocephalus[1,7,9,16,25]. The most common cause of spontaneous cerebellar hemorrhage are hypertension, the remaining are the vascular deformity, tumor, trauma, blood dyscrasia, infection, and medication of anticoagulants. Hypertensive spontaneous cerebellar hemorrhage is due to rupture of the branch of superior cerebellar artery supplying the dentate nucleus[4,6]. Also we found high incidence of hypertension in the etiology of spontaneous cerebellar hemorrhage.

For the treatment of cerebellar hematomas, there are 3 ways; a) evacuation of the hematoma by a posterior fossa approach. b) ventriculostomy to control hydrocephalus and intracranial pressure. c) conservative treatment. Despite this fact, the management of this affection is still controversial and different procedures such as conservative treatment, ventricular drainage, direct or stereotactic clot evacuation have been advocated[5,9,17]. Although surgical evacuation of hematomas is nowadays widely accepted as the treatment of choice , there are reports of cases that good outcome has been achieved either with conservative treatment or with external ventricular drainage.

Surgical indications are an disturbance of consciousness, signs of brain stem compression, hydrocephalus, hematoma with transverse diameter greater than 3cm, degree of forth ventricular compression[10-14,20,24]. It is not desirable to select doing surgery based on the GCS score only. Hoop et al.[8] reported that surgical decompression is indicated in patients with an impaired level of consciousness, provided that brain stem reflexes still intact. Salvati et al.[19] reported that deeply comatose patient for more than 2 hours should receive conservative treatment. However, some authors still encourage aggressive surgical treatment for these comatose patient. Therefore we should consider the evacuation of hematoma as soon as possible even if the patients have no respiration, dilatation of both pupil, in patient with cerebellar hemorrhage.

Prognostic factors affecting outcome are hematoma size, location, presence of hydrocephalus and intraventricular hemorrhage, obliteration of peri-mesencephalic cistern, sign of brain stem compression and GCS score[3,14,22,23]. Taneda et al.[21] were able to establish a relationship between prognosis and changes of quadrigeminal cistern; no patient with a compressed quadrigeminal cistern survived. Ott et al.[18] reported that 75% of comatose patient die in spite of removal of the hematoma, but conscious patient die in only 17%. Once a patient loses consciousness or when signs of brain stem compression developed, mortality is nearly 100% if timely operation is not done. Some authors believed that one of the

most important factor influencing the surgical result was the level of consciousness before operation and therefore deep coma and failure of brain stem reflex have been suggested as probably an irreversible state.

In our cases, poor outcome was shown in patients with intraventricular hemorrhage, hydrocephalus, compression of brain stem, and large hematoma size. It suggests that these findings predict poor prognosis. The mortality of spontaneous cerebellar hemorrhage are 18% (16/89) and in 10 patients who were operated with GCS score 5 or less, mortality was 50% (5/10). However 3 patients (60%) of these dead patients had the all CT findings of intraventricular hemorrhage, fourth ventricular obliteration, obliteration of pre-pontine cistern, and hydrocephalus. Therefore we suggest that prompt surgical intervention may not only improve the chance for survival but also for a good recovery in clinically poor grade patient with spontaneous intra cere-bellar hemorrhage, if considering CT findings.

## Conclusion

As a result of treatment, the patient with high GCS score showed good outcome. This study suggests that operation may be justifiable in clinically poor grade patient with spontaneous cerebellar hemorrhage.

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## Commentary

Surgical treatment is still debated in grave patients with acute cerebellar hemorrhage. Some reports advocate that a good outcome is still possible in comatose patients after immediate hematoma evacuation. However, many authors share the view that coma or absence of the brain stem reflexes are evidence of an irreversible state.

The authors had made a good effort at retrospectively analyzed 89 cases of acute cerebellar hemorrhage with surgical evacuation. Of ten patients with Glasgow Coma Scale scores of 5 or less (even in patients without respiration, or brain stem reflex) at admission who underwent urgent hematoma removal, 4 proceeded to achieve good outcomes and 5 were dead. They suggested that surgical evacuation was justifiable in deeply comatose patients with spontaneous cerebellar hematoma, although data could not support this at a statistically significant level. Their conclusion derived from this study is not surprising or new and only supports the previous reports. The value of comparing surgical and non-surgical approach is also limited due to the small number of surgical cases and the retrospective nature of the analysis.

The outcomes for patients with cerebellar hemorrhage are thought to be influenced by multiple prognostic factors, especially the degree of anatomic damage to the brain stem. Generally, a more aggressive approach should be recommended for young patients even in poor neurological condition with large hematoma. Further investigation will be helpful to identify proper guidelines for the surgical and conservative management of comatose patients with spontaneous cerebellar hematoma.

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