# Controversy of Surgical Treatment for Severe Cerebellar Infarction

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Treatment for severe cerebellar infarction has been controversial. Clinical outcomes of patients with external ventricular drainage (EVD) and decompression as the first treatment for the infarction were compared. A total of 25 patients with severe cerebellar infarction were subdivided into two groups to compare outcome of the group (group A) with EVD with that of the group (group B) with decompressive surgery as the first surgery. There was no statistically significant difference in age between group A with 71 ± 6 years and group B with 61 ± 15 years. The preoperative status was Glasgow Coma Scale (GCS) score 6 in all the patients in group A. It was GCS score 4 in one patient, GCS score 6 in 9 patients, GCS score 7 in 8 patients, and GCS score 9 in two patients in group B. The preoperative neurologic background was almost the same for both groups. In group A, one patient had a good recovery. However, 3 patients became severely disabled and one patient died. In group B, 10 patients had a good recovery and 6 patients became moderately disabled, although two patients were disabled and two patients died. The outcome was good in one patient of group A and in 16 patients of group B, although it was poor in 4 patients each in both groups. Patients in group B had a significantly better prognosis than those in group A. No clear evidence of surgical indications for EVD or suboccipital decompression from neurologic signs or symptoms and from neuroimaging has been reported. Our results seem to suggest that pre-emptive suboccipital decompression with or without resection of necrosis is warranted in the patients with severe cerebellar infarction. **Key Words:** Cerebellar infarction—external ventricular drainage—decompressive surgery—suboccipital craniectomy.
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From the evidence-based treatment guideline for the Japanese patients with cerebral infarction, an external ventricular drainage (EVD) should be recommended for the patients with cerebellar infarction with moderately impaired consciousness and hydrocephalus, although the medical treatment should be given to the patients with clear consciousness and without hydrocephalus or compression to brainstem on computed tomography. For the patients with severe disturbances of consciousness and compression to brainstem, suboccipital decompressive craniectomy should be recommended.[1] Raco et al[2] have reported that EVD is recommended for patients with worsening levels of consciousness and hydrocephalus, and that surgical resection of necrotic tissue (resection) is reserved when the clinical status worsens despite EVD and the worsening is accompanied by signs of brainstem compression and tight posterior fossa. Many other reports have had the same kinds of ideas as this guideline.[3-7] It seems to be reasonable. However, some controversies still exists about the treatments: in severe cerebellar infarction, can we make a correct judg-

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**Table 1.** *Summary of patients in group A*

| Case | Age/Sex | Dept. on admission | Duration from onset to diagnosis (days) | Duration from onset to operation (days) | GCS | Operation | Outcome |
|---|---|---|---|---|---|---|---|
| 1 | 70/F | Internal medicine | 2 | 2 | 6 | EVD | G |
| 2 | 72/M | Internal medicine | 2 | 2 | 6 | EVD and resection | SD |
| 3 | 81/M | Internal medicine | 2 | 2 | 6 | EVD | SD |
| 4 | 66/M | Internal medicine | 1 | 1 | 6 | EVD | D |
| 5 | 66/M | Internal medicine | 2 | 2 | 6 | EVD and resection | SD |

*F,* female; *M,* male; *EVD,* external ventricular drainage; *resection,* resection of necrosis in cerebellum; *G,* good; *SD,* severely disabled; *D,* died.

ment as to whether the cause of the worsening of neurologic conditions is a result of the compression or the hydrocephalus? In observing the patient's condition after EVD, how long should we observe it? When can we make a decision for decompression? Do neurologic conditions become irreversible while we observe the condition after EVD? The purpose of this investigation is to make a comparison of outcomes between EVD and decompression as the first choice of treatment for severe cerebellar infarction.

## Methods

A total of 25 patients with severe cerebellar infarction were surgically treated in 4 hospitals from January 1994 to December 2004. The patient with "severe" infarction was defined as one with Glasgow Coma Scale (GCS) score less than 9 not relating to the size of the infarct. Because it is reported that the most important factor to affect the outcome is neither radiologic findings nor neurologic symptoms or signs, but the level of consciousness.[8,9]

As the first treatment, EVD was performed in one of 4 hospitals (group A). In that hospital, it had been thought that hydrocephalus should be treated first and then suboccipital decompression might be added if neurologic conditions did not recover. In the other 3 hospitals, suboccipital decompression with or without resection was made (group B). Group A had 5 patients and group B had 20 patients. Resection was defined as surgical resection of necrotic tissues. EVD & resection was done as EVD in the first operation and resection was added on the next day as the second operation. EVD + resection was done as EVD and resection in the same operation. Preoperative and postoperative conditions were evaluated by the GCS and Glasgow Outcome Scale (GOS) consisting of 5 grades: (G) good; (MD) moderately disabled; (SD) severely disabled; (V) vegetative; and (D) died.

Statistical analysis was performed using Chi square or Fisher's test. A $P$ value of less than .05 was considered significant. The outcome was dichotomized as good (GOS score: G and MD) or poor (GOS score: SD, V, and D).

## Results

Group A had 4 male patients and one female patient. Group B had 17 male patients and 3 female patients. Male sex was predominant in both groups. The mean ± SD age of the patients was 71 ± 6 years in group A and 61 ± 15 years in group B. There was no statistically significant difference in age between two groups.

The preoperative status was GCS score 6 in all the patients in group A. It was GCS score 4 in one patient, GCS score 6 in 9 patients, GCS score 7 in 8 patients, and GCS score 9 in two patients in group B (Tables 1 and 2). In group A, only EVD was performed in 3 of 5 patients. Resection was added on the next day in two patients because of a lack of neurologic recovery. One patient had a good recovery. However, 3 patients became severely disabled and one patient died (Table 1).

In group B, 10 patients had a good recovery and 6 patients became moderately disabled, although two patients were disabled and two patients died (Table 2). The outcome was good in one patient of group A and in 16 patients of group B, although it was poor in 4 patients each in both groups. Patients in group B had a significantly better prognosis than those in group A ($P < .05$) (Table 3).

## Discussion

Generally, such factors as the preoperative neurologic condition and method of surgical treatment are influential to the patient's outcome. In cerebellar infarction, however, it is reported that the level of consciousness affects the outcome, although no neurologic or neuroradiologic signs are predictive.[8,9] In this series, we investigated whether the method of surgery may affect the outcome. A total of 25 patients were subdivided into two groups, EVD group (group A) and craniotomy group (group B), to investigate their prognosis with those factors taken into consideration.

No significant difference in age was found between the two groups. As for the preoperative neurologic condition, all the patients in group A had GCS score 6, whereas in

**Table 2.** *Summary of patients in group B*

| Case | Age/Sex | Dept. on admission | Duration from onset to diagnosis (days) | Duration from onset to operation (days) | GCS | Operation | Outcome |
|---|---|---|---|---|---|---|---|
| 1 | 62/M | Neurology | 1 | 3 | 6 | EVD + resection | G |
| 2 | 64/M | Emergency | 1 | 1 | 6 | EVD + resection | D |
| 3 | 64/M | Internal medicine | 1 | 3 | 6 | EVD + resection | G |
| 4 | 75/M | Neurology | 1 | 3 | 7 | EVD + resection | G |
| 5 | 78/M | Internal medicine | 2 | 5 | 4 | EVD + resection | G |
| 6 | 43/M | Neurology | 2 | 2 | 7 | EVD + resection | G |
| 7 | 66/M | Cardiology | 2 | 2 | 7 | EVD + resection | G |
| 8 | 61/M | Otolaryngology | 4 | 4 | 6 | EVD + resection | G |
| 9 | 68/M | Internal medicine | 2 | 2 | 6 | EVD + resection | G |
| 10 | 52/M | Internal medicine | 2 | 2 | 7 | Resection | D |
| 11 | 72/M | Internal medicine | 3 | 3 | 7 | Resection | MD |
| 12 | 58/M | Internal medicine | 2 | 2 | 6 | Resection | MD |
| 13 | 69/F | Internal medicine | 2 | 2 | 7 | Ex decompres. | G |
| 14 | 59/M | Internal medicine | 3 | 3 | 7 | EVD + ex. decompres. | G |
| 15 | 72/F | Internal medicine | 2 | 2 | 6 | EVD + resection | MD |
| 16 | 30/M | Internal medicine | 4 | 4 | 6 | EVD + ex. decompres. | SD |
| 17 | 32/M | Internal medicine | 2 | 2 | 7 | EVD + resection | MD |
| 18 | 70/M | Internal medicine | 3 | 3 | 7 | EVD + ex. decompres. | MD |
| 19 | 35/F | Neurology | 1 | 1 | 6 | Ex. decompres. | SD |
| 20 | 79/M | Neurology | 4 | 4 | 9 | EVD + resection | MD |

*F*, female; *M*, male; *EVD*, external ventricular drainage; *resection*, resection of necrosis in cerebellum; *G*, good; *MD*, moderately disabled; *SD*, severely disabled; *D*, died; *ex. decompres.*, external decompression.

group B 8 patients had GCS score 7, two patients had GCS score 9, and one patient had GCS score 4, all of them being in serious condition. There seemed to be no difference in the preoperative neurologic condition between the two groups.

The outcome was good in only one of 5 patients in group A, and in 16 of 20 patients in group B. Prognosis in group B was significantly better than that in group A. Considering that there was no difference in age and the preoperative neurologic condition between the two groups, those results suggest that the first operative procedure decides the outcome.

Controversy still exists regarding the surgical treatment for cerebellar infarction. EVD has been favored in many reports[5,10-14] and craniectomy has been performed in some reports.[15-22] Recently, it has been reported that EVD is done as the first step, and then craniectomy with or without resection is added in the case of there being no recovery of the neurologic condition after EVD.[1,3-7] This opinion seems to be reasonable. However, it is open to some questions. Namely, what is the reason for EVD? Is it caused by hydrocephalus only? How long is the closed observation necessary after EVD?

In severe cases, acute obstructive hydrocephalus occurs as a consequence of ischemic or hemorrhagic infarction producing a swelling mass effect with a shift or obliteration of the fourth ventricle.[6] The brainstem is also compressed by the massive infarction. The patients fall into stupor or coma under such a condition. Although Heros[22] has maintained that the early signs of direct brainstem compression by the cerebellar mass are paresis and then paralysis of the ipsilateral sixth cranial nerve followed by ipsilateral gaze palsy and facial palsy, and that acute hydrocephalus results in a comatose state with small pupils, absent oculocephalic responses, and decortication, it is very difficult, in practice, to know whether the disturbance of consciousness is caused by hydrocephalus or impairment of the brainstem.[23] Tohgi et al[9] have not found any symptoms or signs that predict subsequent severe cerebellar swelling.

There are a few reports about the indications for EVD or craniectomy on neuroimaging. Laun et al[24] have reported that the assessment of the cisterns around the brainstem, particularly the cisterns of the lamina quadrigemina and the great vein of Galen is of critical help in deciding the indications for suboccipital craniotomy and decompression. In the German-Austrian cerebellar in-

**Table 3.** *Comparison of the outcome between the two groups*

| | Good outcome (GOS: G and MD) | Poor outcome (GOS: SD, V, and D) |
|---|---|---|
| Group A | 1 (1 and 0) | 4 (3, 0, and 1) |
| Group B* | 16 (10 and 6) | 4 (2, 0, and 2) |

*$P < .05$ compared with group A.

farction study, EVD was preferred in the patients with computed tomography evidence of inferior horn enlargement, and decompressive craniotomy was performed in those with computed tomography signs of quadrigeminal cistern compression.[8] At this time, however, no conclusive data on the appropriateness of particular therapeutic approaches for the infarction are available. How long is the closed observation necessary, when EVD is done as the first treatment?

Many authors have reported that decompressive surgery should be added for the patients with a deteriorating neurologic condition after EVD. But they have made no mention of the time of the second operation. Only Horwitz and Ludolph[6] have reported that prompt suboccipital craniectomy with resection of necrotic cerebellar tissues is recommended, in the case of there being no improvement in the level of consciousness within a few hours after ventricular decompression. However, they have given no explanation on the reason for observation of a few hours. We do not know how many hours or days we should observe. Hornig et al[19] commented that in most cases clinical deterioration started on the third day and a comatose state was reached within 24 hours. Ogasawara et al[25] have reported that the patients whose consciousness had deteriorated from clear to stuporous soon became comatose. Therefore, it is in anxiety that reversible neurologic conditions change to be irreversible during observation. As for upward herniation by EVD, controversy has remained. Shenkin and Zavala[14] and Ito et al[7] reported no herniated cases. Chen et al,[15] however, pointed out the risk and favored the decompressive craniectomy.[22]

Although our series is small and may be unable to answer any of the questions mentioned above, our results seem to suggest that suboccipital decompression is significantly more favorable than EVD as the first surgical treatment. Suboccipital decompression with or without resection is advocated positively or prophylactically in the patients with severe cerebellar infarction, because no clear evidence of surgical indications for EVD or suboccipital decompression from neurologic signs or symptoms and from neuroimaging has been reported.

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