

Factors Determining the Outcome of Pontine Hemorrhage in the Absence of Surgical Intervention

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ABSTRACT

Objectives and Importance: Although pontine hemorrhage is very often fatal, the clinical manifestations vary according to the location and extent of the hematoma. We investigated the prognostic factors of pontine hemorrhage by assessing clinical manifestation and CT findings in relation to outcome. **Materials and Methods:** The outcome and clinical features of 19 patients with pontine hemorrhage without surgical intervention were analyzed. The CT features of the hematoma were classified into four types: massive, tegmento-basilar, transverse oval, and small unilateral. The Glasgow Outcome Scale (GOS) was used to assess patient outcome (G, good recovery; MD, moderate disability; SD, severe disability, V, vegetative state, D, death) at discharge. **Results:** The outcome was MD in 7 cases, SD in 3, and D in 9. Eight of 9 patients with acute hydrocephalus died, whereas only one of 10 patients without hydrocephalus died ($p < 0.01$). Patients who survived until discharge tended to younger than those who died (61 and 77 years, $p < 0.05$). Death was more frequent among patients with a GCS score of >12 , tetraparesis, or respiratory failure ($p < 0.01, 0.05, 0.01$, respectively). Four of 5 patients with CT evidence of massive hemorrhage died, and another patient became vegetative. The outcome in 6 patients with tegmento-basilar-type hematoma included D in 3, V in 2, and MD in 1, and that in 7 patients with transverse oval hematoma included D in 2, V in 1, SD in 1, and MD in 3. Five (65%) of the 8 patients with transverse oval or small unilateral hematomas were able to walk (MD) with or without assistance, whereas only 2 (18%) of 11 patients with tegmento-basilar-type and massive hematoma were ambulatory at discharge ($p < 0.05$). **Conclusion:** On the basis of CT classification, the functional prognosis of transverse oval pontine hemorrhage is as favorable as that of the small unilateral type.

Keywords: Pontine Hemorrhage; CT Findings; Prognosis

1. Introduction

Six to 7.5% of all intracranial hemorrhages occur in the pons [1-3]. Clinical manifestations vary according to the location or extent of the hematoma, and the causes, including hypertension, vascular anomaly and tumor. Partial pontine hematomas resulting from rupture of cryptic vascular malformations sometimes have a better prognosis than those occurring due to hypertension [3]. The outcome of hypertensive pontine hemorrhage is generally fatal, and the clinical course is rapid, death sometimes occurring within hours [4,5]. However, even patients with bilateral hemorrhage occasionally have a favorable outcome. The purpose of this study was to clarify the clinical factors affecting the functional outcome of brainstem hemorrhage without any evidence of vascular anomaly or tumors, in the absence of surgical intervention, in relation to CT findings upon presentation.

2. Materials and Methods

Nineteen patients with pontine hemorrhage were conservatively treated at our hospital in the 6-year period from 2002 to 2008. Patients who underwent surgical evacuation of the hematoma, or those with apparent vascular anomaly, were excluded. The patients included 11 men and eight women, with a median age of 68 years (range 53 - 88). Clinical characteristics of the patients examined included age, gender, Glasgow coma scale (GCS) score, pattern of paralysis, pupil abnormality, respiratory status, medical history including medication, presence of hydrocephalus, hematoma volume, and Glasgow Outcome Scale assessment (GOS; G, good recovery; MD, moderate disability; SD, severely disability, V, vegetative state, D, death) at discharge. Favorable outcome was defined as GOS 2 or 3. The CT findings were classified into four types, according to the classification reported by Russell

et al. [6] and Chung, *et al.* [7], with some modifications: massive, tegmento-basilar, transverse oval, and small unilateral. The massive type was defined as a hematoma occupying both the basis and tegmentum bilaterally (**Figure 1**). The tegmento-basilar type included both unilateral and bilateral hematomas (**Figure 2**). Transverse oval types were defined as bilateral elliptical hematomas including the basis, tegmentum or basal-tegmental junction (**Figure 3**). The small unilateral type was defined as being present exclusively in the unilateral tegmentum (**Figure 4**). Several percentages were compared using chi-square with kappa. Mean values were analyzed using unpaired t-test. Differences at a $p < 0.05$ were considered to be statistically significant.

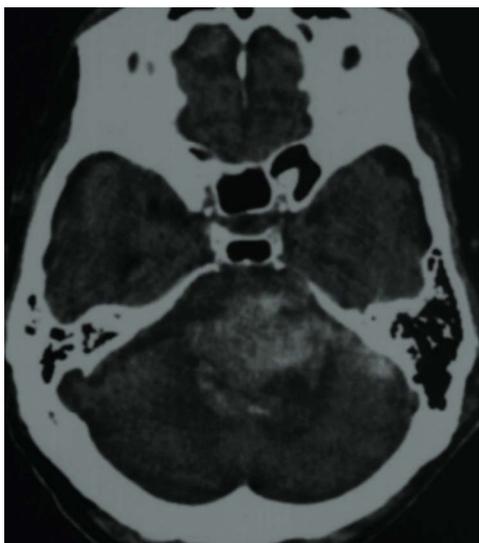


Figure 1. Massive hematomas were defined as those occupying both the basis and tegmentum bilaterally.

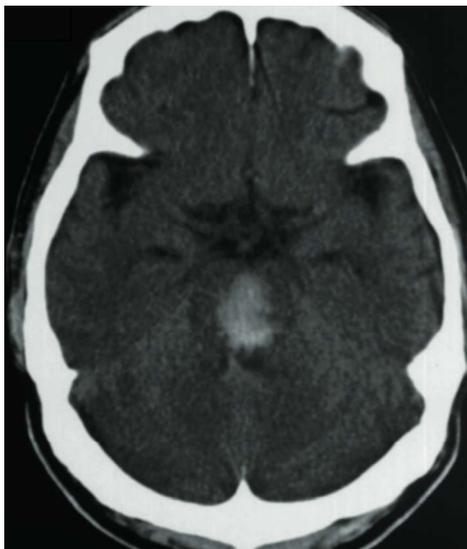


Figure 2. Tegmento-basilar hematomas included both unilateral and bilateral types.

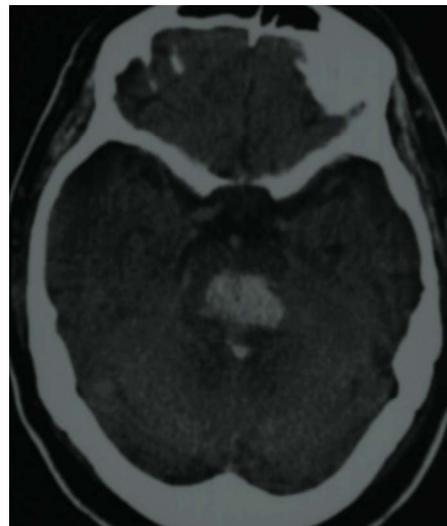


Figure 3. Transverse oval hematomas included elliptical hematomas bilaterally involving the basis, tegmentum or basal-tegmental junction.

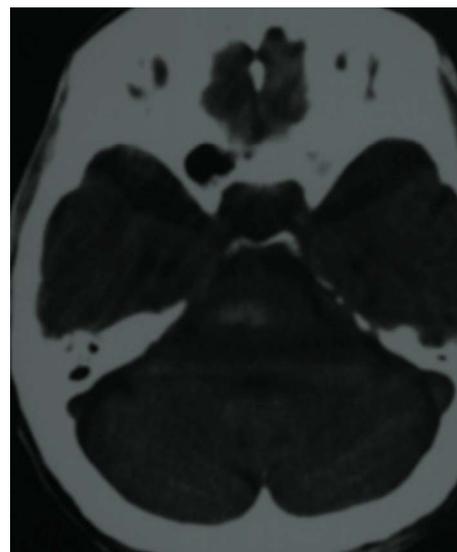


Figure 4. Small unilateral hematomas included those present exclusively in the unilateral tegmentum.

3. Results

The patients' clinical features and outcomes are listed in **Table 1**. The outcome was MD in 7 cases, SD in 3, and D in 9. With regard to hematoma type defined by CT, four of 5 patients with massive hemorrhage died, and the other patient became vegetative. The outcome (GOS) in the 6 patients with tegmento-basilar hematomas was D in 3, V in 2, and MD in 1, and that in the 7 patients with transverse oval hematomas was D in 2, V in 1, SD in 1, and MD in 3. The outcome in the patient with a small unilateral hematoma was MD.

Mortality: Eight (89%) of the 9 patients with acute hydrocephalus died, whereas only one (11%) of the 10

Table 1. Clinical features and outcomes of the patients with pontine hemorrhage.

Age & gender	GCS	respiration	hydrocephalus	Location	type	volume (ml)	GOS
1) 46M	6	failure	no	pons	TO	5.2	V
2) 54M	14	good	no	pons	TB	2.3	MD
3) 55M	15	good	no	pons	TO	0.5	MD
4) 85F	7	failure	yes	pons-midbrain	TB	10	D
5) 68M	15	good	no	pons	DL	0.8	MD
6) 81F	14	good	no	pons	TO	0.8	MD
7) 62F	4	good	mild	pons	TO	7.9	MD
8) 54F	7	failure	mild	pons	TO	1.2	D
9) 71F	4	good	no	pons-vermis	M	28.3	V
10) 80M	3	failure	yes	pons-vermis	M	22.6	D
11) 59M	7	failure	no	pons	TO	3.5	MD
12) 73F	3	failure	yes	pons-midbra	TB	13.8	D
13) 84F	3	failure	yes	pons	TO	2.8	D
14) 88	4	failure	yes	pons	M	17.1	D
15) 59M	14	good	no	pons	TB	3.9	SD
16) 53F	13	good	no	pons-midbra	TB	5.7	V
17) 73M	12	good	no	pons	TB	6.3	D
18) 80M	4	failure	yes	pons	M	9.4	D
19) 58M	3	failure	yes	pons	M	15.5	D

patients without hydrocephalus died ($p < 0.01$). Surviving patients tended to be younger than those who died (61 vs. 77 years, $p < 0.05$), and the hematoma volumes were 5.9 and 11.0 ml, respectively (NS). Mortality in patients with a GCS score of >12 , tetraparesis, or respiratory failure on admission was higher than in the others ($p < 0.01$, $p < 0.05$, $p < 0.01$, respectively). A history of hypertension and pupil abnormality was unrelated to patient survival rate. With regard to CT classification of the hematoma, two (25%) of 8 patients with transverse oval or small unilateral hematomas died, while 7 (65%) of 11 patients with massive or tegmento-basilar hematomas died (NS).

Functional outcome (MD or SD): A favorable functional outcome (MD or SD) was obtained in only one of 9 patients with acute hydrocephalus, in comparison to 6 of 10 patients without hydrocephalus ($p < 0.05$). The mean ages of the patients with better (MD or SD) and poorer (V or D) outcome were 62 and 72 years, respectively (NS). The hematoma volume of patients with a better outcome was greater than that of patients with a poor outcome (2.8 vs. 11.5 ml, $p < 0.05$). Patients with a GCS score of >12 , tetraparesis, or respiratory failure on admission tended to have a better outcome than the others ($p < 0.05$, $p < 0.01$, $p < 0.05$, respectively). Neither a history of hypertension, pupil abnormality, nor age affected the functional outcome of the patients. Five (65%) of the 8 patients with transverse oval or small unilateral

hematomas were discharged as ambulatory (MD) with or without assistance, whereas this was possible for only 2 (18%) of 11 patients with massive or tegmento-basilar hematomas ($p < 0.05$).

4. Discussion

Clinical parameters and prognosis: Mangiardi *et al.* reviewed the outcome of brainstem hemorrhage by comparing surgically treated with conservatively managed cases [8]. They suggested that cases with a poor outcome were associated with hypertension, absence of vascular malformation, older age, ventricular extension, and non-surgical treatment. Our results were similar to their conclusions, in that older age or ventricular extension causing hydrocephalus was related to a fatal outcome. Manjiardi *et al.* also reported that 85% of patients treated surgically were normal or had mild to moderate neurological deficits, whereas only 30% of patients managed conservatively had a similar outcome [8]. It is difficult to assess the effectiveness of surgery relative to conservative therapy, because most patients with massive pontine hemorrhage and in poor clinical condition are not treated surgically. In order to clarify the natural course of pontine hemorrhage, patients who underwent surgical intervention were excluded from this series. Patients with apparent vascular malformations were also excluded; such lesions tend to be focal or localized only in the subependium, and are rela-

tively non-fatal in comparison to hypertensive brainstem hemorrhage [1,2]. Therefore, such patients often undergo surgery. However, it is sometimes difficult to distinguish patients with and without vascular malformation. Among the present patients who survived, none of the repeated MRI examinations revealed apparent vascular malformation during follow-up.

CT classification of pontine hemorrhage: CT classification is an unequivocally useful tool for prognostication in patients with brain hemorrhage. Massive and diffuse pontine hemorrhages are likely to be more often fatal than those that are subependymal or focal [8]. Russell *et al.* subdivided pontine hematomas into three types on the basis of CT findings: central, tegmentobasilar and dorsolateral tegmental [6]. Large hematomas resulting from systemic hypertension generally occupy the central pons, resulting in a fatal outcome, and involve the reticular activating system, giving rise to abrupt coma with quadriplegia, a decerebrate posture, or pinpoint pupils. Other types of hematoma include partial pontine hematomas restricted to the lateral half of the pons with sparing of the reticular system, and these can be either tegmentobasilar or dorsolateral tegmental.

Our present series included cases in which the CT findings were difficult to classify. Transverse oval hematoma was defined as an elliptical hematoma with bilateral involvement of the basis, tegmentum, or basal-tegmental junction. This category is similar to that of Chung's classification [7], namely that bilaterally involving the basal-tegmental junction between the basis pontis and the tegmentum. However, in the present cases, the hematoma sometimes involved only the basis or the tegmentum. Therefore, we classified such hematomas as the transverse oval type when the basal-tegmental junction was involved, or the basis or tegmentum alone. We experienced one case of small unilateral hematoma exclusively involving the unilateral tegmentum, which conformed to Chung's classification. It was of interest that some patients with transverse oval hematoma, as well as those with the small unilateral type, showed a favorable outcome. Such patients had a significantly favorable outcome, as defined in terms of functional ability. However, further investigation is required because we believe that transverse oval-type hematoma may not fatally destroy

the pyramidal fibers, in contrast to massive or tegmentobasilar hematomas.

5. Summary

We investigated the prognostic significance of clinical features and CT findings during the natural course of pontine hemorrhage. The presence of hydrocephalus, older age, lower GCS, tetraparesis, and respiratory failure were associated with a fatal outcome. Transverse oval spread of the pontine hemorrhage on CT scans was associated with a favorable functional outcome.

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