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CLINICAL ARTICLE
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Analysis of Prognostic Factors for Chronic Subdural Hematoma

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Objective: Chronic subdural hematoma (CSDH) is a relatively common disease with a simple treatment strategy. However, the prognosis for CSDH patient is not always easily determined. The aim of this study was to investigate the prognostic factors for patients with CSDH. **Methods**: Forty-six patients who were treated with burrhole trephination surgery for CSDH were retrospectively analyzed. The possible prognostic factors were age, sex, the size of the hematoma, pre-operative midline shifting, density and the location of the hematoma, pre-operative Glasgow Coma Scale (GCS), medical histories, post-operative brain expansion, and post-operative pneumocephalus. Post-operative clinical outcomes were evaluated by modified Rankin Scale (good outcome: mRS 0-1, poor outcome: mRS 2-5). **Results**: Among 46 patients, 33 patients (72%) were in the good outcome group while 13 (28%) patients demonstrated a poor outcome. Among variable factors, being older than 65 years, a poor pre-operative GCS (6-12) and a history of diabetes were significantly related to a poor clinical outcome statistically. As a result of logistic regression analysis for these factors, being older than 65 years and a pre-operative GCS under 12 were revealed as independent prognostic factors for CSDH. **Conclusion**: Being older than 65 years and a pre-operative GCS under 12 were independent, significant prognostic factors for CSDH. The presence of diabetes was also statistically related with a poor prognosis without a high-risk value. These results could be helpful to predict the prognosis for CSDH after burrhole trephination. (J Kor Neurotraumatol Soc 2008;4:14-18)

KEY WORDS: Chronic subdural hematoma · Burrhole trephination · Prognostic factor.

Introduction

Chronic subdural hematoma (CSDH) is a relatively common disease, which is thought to develop after injury to vessels between the dura and arachnoid after trauma.[7,24] Overall mortality with surgical treatment of CSDH is 0-8%.[13] Various factors like coagulopathy, pre-operative neurologic condition, patient's age, post-operative pneumocephalus, and brain expansion rates were known as related with prognosis.[17] There have been many surgical and nonsurgical techniques to approach CSDH treatment. Burrhole trephination and hematoma removal have been widely-used as effective surgical management of CSDH.[13,24] However, in some patients, neurosurgeons have encountered neurological deterioration after surgery. We have developed this clinical analysis to assess factors associated with the prognosis for CSDH.

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Materials and Methods

Forty-six patients with CSDH were surgically treated from January 2003 to November 2006 in our institution. All patients underwent simple burrhole trephination and hematoma removal, and a subdural drain catheter was inserted into the hematoma cavity for several days. Careful history taking, neurological examinations, and computed tomography (CT) scans were performed for the initial diagnosis and at post-operative days 1, 7, and 30.

We analyzed not only clinical factors like age, sex, medical histories, coagulopathy, pre-operative Glasgow Coma Scale (GCS), but also radiologic factors like pre-operative amount of hematoma, pre-operative midline shifting, density and location of the hematoma, post-operative brain expansion, and post-operative pneumocephalus. Post-operative clinical outcomes were measured by one of the authors at post-operative day 30 with the modified Rankin Scale (mRS).[18]

Coagulopathy was defined as the need for anticoagulant or thrombolytic therapy, a hematological disorder with an increased risk of bleeding, hepatic failure, or hemodialysis.

Patients were divided into the following two groups by age: 1) younger than 65 years and 2) older than 65 years. They were also grouped according to the presence of medical disease(s), such as coagulopathy, diabetes mellitus (DM), or hypertension (HTN), time from trauma to diagnosis (within 30 days, over 30 days ago), air accumulation after the surgery, which was measured by the longest axis of the larger air density on the CT scan at post-operative day 1 (minimal air accumulation below 5 mm, mild accumulation between 5 to 10 mm, moderate accumulation between 11 to 20 mm, and large accumulation over 21 mm), and length of hospitalization (HD) (within a month, over a month). Brain expansion was calculated by comparing the differences between the longest vertical diameter from the inner table of the skull to the brain cortex pre-operatively and at post-operative day 1 (>10 mm, 0−10 mm, <0). Among variable cuts of the CT scan, one of the images was selected that have longest vertical diameter from the inner table of the skull to the brain cortex. We simply comparing the differences of two image cuts.

TABLE 1. Clinical and radiological characteristics of 46 patients with CSDH

Characteristics	No. of patients (%)
Age	
≧65 years old	30 (65.2%)
<65 years old	16 (34.8%)
Sex	
Male	32 (69.6%)
Female	14 (30.4%)
Patient's medical history	
Diabetes mellitus	6 (13 %)
Hypertension	16 (34.8%)
Coagulopathy	8 (17.4%)
Preoperative GCS	12.8±0.3
≧13	27 (58.7%)
<13	19 (41.3%)
Time to diagnosis	
<30 days	25 (54.3%)
≧30 days	16 (34.8%)
Hospitalization	
<1 month	31 (67.4%)
≧1 month	13 (28.3%)
Preoperative hematoma (mm)	19.2±0.9
Preoperative midline shifting (mm)	6.2±0.8
Hematoma density	
High	1 (2.2%)
Low	20 (43.5%)
Iso dense	17 (37.0%)
Mixed density	8 (17.4%)
Hematoma location	
Right	15 (32.6%)
Left	16 (34.8%)
Bilateral	15 (32.6%)
Postoperative pneumocephalus	
<5 mm	10 (21.7%)
5−10 mm	12 (26.1%)
11−20 mm	15 (32.6%)
>20 mm	9 (19.6%)
modified Rankin Scale	
mRS=0−1	33 (71.7%)
mRS=2−5	13 (28.3%)

Pre-operative clinical status was measured by the GCS, and patients were categorized into two groups (GCS under 12, GCS over 13). Patients' outcomes were assessed by mRS at 1 month post-operative day and categorized into two groups (mRS 0−1, mRS 2−5). The amount of hematoma and the air accumulation were measured by one of the authors at post-operative days 1, 7 by CT scan. The longest vertical length from the inner table of the skull to the outer layer of the brain parenchyme on the largest available CT scan image was used as the size of the hematoma, or air accumulation. The clinical and radiological characteristics in all patients are summarized in Table 1.

Categorical variables were compared using the Pearson chi-square test. Factors like age, sex, time interval to diagnosis, pre-operative GCS, hospitalization day, and the presence of coagulopathy, DM, HTN are also analyzed with a Fisher's exact test. Factors related to poor prognosis are analyzed using the logistic regression model. In these models we controlled for and included the following risk factors: patient age (age under 65 compared to age over 65), pre-operative GCS (GCS≧13 compared to GCS≦12) and the presence of DM (no or yes). Consequently, an odd ratios (OR) significantly lower than 1 would indicate that the occurrence would be less likely to occur, whereas an OR significantly greater than 1 would be a valuable prognostic factor for predicting a poor outcome. Ninety-five percent confidence intervals not containing 1 were considered independent prognostic factors. A p-value less than 0.05 was considered statistically significant.

Results

Thirty-two (69.6%) patients were male, and their mean age was 65.2 years (range from 7 to 88 years). A poor post-operative clinical outcome was related to patients older than 65 years (p=0.002).

The mean duration between trauma and the diagnosis was 26.4 days (range from 7 to 90 days), and the mean length of hospitalization was 46.2 days (range from 4 to 243

TABLE 2. Variable factors and clinical outcomes

Factors	Outcome		p-value
	Good (mRS 0, 1)	Poor (mRS≧2)	
Age			0.002
≧65	17	13	
<65	16	0	
Sex			0.458
Male	24	8	
Female	9	5	
Diabetes			0.025
Yes	2	4	
No	31	9	
Hypertension			0.088
Yes	9	7	
No	24	6	
Coagulopathy			0.276
Yes	7	1	
No	26	12	
Preoperative GCS			0.002
GCS=6−12	24	3	
GCS≧13	9	10	
Time to diagnosis			0.833
<30 days	18	7	
>30 days	12	4	
Hospitalization			0.567
<1 month	24	7	
≧1 month	9	4	
Size at diagnosis			0.662
<10 mm	2	0	
11−20 mm	19	8	
>20 mm	12	5	
Midline shifting			0.393
None	7	5	
<5 mm	10	2	
>5 mm	16	6	
Hematoma density			0.424
High	0	1	
Low	14	6	
Iso	13	4	
Mixed	6	2	
Hematoma location			0.416
Right	11	4	
Left	13	3	
Both	9	6	
Brain expansion			0.281
>10 mm	16	3	
0−10 mm	13	8	
Negative	4	2	
Postoperative pneumocephalus			0.064
<5 mm	9	1	
5−10 mm	10	2	
10−20 mm	7	8	
>20 mm	7	2	
Size of hematoma at postoperative 7 day			0.212
<5 mm	18	3	
6−10 mm	8	5	
>10 mm	7	4	

TABLE 3. Logistic regression analysis for factors affecting poor outcome

	Odd ratio	95% confidence interval
Poor outcome (mRS≧2)		
Age≧65	1.765	1.045− 1.402*
Preoperative GCS 6 to 12	1.639	1.065− 2.524*
Presence of diabetes	0.145	0.061−16.382

*independent factor affecting on poor outcome do not contain 1 in 95% confidence interval

days). Neither of these factors affected the clinical outcome.

Eight (18%) patients had a history of coagulopathy, and 22 (48%) patients had chronic medical diseases such as DM and HTN. Chi-square analysis revealed that the presence of DM (p=0.025) was related to poor prognosis.

Poor pre-operative clinical status (GCS from 6 to 12) was significantly related to the poor clinical outcome (p=0.002), which had been reported by many authors as an important prognostic factor for CSDH.[8,21,25,26] The effects of pre-operative midline shifting, the size of the hematoma, post-operative pneumocephalus, and the degree of brain expansion on the clinical outcome were not statistically significant (Table 2).

Being older than 65, a pre-operative GCS under 12, and the presence of DM were closely related to poor prognosis. However, the odds ratios for DM presence was lower than 1, which could be considered low risk values. The 95% CI for these factors contained 1, and so they were not regarded as independent prognostic factors (Table 3). On the other hand, being older than 65 and pre-operative GCS under 12 carried odd ratios over 1, and the 95% CI indicated that they were independent factors affecting on poor prognosis in patients with CSDH.

Discussion

CSDH is believed to develop after the tearing of a bridging vein after direct or indirect trauma to the brain.[2,4,9) It has many multifactorial prognostic factors such as decreased intracranial pressure, brain atrophy, changes of the skull, and cerebrospinal fluid fistula.[13,17] Some non-traumatic factors such as hematological coagulopathy, a clinical history of alcoholism, arteriovenous malformation, anticoagulant therapy, and bleeding tendency can aggravate the clinical outcomes of the disease.[1,2]

CSDH is known to be prevalent in two age groups-infants and the elderly, especially those over 75 years old, but can occur in any age group.[12] CSDH still occupies a large portion of mortality, despite radiological and surgical improvements. Van Havenbergh et al.[25] reported that the morbidity of CSDH with GCS 12 or 13 reached 16.5%, while mortality rates were as high as 6.5%. Ritcher et al.[19] and Robinson et al.[20] noted that the mortalities of CSDH patients who underwent surgical evacuation were between 1.5% and 8%. These data were very similar to our result of 4%. Old age is known to be an important prognostic factor for CSDH.[8] More tensile force on the bridging vein caused by a decrease of total brain parenchymal volume as the patient ages is thought to be the main reason for a high prevalence of CSDH in the elderly. Frequent trauma in the elderly, especially falls, and prevalent anticoagulant therapy can contribute to the high prevalence of CSDH.[3,5,6,10] Van Havenbergh et al.[25] and Merlicco et al.[15] reported that old age and poor pre-operative conditions could affect a patient's outcome. These reports support our data showing that old age (>65 years) independently affects the clinical outcome.

CSDH is known to show a 2−3 times higher incidence in male patients. This is believed to occur not only because of higher head trauma rates in men but also because of the vasoprotective effects of estrogen in women.[14,22] In this study, the number of male patients was almost twice that of women, but there was no clinical contribution to the clinical outcome.

Patient's neurological conditions on admission are measured by GCS in this study. Rozzelle et al.[21] reported patients with CSDH especially with GCS under 7 had high mortality rates. Weisse et al.[26] also recommended early diagnosis and treatment for CSDH because of poor prognosis of patients with GCS under 8. Our study supported this results that poor clinical condition, especially GCS from 6 to 12, not only have had correlation with poor prognosis but also have shown as independent prognostic factor (Table 2, 3).

The pre-operative neurological condition is an index for brain compression by hematoma, and seems to be correlated conversely with the duration to initial diagnosis. Most of the CSDH patients were elderly, and showed mild neurological changes at the early stage of CSDH. This might be the main reason for delayed diagnosis due to mistaking CSDH with dementia, alcoholism, or other diseases.

Poor re-expansion of brain tissue in patients undergoing burrhole trephination and hematoma evacuation with closed drainage is known to be a poor prognostic factor.[11] However, in our study, the degree of brain re-expansion was not related to the clinical outcome.

Nagata et al.[16] reported that there was no relationship between the amount of air collection in the subdural space after surgery and the prognosis for CSDH. In our study, there was no statistically significant relationship between post-operative pneumocephalus and the clinical outcome.

Patient's old age, pre-operative GCS score, preoperative presence of DM affected the prognosis significantly in this study, and the 95% CI for these factors revealed that age over 65 years and GCS score from 6 to 12 are independent factors affecting poor prognosis in patients with CSDH. This information would be helpful not only to predict the prognosis of the patient, but also to make treatment plans according to these prognostic factors.

Conclusion

Many factors affecting patients' clinical outcomes of CSDH have been analyzed and reported in the literature. However, there have been limited studies about multi-factorial clinical analysis. In this study, the authors recognized important prognostic factors related to the clinical outcome, such as patient age over 65 years, pre-operative neurological condition, and the presence of DM. CSDH is known to be a relatively simple pathological condition with a simple treatment strategy. Nevertheless, its clinical outcome is not so simple, and surgeons may sometimes encounter unpredicted results. In this regard, the prognostic factors would be helpful to estimate the clinical outcomes of CSDH, and to prevent undesirable results.

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