CLINICAL ARTICLE

J Korean Neurosurg Soc 41 : 11-15, 2007

Factors Influencing Recurrent Chronic Subdural Hematoma after Surgery

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Objective : The authors attempted to confirm the risk factors for recurrent chronic subdural hematoma(CSDH) after simple burr-hole drainage.

Methods : A total of 302 patients with CSDH who were treated at our hospital between January 1998 and May 2005 were studied. Various parameters considered for analysis of factors associated with CSDH recurrence; demographic and clinical findings (age, sex, history of seizures, diabetes, vascular diseases), initial and perioperative CT findings (hematoma density, location of catheter tip, post operative intracranial air, intracranial hematoma extension, hematoma width, hematoma site).

Results : Twenty-four patients (7.9%) experienced recurrence, whereas 278 patients (92.1%) did not. Five major risk factors should be considered : 1) layered type by hematoma density, 2) type I, II by location of catheter tip, 3) presence of postoperative intracranial air, 4) cranial base type of intracranial hematoma extension, 5) greater hematoma width.

Conclusion : In this study, we report that the incidence of postoperative CSDH recurrence can be reduced by the examination of the hematoma chracteristics on initial and perioperative CT findings and by preventing subdural air accumulation during operation. In addition, the location of the catheter tip can be used as a helpful factor in reducing the recurrence.

KEY WORDS : Risk factors · Chronic subdural hematoma · Recurrence .

Introduction

Chronic subdural hematoma(CSDH) is one of the most common types of intracranial hemorrhage and often occurs in older patients[2,6,13,19]. Although CSDH is well known as a curable disease, it has been reported to have recurrence rates of 3 to 20% after surgery such as burr-hole drainage[12,19]. To our knowledge, there is insufficient information in the literature to determine the factors influencing its recurrence. We therefore evaluated predictors associated with the recurrence of CSDH in 302 patients who underwent surgery for CSDH in our department.

Materials and Methods

Among the 302 patients with CSDH who were treated at our hospital between January 1998 and May 2005, all 302 consecutive patients were studied. Every patient underwent surgical intervention including the creation of one burr hole and postoperative closed-system drainage with the aid of a silicon catheter and bag. Burr-hole drainage was also conducted in all symptomatic recurrent cases. Every operation was performed under local anesthesia. CSDH recurrence was defined as an increase in the volume of the SDH on the operation side and compression of the brain surface observed on CT scans obtained within three months postoperatively, when compared with findings one day after surgery[13,18]. The head of the patient was placed at the same height as his heart and enough fluid was supplied to develop brain expansion.

After patients' symptoms disappeared, the color of the draining fluid became clear and after the near total removal of CSDH in postoperative brain CT, the drainage catheter was removed. The drainage catheter was usually removed within 48 hours after surgery, if possible, to prevent catheter adhesion to the brain surface and infection. Various parameters considered in the analysis of factors associated with CSDH recurrence were : demographic and clinical findings (age, sex, history of seizures, diabetes, vascular diseases), initial and perioperative

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CT findings (hematoma density, location of catheter tip, postoperative intracranial air, intracranial hematoma extension, hematoma width, hematoma site).

The patient's medical history was obtained from a chart review. A history of seizures, diabetes, vascular diseases were determined and treatment was based on these findings until the diagnosis of CSDH could be obtained. Vascular disease was defined as cerebrovascular or cardiovascular (ex. hypertension) disease. The hematoma density, location of catheter tip, intracranial air, intracranial hematoma extension, hematoma width and hematoma site (unilateral or bilateral) on initial or perioperative CT scans were evaluated independently by observers who were blinded to the patients' medical charts. We performed a univariate analysis to assess the relationship between each parameter and the recurrence of the CSDH by applying the chi-square test and cross stab test.

Results

Twenty four patients (7.9%) experienced recurrence, whereas 278 patients (92.1%) did not. All 24 recurrent patients underwent surgery.

Demographic and clinical findings

Demographic data such as the patient's age and sex were not related to CSDH recurrence. There were 236 men (78.1%) and 66 women (21.9%) in total category with CSDH. The recurrence rate among males (9.3%) and in the elderly (42.9%) was higher than that found in other groups, but there was no statistical significance in this study ($p>0.05$) (Table 1). Clinical findings such as a history of seizure, diabetes, vascular disease were unrelated to a recurrence of CSDH after surgery ($p>0.05$) (Table 2).

Initial and perioperative CT findings

Hematoma density and recurrence

The 302 CSDHs were classified into five types according to their density on CT scan[7,11] (Fig.1) : High (52 cases), Iso (59 cases), Low (124 cases), Mixed (51 cases), and Layered type (16 cases). The incidences of recurrence were 1, 6, 6, 6 and 5 cases, respectively. The recurrence rate in the Layered type (31.3%) was significantly higher than that found in the other types (High : 1.9%, Iso : 3.0%, Low : 4.8%, Mixed : 11.8%) ($p < 0.05$) (Table 3).

Location of catheter tip and recurrence

After a review of the postoperative imagings of CSDH patients, we classified them into four types according to radiological changes in the hematoma area with the location of the catheter tip and calculated the prevalence of recurrence respectively using Kwon et al.[9] (Fig. 2). The recurrence rate of CSDH was lower if the hematoma was totally replaced with CSF (type III) or the brain was re-expanded completely with a drainage catheter (type IV) on postoperative imaging. Among the recurrent groups, type I (17.3%) and type II (16.0%) rates were significantly higher than type III (0.8%) and type IV (4.0%) ($p<0.05$) (Table 4).

Table 1. Age and sex distribution and recurrence

Age and Sex		No. of recurrences (%)		Total
		Yes	No	
Age*	<30	3 (42.9)	4 (57.1)	7 (100)
	30~60	6 (7.0)	80 (93.0)	86 (100)
	>60	15 (7.2)	194 (92.8)	209 (100)
	Total	24 (7.9)	278 (92.1)	302 (100)
Sex†	Male	22 (9.3)	214 (90.7)	236 (100)
	Female	2 (3.0)	64 (97.0)	66 (100)
	Total	24 (7.9)	278 (92.1)	302 (100)

*p=0.98, †p=0.095

Table 2. Clinical findings and recurrence

History		No. of recurrences (%)		Total
		Yes	No	
Seizure*	Yes	2 (6.7)	28 (93.3)	30 (100)
	No	22 (8.1)	250 (91.9)	272 (100)
	Total	24 (7.9)	278 (92.1)	302 (100)
Diabetes†	Yes	2 (7.1)	26 (92.9)	28 (100)
	No	22 (8.0)	252 (92.0)	274 (100)
	Total	24 (7.9)	278 (92.1)	302 (100)
Vascular disease‡	Yes	11 (11.3)	86 (88.7)	97 (100)
	No	13 (6.3)	192 (93.7)	205 (100)
	Total	24 (7.9)	278 (92.1)	302 (100)

*p=0.785, †p=0.869, ‡p=0.134

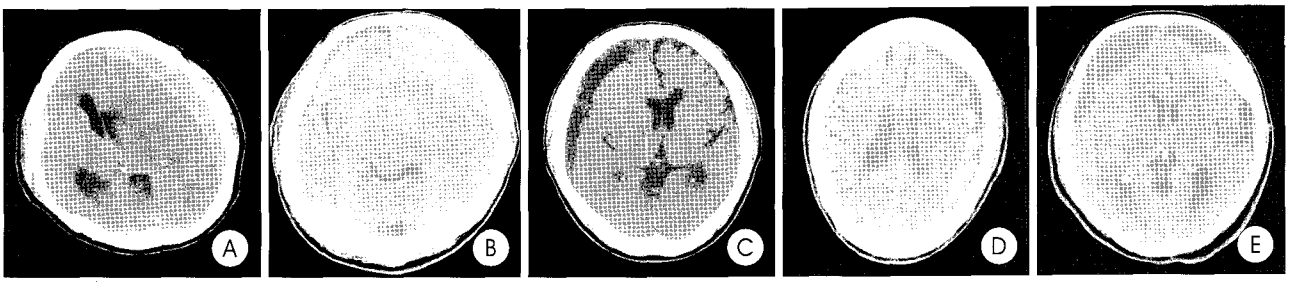

Fig. 1. Chronic subdural hematoma is classified according to its density on brain computed tomography scans. A : High type, B : Iso type, C : Low type, D : Mixed type, E : Layered type.

Table 3. Classification by hematoma density and recurrence*

Type	No. of recurrences (%)		Total
	Yes	No	
High	1 (1.9)	51 (98.1)	52 (100)
Iso	6 (3.0)	53 (97.0)	59 (100)
Low	6 (4.8)	118 (95.2)	124 (100)
Mixed	6 (11.8)	45 (88.2)	51 (100)
Layered	5 (31.3)	11 (68.7)	16 (100)
Total	24 (7.9)	278 (92.1)	302 (100)

*p=0.02

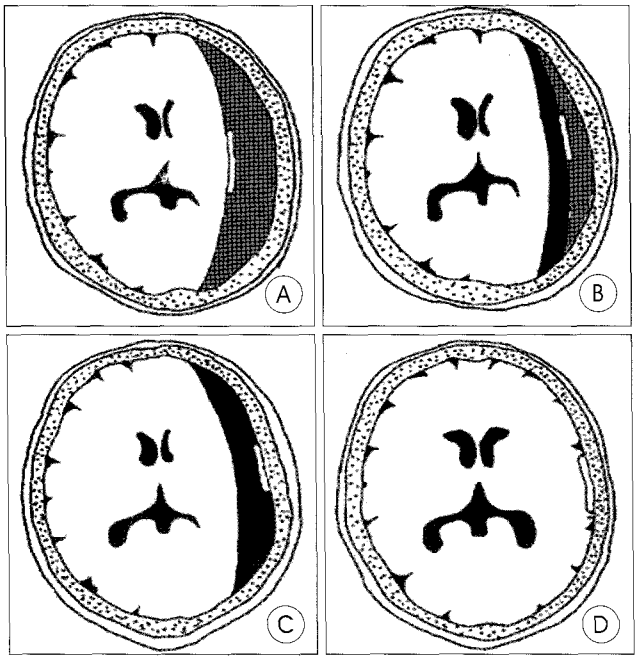

Fig. 2. Four types of postoperative hematoma changes according to brain computed tomography findings. Black and gray area at the catheter site represent cerebrospinal fluid (black area) and the remaining hematoma (gray area) respectively and note the location of catheter tip. A : Type I, B : Type II, C : Type III, D : Type IV. (From Kwon et al[9]).

Table 4. Types by location of catheter tip and recurrence*

Type	No. of recurrences (%)		Total
	Yes	No	
Type I	9 (17.3)	43 (82.7)	52 (100)
Type II	12 (16.0)	63 (84.0)	75 (100)
Type III	1 (0.8)	124 (99.2)	125 (100)
Type IV	2 (4.0)	48 (96.0)	50 (100)
Total	24 (7.9)	278 (92.1)	302 (100)

*p=0.01

Presence of postoperative intra-cranial air and recurrence

Among the recurrent groups, the ratio of the presence of postoperative intracranial air at 7 days on CT scans (28.6%) was higher than absent intracranial air (4.6%) ($p<0.05$) (Table 5).

Types of intracranial hematoma extension and recurrence

The CSDHs were classified into two types according to their intracranial extension : hematomas localized at the convexity without involvement of the cranial base were named Convexity type; hematomas that extended to the cranial base were named Cranial Base type. According to this classification, the cranial base was related to the main trunks of the middle meningeal artery. By examining preoperative or postoperative day one CT scans, the Convexity type accounted for 242 cases while there were 60 Cranial Base types among the 302 cases. The recurrence rate in the Cranial Base type (26.7%) was significantly higher than that found in the Convexity type (3.3%) ($p<0.05$) (Table 6).

Table 5. Postoperative intracranial air and recurrence*

Postop. air	No. of recurrences (%)		Total
	Yes	No	
Yes	12 (28.6)	30 (71.4)	42 (100)
No	12 (4.6)	248 (95.4)	260 (100)
Total	24 (7.9)	278 (92.1)	302 (100)

*p=0.01

Table 6. Types of intracranial hematoma extension and recurrence*

Type	No. of recurrences (%)		Total
	Yes	No	
Cranial Base	16 (26.7)	44 (73.3)	60 (100)
Convexity	8 (3.3)	234 (96.7)	242 (100)
Total	24 (7.9)	278 (92.1)	302 (100)

*p=0.01

Table 7. Hematoma width and recurrence*

Hematoma width	No. of recurrences (%)		Total
	Yes	No	
<1cm	3 (3.5)	82 (96.5)	805 (100)
1~2cm	14 (7.3)	177 (92.7)	191 (100)
>2cm	7 (26.9)	19 (73.1)	26 (100)
Total	24 (7.9)	278 (92.1)	302 (100)

*p=0.04

Table 8. Hematoma site and recurrence*

Hematoma site	No. of recurrences (%)		Total
	Yes	No	
Unilateral	19 (7.1)	248 (92.9)	267 (100)
Bilateral	5 (14.3)	30 (85.7)	35 (100)
Total	24 (7.9)	278 (92.1)	302 (100)

*p=0.140

Hematoma width and recurrence

The width of the hematoma was significantly associated with CSDH recurrence. Among the recurrent groups, the one with a width greater than 2cm (26.9%) was significantly higher than that of 1~2cm (7.3%) and the one below 1cm (3.5%) ($p<0.05$) (Table 7).

Hematoma site and recurrence

In patients with bilateral CSDH, the rate of recurrence (14.3%) was higher than that of patients with unilateral CSDH (7.1%)

(Table 8). However, there was no statistical significance in this study ($p>0.05$).

Discussion

In previous studies, many risk factors for CSDH recurrence have been reported[9,10,12,13,18,19]. Advanced age, bleeding tendency, brain atrophy, alcohol abuse, and bilateral CSDHs have commonly been reported as risk factors for recurrence[4,5,12,18,19]. Risk factors, however, should be changed with advances in medical care and changes in environmental factors (ex. social and economic status, cultural and educational background). In this study, hygroma, infantile CSDH and asymptomatic CSDH were excluded because they were considered to be different entities. We therefore attempted to confirm the risk factors for CSDH recurrence in our hospital series by performing a multivariate analysis with the aid of a logistric regression model. Finally, CSDH recurrence was correlated with the following variables in the present study, especially with the initial and perioperative findings.

Demographic and clinical findings

Age and sex

In this study, old age was not a risk factor for recurrence. It seems that the older the patient, the longer it takes for the brain to be restored. In studies found in the literature, it is possible that prolonged reaccumulations of blood within the hematoma cavity might have been misunderstood as unnecessarily subjective to reoperation[18]. Although men had a higher recurrence rate, no significant difference was seen between the sexes.

Presence of a history of seizures, diabetes, vascular diseases

It is said that seizure disorders and vascular disease are frequently associated with brain atrophy[1,15]. The blood of patients with diabetes has a high osmotic pressure and increased platelet aggregation. This suggests that diabetes may play a role in decreasing the rebleeding tendency of a CSDH[16]. However, in this study, a history of seizures or vascular diseases and absence of diabetes were not predictors of CSDH recurrence and were not statistically significant.

Initial and perioperative CT findings

Hematoma density

CSDH is often classified according to its density on CT scan. However, these clssification systems can be subjective. Nomura, et al.[14] concluded that the Mixed and Layered type tended to rebleed less. In our study, the recurrence rate in the Layered type was significantly higher than that found in other types[8,11,18]. It seems that recurrence predictors based on CT scans are related to CSDH recurrence rates.

Location of catheter tip

The low-density area found on postoperative CT medial to the residual hematoma in CSDH is filled with CSF and can be a helpful factor in reducing recurrence[9]. The catheter tip location can be used as a good index influencing recurrent CSDH after surgery.

Postoperative intracranial air

The presence of postoperative intracranial air on CT scans one day after surgery may play a role in the high recurrence of CSDH. The postoperatively wide subdural space caused by intracranial air 7 days after surgery may cause the rebleeding tendency[3,6]. The timing of the drainage catheter removal after surgery was not associated with CSDH recurrence in our study.

Intracranial hematoma extension

The recurrence rate of the Cranial Base type of CSDH was high and that of the Convexity type was low. Tanaka, et al.[17] reported that CSDH membranes are mainly supplied by the middle meningeal artery(MMA). If CSDHs are mostly fed by the MMA, hematomas with cranial base extension are expected to have a higher rebleeding rate or a higher postoperative recurrence rate than those without cranial base extension because the feeding vessels are disturbed more widely[13]. In addition to the extent of the feeding vessels from the MMA, the more enlarged subdural space and the greater difficulty in hematoma removal encountered with the Cranial Base type, compared to the Convexity type, are considered to be factors influencing the higher recurrence rate.

Hematoma width

The width of a hematoma is usually determined at the level of its maximum thickness. We speculated that a larger hematoma had a greater tendency to recur because the postoperative subdural space was larger than that found after the removal of a small lesion[6].

Hematoma site

In patients with bilateral CSDH, the rate of recurrence was higher than that of unilateral CSDH[10,11]. However, in this study, it was not statistically significant. It is still controversial that a hematoma site is associated with CSDH recurrence.

Conclusion

The results of this study may be helpful in predicting the recurrence of CSDH after simple burr-hole drainage. Five major risk factors should be considered to predict the recurrence: 1) layered type by hematoma density, 2) type I, II by location of catheter tip, 3) presence of postoperative in-

tracranial air, 4) cranial base type of intracranial hematoma extension, 5) greater hematoma width. The incidence of postoperative CSDH recurrence can be reduced by the examination of the hematoma characteristics on initial and perioperative CT findings and by preventing subdural air accumulation during operation. In addition, the location of the catheter tip can be used as a helpful factor in reducing the recurrence. Careful neurosurgical observation is needed for preoperative and postoperative CSDH patients and further investigations into other factors related to the promotion of the recurrence of CSDH should be conducted, too.

• Acknowledgement
This study was financially supported by research fund of Chungnam National University in 2004.

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