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Clinical Article

Independent Predictors for Recurrence of Chronic Subdural Hematoma

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Objective : Chronic subdural hematoma (CSDH) is one of the most frequent problems encountered in neurosurgery. Although burr-hole trephination is widely performed to treat CSDH, the incidence rate of recurrent CSDH is still 2–37%. The goal of this study is to determine the risk factors that affect recurrent CSDH.
Methods : A total of 182 patients were included in this study who underwent burr-hole trephination. The clinical factors and radiographic features between the recurrence and the no recurrence groups were analyzed to find the parameters related to the postoperative recurrence of CSDH.
Results : For the recurrence of CSDH that occurred in 25 patients (13.7%), among various risk factors, pre and postoperative midline displacements, which are more than 10 mm (p=0.000), and preoperative hemiparesis (p=0.026) had contributed to recurrent CSDH with statistical significance by univariate analysis. Unilateral CSDH were more frequently related to recurrent CSDH (16.3%), although it was not a statistical significant result (p=0.052). Furthermore, preoperative midline displacement only had statistical meaning for the recurrence of CSDH by multivariate analysis.
Conclusion : This study indicates that the midline displacement on the preoperative computed tomography scan is the only independent predictor for the recurrence of CSDH.

Key Words : Chronic subdural hematoma · Hemiparesis · Midline displacement · Recurrence.

INTRODUCTION

Chronic subdural hematoma (CSDH) is one of the most commonly encountered entities in neurosurgery practice. The incidence rate of CSDH has been reported to be as high as 13.1 cases per 100000 inhabitants[24]. It is common in the elderly, with the highest incidence rate in people older than 70 years[17,18,23].

Surgical management is the preferred treatment for CSDH, which includes twist-drill drainage, burr-hole trephination, craniotomy with capsulectomy, and subduro-peritoneal shunt. Among them, burr-hole trephination is widely performed because of its less invasiveness and relative simplicity[15]. However, the incidence rate of recurrent CSDH is reported to range from 2 to 37%[4,7,11,12,14,16,21,22,24]. Furthermore, the crucial risk factors are still debatable despite the various elements that may be associated with the recurrence of CSDH. Thus, the goal of this study is to determine the predictors for recurrence of CSDH after burr-hole trephination.

MATERIALS AND METHODS

Patients' population

The authors retrospectively reviewed the medical records as well as the pre and postoperative computed tomography (CT) scans of the 182 patients who underwent burr-hole trephination from January 2008 to December 2012. There were 131 male (71.9%) and 51 (28.1%) female in this study, ranging in age from 24 to 94 years old (median age : 68.12 years old). The patients were divided into two groups according to the recurrence of CSDH. The clinical and radiological factors were compared between the recurrence group and the no recurrence group. In this study, 35 patients with bilateral CSDH were excluded in analyzing the CT density, the width of hematoma, the degree of air collection, the number of burr hole, and the drainage tube.

Clinical and radiological evaluations

The recurrence of CSDH was defined as a subsequent increase in hematoma volume in the subdural space for which reopera-

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tion was required because of newly developed symptoms[21].

Hematoma type was classified into four types according to their density on CT scan : homogeneous, laminar, separate, and trabecular type[14]. Brain atrophy was divided into three stages : none or mild atrophy, definite atrophy, such as dilated sulci, and severe atrophy, such as widely dilated sulci and subdural space[10,17]. Air collection was categorized into two groups according to the subdural air found on immediate postoperative CT scan : none or mild, such as residual air bubble, and definite, such as total replacement with air[17]. The midline displacement of the septum pellucidum and pineal body were measured at the level of foramen of Monro on the CT scans taken before and after surgery. The cut-off values for the midline displacement were defined based on previous reports[10,16,19]. Follow-up was for at least 1 year.

Surgical procedure and management

All patients underwent one or two burr-hole trephination with closed-system drainage under general anesthesia. After dural incision, the outer hematoma membrane was opened, and irrigation was performed with lactated Ringer solution. A silicon tube was inserted into the cavity of the hematoma and connected to a closed drainage system. All patients were kept in the supine position and enough fluid was supplied to promote brain expansion. The closed-system drainage tube was usually removed after 2–3 days, when the drainage became negligible.

Statistical analysis

A univariate analysis was performed with Pearson's chi-square test and Student t-test to assess the relationship between each factor and the recurrence of CSDH. A multivariate analysis was performed using a logistic regression model. The relationship between the variables and the recurrence of CSDH are presented based on the 95% confidence interval and the odd ratio (OR). The statistical significance was set at $p<0.05$.

RESULTS

Patients' characteristics are summarized in Table 1. Reoperation was performed in 25 patients (13.7%) because of the symptomatic recurrence of CSDH. The demographic data and history of head trauma were not significantly associated with recurrence of CSDH. Underlying medical diseases, antithrombotic usage, and smoking or alcohol consumption were also not related to the recurrence of CSDH.

Table 1. Characteristics in 182 patients with chronic subdural hematomas

	NRG (n=157)	RG (n=25)	Total (n=182)	*p* value
Sex				0.473
Male	111 (70.7)	20 (80)	131 (72)	
Female	46 (29.3)	5 (20)	51 (28)	
Age (years)				0.568
<65	51 (32.5)	9 (36)	60 (33)	
≥65	106 (67.5)	16 (64)	122 (67)	
Mean age	68±12	68±12		0.804
Head trauma				
Presence	106 (67.5)	19 (76)	125 (68.7)	0.396
Trauma to surgery (days)	53.6±5.7	59.8±14.4		0.693
Comorbidity				
Hypertension	65 (41.4)	9 (36)	74 (40.7)	0.610
Diabetes mellitus	22 (14)	2 (8)	24 (13.2)	0.538
Liver cirrhosis	3 (1.9)	1 (4)	4 (2.2)	0.449
Chronic renal failure	6 (3.8)	0 (0)	6 (3.3)	1.000
Seizure	1 (6)	0 (0)	1 (0.5)	1.000
Atrial fibrillation	5 (3.2)	3 (12)	8 (4.4)	0.081
Cancer	15 (9.6)	2 (8)	17 (9.3)	1.000
Ischemic heart disease	10 (6.4)	1 (4)	11 (6)	1.000
Cerebral infarction	21 (13.4)	1 (4)	22 (12.1)	0.319
Cerebral hemorrhage	3 (1.9)	1 (4)	4 (2.2)	0.449
Medication				
Antiplatelet	31 (19.7)	5 (20)	36 (19.8)	1.000
Anticoagulants	8 (5.1)	2 (8)	10 (5.5)	0.630
Alcohol	58 (36.9)	7 (28)	65 (35.7)	0.386
Smoking	28 (17.8)	8 (32)	36 (19.8)	0.099

NRG : no recurrence group, RG : recurrence group

Clinical manifestations between the recurrence and the no recurrence group are shown in Table 2. The incidence of recurrence in patients with hemiparesis (18.8%) was higher than that in those without hemiparesis (7.4%) with statistical significance (p=0.026). However, any other clinical factors were not related to the recurrence of CSDH.

Comparison of radiological factors between the two groups is demonstrated in Table 3. In patients with unilateral CSDH, the incidence of recurrence (16.3%) was higher than that in patients with bilateral CSDH (2.9%). Although it did not get the statistical significance (p=0.052), unilateral CSDH tended to be associated with recurrence of CSDH. In patient with midline displacement of more than 10 mm before surgery, the incidence of recurrence rate (27.3%) was higher than that in patients with midline displacement of less than 10 mm (6.0%). The relationship between the preoperative midline displacement and the recurrence of CSDH was statistically significant (p=0.000). Immediate postoperative midline displacement of more than 10 mm was also associated with the recurrence of CSDH (31.3% vs. 7.7%; p=0.000). Other radiological parameters did not have statistical meaning to affect recurrent CSDH.

In summary, univariate analysis clarified that hemiparesis (p=0.026), pre (p=0.000) and postoperative (p=0.000) midline displacement of more than 10 mm were risk factors for recurrence of CSDH. The preoperative midline displacement of more than 10 mm (OR, 5.7; 95%; p=0.000) was the only independent risk factor for the recurrence of CSDH by multivariate logistic regression analysis (Table 4).

DISCUSSION

CSDH is defined as a watery or xanthochromic fluid collection under dura mater. The mechanism of CSDH is a pathophysiologic process that begins as a local inflammatory reaction of the dura mater to injury or external stimuli, such as blood or CSF. This process causes the neovascularization of the outer membrane of CSDH and vascular hyperperrmeability. Exudation through the microcapillaries in the outer membrane of CSDH plays an important role in the enlargement of CSDHs[1].

The reported recurrence rates of CSDH range from 2 to 37%, and this study showed a recurrence rate of 13.7%. In the previous study, a few factors for the recurrence of CSDH have been reported, such as advanced age, bleeding tendency, brain atrophy, alcohol abuse, as well as bilateral CSDH, hematoma density, diabetes mellitus, arachnoid cyst, postoperative posture, postoperative subdural air accumulation, inflammatory cytokines, and some technical aspects of surgery[3,5,13,23]. However, the crucial risk factors are debatable until now. In this study, the recurrence of CSDH was correlated with the following variables : 1) midline displacement of more than 10 mm and 2) clinical presentation of hemiparesis.

Midline displacement

The authors found that the pre and postoperative midline displacement of more than 10 mm were the predictors for the recurrence of CSDH. In the series reported, the recurrence rate was significantly higher when the postoperative midline displacement was more than 5 mm compared to less displacement[2,19]. In patients with CSDH, it is reasonable to evaluate the pre and postoperative midline displacement because it shows that hemorrhage has filled up the potential space in the cranium and has exerted compression on the brain tissue. Fukuhara and coworkers showed that advanced age, brain atrophy, large amount of hematoma, and prolonged compressed parenchyma influenced brain elasticity[2,6]. Brain with high elastance tends to reexpand poorly, and poor reexpansion of the brain may lead to the persistence of postoperative midline displacement[2,6]. A prolonged postoperative midline displacement may cause impaired adhesion between the inner and outer neomembranes, thus facilitating postoperative recurrence[2,15].

Hemiparesis

CSDH is asymptomatic in a large number of patients, but it may also cause high intracranial pressure that results in coma. Among these extreme states, nearly every constellation of speech, sensorimotor, neuropsychiatric, or mood disturbances may oc-

Table 2. Relationship between clinical presentation and recurrence of chronic subdural hematoma

	NRG (n=157)	RG (n=25)	Total (n=182)	p value
GCS				0.696
≥13	143 (91.1)	23 (92)	166 (91.2)	
9–12	10 (6.4)	2 (8)	12 (6.6)	
≤8	4 (2.5)	0 (0)	4 (2.2)	
Headache	87 (55.4)	14 (56)	101 (55.5)	0.956
Hemiparesis	82 (52.2)	19 (76)	101 (55.5)	0.026
Speech disturbance	26 (16.6)	5 (20)	31 (17)	0.671
Dementia	17 (10.8)	0 (0)	17 (9.3)	0.135
Urinary incontinence	2 (1.3)	1 (4)	3 (1.6)	0.360
Anisocoria	5 (3.2)	1 (4)	6 (3.3)	0.593
Dizziness	12 (7.6)	3 (12)	15 (8.2)	0.438

NRG : no recurrence group, RG : recurrence group, GCS : Glasgow Coma Scale

Table 3. Summary of perioperative CT findings in recurrence group and no recurrence group

	NRG (n=157)	RG (n=25)	Total (n=182)	*p* value
Laterality				0.052
Unilateral	123 (78.3)	24 (96)	147 (80.8)	
Bilateral	34 (21.7)	1 (4)	35 (19.2)	
Brain atrophy				0.523
None or mild	35 (22.3)	5 (20)	40 (22)	
Definite	76 (48.4)	15 (60)	91 (50)	
Severe	46 (29.3)	5 (20)	51 (28)	
Midline displacement				
Preoperative				0.000
<10 mm	109 (69.4)	7 (28)	116 (63.7)	
≥10 mm	48 (30.6)	18 (72)	66 (36.3)	
Postoperative				0.000
<10 mm	119 (75.8)	10 (40)	129 (70.9)	
≥10 mm	38 (24.2)	15 (60)	53 (29.1)	
Hematoma subtype				0.435
Homogeneous	57 (46.3)	15 (62.5)	72 (49)	
Laminar	15 (12.2)	3 (12.5)	18 (12.2)	
Separated	19 (15.4)	3 (12.5)	22 (15)	
Trabecular	32 (26)	3 (12.5)	35 (23.8)	
Width of hematoma (mm)	21.54 ± 0.67	21.42 ± 1.13		0.928
Degree of air collection				0.633
None or mild	58 (36.9)	8 (32)	66 (36.3)	
Definite	99 (63.1)	17 (68)	116 (63.7)	
Number of burr hole				0.691
One	41 (33.3)	7 (29.2)	48 (32.7)	
Two	82 (66.7)	17 (70.8)	99 (67.3)	
Location of drainage tube				0.658
None	5 (4.1)	1 (4.2)	6 (4.1)	
Frontal	40 (32.5)	5 (20.8)	45 (30.6)	
Occipital	22 (17.9)	4 (16.7)	26 (17.7)	
Parietal	56 (45.5)	14 (58.3)	70 (47.6)	

NRG : no recurrence group, RG : recurrence group

Table 4. Results of univariate and multivariate analysis of variables related to the recurrence of chronic subdural hematoma

	OR (95% CI)	*p* value
Univariate analysis		
Hemiparesis	2.896 (1.098–7.639)	0.026
Laterality	0.151 (0.020–1.155)	0.052
Preoperative midline displacement	5.839 (2.288–14.900)	0.000
Postoperative midline displacement	4.697 (1.949–11.320)	0.000
Multivariate analysis		
Preoperative midline displacement	5.707 (2.156–15.101)	0.000

OR : odds ratio, CI : confidence interval

cur[24]. In the present study, hemiparesis and headache are the most common preoperative symptoms in CSDH, and the incidence of recurrent CSDH in patients with hemiparesis is higher than that in those without hemiparesis. The cause of hemiparesis in CSDH was reported to be the reduced local cerebral blood flow in the rolandic cortex or in deep structures, including the thalamus[8,20]. When the hematoma thickness increased beyond spatial compensation, both the superficial and deep brain structures shifted and deformed, and hemiparesis occurred in relation to the degree of midline displacement[9]. In other words, based on the aggravation of the midline displacement, hemiparesis occurred.

Laterality

In previous studies, hematoma laterality was not associated with the recurrence of CSDH[5,23]. Inconsistent with previous studies, our study show that the incidence of recurrence in patients with unilateral CSDH (16.3%) was higher than that in patients with bilateral CSDH (2.9%). Although it did not get the statistical significance (p=0.052) because of the lack of the number of cases, unilateral CSDH tended to be associated with recurrence of CSDH. As such, further study is necessary to clarify the association between the laterality of hematoma and the recurrence of CSDH.

CONCLUSION

The present study suggested that patients who show hemiparesis or pre and postoperative midline displacement of more than 10 mm could go through recurrent CSDH and shall undergo further surgical management. Therefore, the clinical and radiological surveillance is essential for the patients who have moderate midline displacement or motor weakness.

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