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Clinical Article

Analysis of Management According to CT Findings in Chronic Subdural Hematoma

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Objective : The brain computed tomography(CT) is an important tool throughout the clinical course of chronic subdural hematoma(CSDH). In CT findings, the density of CSDH is different in each case. We analyze management options and results according to the density of CSDH.

Methods : Seventy one patients with CSDH, who had been managed in our institute from August 2001 to December 2003, were reviewed retrospectively. The authors divided the patients into six groups according to the density of hematoma; Group A-hypodense rather than the brain parenchyma, group B-isodense, group C-hyperdense, group D-mixed with hypodense and hyperdense, group E-mixed with isodense and hypodense and group F-mixed with isodense and hypersdense. In each group, the operation method, the duration of the indwelling catheter and prognosis were analyzed.

Results : The patients who showed mixed density were 39 and, those who showed single density were 32. All the patients underwent burr hole drainage for the primary choice. There was only two cases that needed additional craniotomy. The average duration of indwelling catheter was 5.40±1.91days. Statistically the duration was not different in each group(p-value<0.05, x^2 test). Three cases recurred, one in group C, another in group D, and the last in group E. It had no statistical significance due to low incidence of recurrence.

Conclusion : We conclude that burr hole drainage is an acceptable primary treatment option for CSDH even though the density of hematoma is different in every single case.

KEY WORDS : Chronic subdural hematoma(CSDH) · Management · Computed tomography(CT).

Introduction

When old blood that is located over the surface of the brain in the subdural space is accumulated over three weeks, it is called chronic subdural hematoma(CSDH). The cause is mostly due to trauma and it occurs mainly in tearing of bridging veins between dura mater and cerebral cortex.

The brain computed tomography(CT) plays an important role ranging from the diagnosis of CSDH to its treatment and follow-up. It has been reported that CSDH traditionally has a membrane of contrast enhancement and hematoma has been observed as a low density[6,13]. However, it has been reported that genuinely traditional findings are shown partly in brain CT and it is mainly shown as isodense[8]. Lipper and Kishore reported that the density of SDH changes surely as time goes, but what hematoma is classified only by the findings of CT leads to fault of diagnosis[8]. Also while Hiroshi Nakaguchi et al. represented on the relationship of the phase of brain CT, recurrence rate and re-operation, they reported that much more recurrence and re-operation occurred in the patients who showed hyperdense intensity in brain CT[11]. The treatment of CSDH has many debates with surgical operative method and its indication etc.[1,3,7]. However, it is clear that the phase of initial brain CT and neurologic condition are the most important factors in the treatment of CSDH[6]. In domestic cases, the relationship of age, brain expansion, recurrence and CT findings etc. has been reported [2,5,9,16], but it is rare to find a report on the difference of management options and results according to density of hematoma. Thus, the authors have classified patients according to density and pattern of hematoma. Based on the results, we investigated whether the management of CSDH should be altered or not according to the density and pattern of hematoma.

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Materials and Methods

Seventy one patients with CSDH, who had been managed in our institute from August 2001 to December 2003,

Table 1. Age and Sex distribution of the patients with CSDH(n=71)

	Age distribution			Sex distribution		
	≧65	<65	Total	Male	Female	Total
A	4	6	10	9	1	10
B	11	6	17	12	5	17
C	2	3	5	4	1	5
D	10	8	18	16	2	18
E	8	4	12	7	5	12
F	4	5	9	9	0	9

*CSDH = chronic subdural hematoma. A : hypodense rather than the brain parenchyma in brain computed tomography(CT), B : isodense, C : hyperdense, D : mixed with hypodense and hyperdense, E : mixed with isodense and hypodense, F : mixed with isodense and hyperdense

Table 2. The patients who memorized their head trauma

	Number of the patients	Percentage(%)
A	7	70
B	12	70.6
C	5	100
D	14	77.8
E	8	66
F	7	77.8

A : hypodense rather than the brain parenchyma in brain computed tomography(CT), B : isodense, C : hyperdense, D : mixed with hypodense and hyperdense, E : mixed with isodense and hypodense, F : mixed with isodense and hyperdense

were reviewed. The medical record and radiological findings were reviewed retrospectively. The male to female ratio was 57:14. And 38 patients are above 65 years and 33 below 65 years. Age ranged from 33 to 86 and its average age was 63.6 (Table 1). Bilateral CSDH patients were 12. All of 71 persons were treated with burr hole trephination and the closed drainage. And the total number of surgical operations was 83. Among them, 2 persons who could not recover completely through burr hole underwent craniotomy additionally. The position of burr hole was decided in accordance with the spot where hematoma occurred and silicon 4L Extraventricular Drainage(EVD) catheter placed on the subdural space. In the initial diagnosis, the brain CT was performed, and it counted average 3.6 times until drainage catheter was removed. The findings of the last brain CT taken before the removal of the drainage catheter were investigated to record the density of hematoma, maximum thickness and degree of midline shift. The symptom of patients, color of drainage, findings of the brain CT which was followed up before the removal of the drainage catheter were considered to judge the time for the removal of drainage catheter. After the symptom of patients disappeared, the color of drainage became clear and all CSDH in brain CT was drained out, drainage catheter was removed.

Liver function and bleeding tendency were investigated to find out the causes of hematoma except for initial trauma. The liver function was estimated by the examination of SGOT/SGPT/total bilirubin, protein and albumin in initial serum of the patients. For the bleeding tendecy, PT/PTT examined in initial serum were investigated.

Based on density and pattern of hematoma in the first diagnosis, patients were divided into six groups. A group included patients who have hypodense rather than the brain parechyma in brain CT. B group is isodense, C group is hyperdense, D group included patients who have mixed density with hypodense and hyperdense, E group included patients who have mixed density with hypodense and isodense, and lastly F group included patients who have mixed density with hyperdense and isodense[14]. In each group, the distribution of gender and age, the existence and date of initial trauma, the duration of maintenance and removal time, liver function, bleeding tendency, prognosis, recurrence, and the findings of brain computed tomography, which were taken before the removal of drainage catheter, were investigated.

Results

Causes and diagnosis of CSDH

53 out of 71 patients memorized their initial head trauma and its distribution in each group can be demonstrated in Table 2. The rest of them did not have any signs of initial trauma or could not memorize anything. It took 3 weeks to 3 months (42.9days on the average) for the patients with the history of initial trauma to make an initial diagnosis. The patients were diagnosed average 11.7days after having their symptom (Fig. 1). The diagnosis is delayed in Group C and E

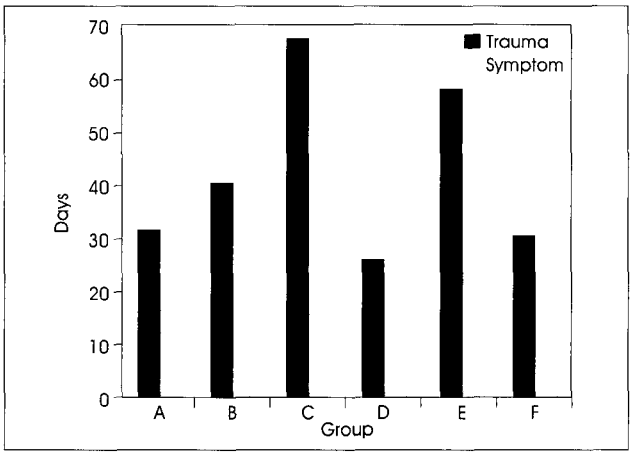

Fig. 1. The time of diagnosis after initial trauma and the duration of the symptom. A : hypodense rather than the brain parenchyma in brain computed tomography(CT), B : isodense, C : hyperdense, D : mixed with hypodense and hyperdense, E : mixed with isodense and hypodense, F : mixed with isodense and hyperdense.

Table 3. Brain computed tomography findings which was scanned before the removal of draining catheter (n=82)

	Midline shift>5mm	Maximal depth of SDH>10mm
A	2(20%)	2(20%)
B	4(23.5%)	4(23.5%)
C	1(20%)	1(20%)
D	4(22.2%)	3(16.7%)
E	3(33.3%)	4(33.3%)
F	2(22.2%)	1(11.1%)
total	16(19.3%)	15(18.1%)

A : hypodense rather than the brain parenchyma in brain computed tomography(CT), B : isodense, C : hyperdense, D : mixed with hypodense and hyperdense, E : mixed with isodense and hypodense, F : mixed with isodense and hyperdense

compared with others, it is statistically meaningful(p-value<0.05, x^2 test).

Only one patient showed SGOT/SGPT were 41/93, and the rest were within normal limits. All of 71 patients showed normal levels in their initial PT/PTT, so we think that there were no patients with bleeding tendency.

The duration of indwelling catheter and appropriate removal time

All of 71 patients were treated with burr hole trephination, and their closed drainage was maintained using silicone 4L EVD catheter. The duration of indwelling catheter was 2 to 14 days after operation, and its average time was 5.40 ± 1.91 days (Fig. 2). The removal time in each group did not show the difference statistically (p-value<0.05, x^2 test).

70 patients showed isodense with CSF in brain CT taken before the removal of drainage catheter. Only one patient showed hyperdense. The midline shift on brain CT was less than 5mm and its maximal thickness was also less than 10mm in over 80% of total patients (Table 3). The changes of midline shift and maximal thickness did not show statistical difference in each group(p-value<0.05, x^2 test).

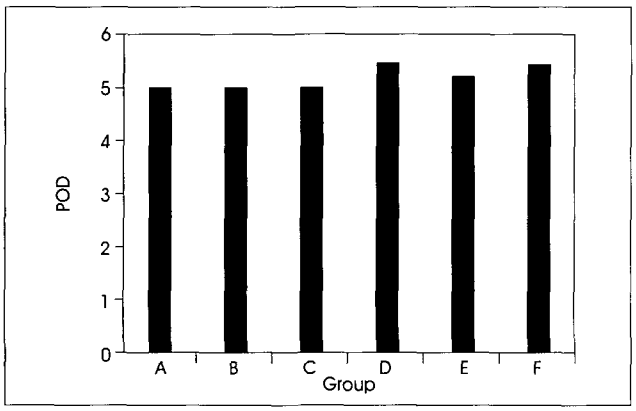

Fig. 2. The removal of the draining catheter. A : hypodense rather than the brain parenchyma in brain computed tomography(CT), B : isodense, C : hyperdense, D : mixed with hypodense and hyperdense, E : mixed with isodense and hypodense, F : mixed with isodense and hyperdense.

Prognosis and recurrence

Seventy patients have been recovered in their normal condition while one patient died of sepsis due to exacerbation of pneumonia.

Three patients recurred in this study. One out of three belonged to group D and recurred within a month. He had midline shift with less than 5mm and the maximal thickness of less than 5mm in last follow-up brain CT before removal of drainage catheter. When recurred, he complained headache but showed no neurological focal signs. His hematoma was low density. We followed up his CSDH on each month and it disappeared naturally after 2months.

Two remaining patients belonged to group C and E respectively. They had hematoma with the maximal thickness of 12 and 21.5mm in each before removal of the catheter. They preserved the drainage catheter with the maximum of 14days, but they were the cases, in which no satisfactory results could be obtained through brain CT even when drainage catheter was removed. When recurred, all of them complained hemiparesis. They underwent burr hole trephination again.

There were 15 patients who had hematoma with the maximal thickness of more than 10mm, and two among them recurred. It was difficult to acknowledge its statistical significance due to small frequency of recurrence.

Discussion

Approximately 80% of its causes lie in light head trauma, but CSDH may develop even without head trauma [5,6,16]. It has been reported that its incidence rate reaches 1 to 2 out of 100,000 persons annually[13,18]. It has been noticed that especially those aged 65 and above had CSDH from 10% of head trauma[1]. Speaking of a gender difference in its distribution, men are more than women in number presumably because the former drink more and are involved with more activities than the latter so that the chance of the former's having head trauma is likely to be high. According to the references, there are approximately 59% of the patients memorizing that they had initial head trauma and it takes 49 days on the average to take an initial brain CT scan[11]. In this study, it has been demonstrated 74.6% and 42.9days respectively. These are more than those shown in the refe-rences. Several literatures have been reported on pathogenesis. Markwalder[10] claimed in 1981 that to have the expansion of CSDH should

be a phenomenon due to the formation of membrane and the repetition of trivial hemorrhage. Ernestus et al.[3] reported in 1997 that the blood in the subdural space made inflammatory response with disposed fibrin. In 1998, Lee et al.[8] explained that CSDH became bigger and bigger because there were more repetitive trivial hemorrhages in the membrane of hematoma than its absorption on its own.

CSDH is mostly common in the elderly and there are many cases when no significant symptoms and conditions are prominent in its early stage[5]. The older people are, the more serious their brain atrophy is; therefore, there are many occasions when hematoma progresses for a fairly good amount of time after its occurrence without the effect of elevated intracranial pressure[1]. Aung et al. reported that the patients aged 50 and above had the volume of their brain weighing 200g less than the ordinary person and the space other than their brain expanded 11%; in the meantime, the venous channel was under pressure due to the gradual increase in hematoma so that the brain was adjusted enough to create the space for the expansion of hematoma[1].

Headache occurs most commonly, and vomiting, emesis, weakness, unconsciousness, seizure, aphasia and so forth could take place; however, it is varied slightly in accordance with age. As a whole, young people are likely to experience at first the symptoms of elevated intracranial pressure such as a headache and papilledema. In the elderly, the malfunction of cognition is likely to take place. It is also likely to have localized neurological symptoms such as the change of consciousness along with confusion or loss of memory and weakness[6]. Jeong et al.[5] have reported that it was likely for those aged 50 and above to have the neurological defects such as the change of consciousness or hemiplegia and for those aged less than 50 to have the symptoms of elevated intracranial pressure such as a headache, vomiting and emesis.

Enhanced membrane and hypodense hematoma can be typically observed on brain CT of CSDH[6,13]. In 3 weeks hematoma can be observed as hypodense intensity in about 75% of patients and as isodense intensity in the rest. The blood-fluid level is distinguishable in 5%, and the calcification can be observed in 1~2%[13]. However, in practice, the hematoma can be seen in variety density and pattern at the time of being diagnosed. Only 14% can be seen in pure hypodense intensity also in this study. By analyzing the findings of brain CT from 466 patients with SDH, Lee et al.[8] have reported that 64% of SDHs in hypodense intensity is subacute and 73.2% of isodense intensity is CSDH.

CSDH may appear to be mixed density on brain CT, and it should be explained as a phenomenon due to the rebleeding[17]. And it has been thought that the possible observation of blood-fluid level was due to a phenomenon of the sedimentation of blood components. It has been reported that it was highly likely to be recent bleeding in hematoma if the hematoma was seen in hyperdense intensity[7]. It can be assumed that there was repetitive hemorrhage in a simultaneous or intermittent manner when the hematoma is consist of several chambers. In this case, all the chambers should be drained to have a complete recovery when the operative treatment is practiced. When the isodense hematoma is visible on brain CT, and the findings can be helpful to diagnosis, such as the medial shift of the boundary between gray matter and white matter, the compression of lateral ventricle or non-visualization, the dislocation of the midline and the effacement of sulci[17].

The most widely used treatment method is burr hole trephination and the closed drainage. Besides, craniotomy, capsulectomy and craniectomy could be practiced[9]. The burr hole trephination is simple and effective method. However, it has been reported that there were 2.7% to 30% of re-operation rate according to the references[1,11]. In this study, the cases of recurrence were three cases(3.6%) out of 83 operations and those of re-operation were 2cases(2.4%). Nakaguchi et al.[12] have claimed that the postoperative recurrence rate has been closely related to the area of the subdural space on brain CT scan taken 7days after operation, while they have also reported that recurrence rate was 12% in cases of their thickness of less than 10mm and 45% in cases of those of more than 10mm. In this study, two recurred cases showed the maximal thickness of more than 10mm on last follow up brain CT before the removal of the catheter.

In addition, it has been reported that its infection rate has reached 2.1% out of the whole[1]. In rare cases, it might have postoperative cerebral infarct, seizure and tension pneumocephalus[1,17]. Craniotomy and capsulectomy could be practiced in case of recurred CSDH or non-liquefaction of hematoma. However, there are subsequent burdens such as the damage of cerebral cortex and the increase on the frequency of seizure due to the adhesion between cerebral cortex and hematoma and long operation time. The authors practiced craniotomy and capsulectomy for two patients who had undergone burr hole trephination and the closed drainage but had failed. When the surgery is not preferred, the conservative treatment such as steroid can be practiced. Steroid suppresses inflammatory response and formation of membrane so that the absorption of hematoma increases and the recurrence decrease[5]. Rodziewicz et al.[15] suggested in 1995 that organized hematoma could be removed via endoscope.

There was a case also in this study that CSDH had recurred

and it was absorbed naturally. The hematoma may disappear naturally when it is a small lesion in frontal area, that does not cause the elevation of intracranial pressure or neurological symptoms[4]. Besides, when the line of hypodense intensity between cerebral cortex and hematoma is visible, which means that cerebrospinal fluid stays under the internal membrane and the pressure is not severe so that the hematoma is highly like to disappear naturally[4]. It has been reported the hematoma mostly absorbed naturally when midline shift on brain CT scan is less than 5mm[4]. Therefore, one can consider an observation without the operative treatment in case that there are no neurological symptoms even if CSDH is discovered or recurred; in case that it is a small lesion in the frontal area; and in case that the effect of intracranial pressure is low.

Conclusion

Brain CT is an useful tool in diagnosis and management of CSDH. In brain CT, high density of CSDH is thought as the result from repetitive bleeding. But in our analysis, burr hole trephination and the closed drainage can be primary choice in management of CSDH although the density of CSDH is different in each case. The duration of indwelling catheter was not different either even though the density of CSDH was different. Furthermore, we recommend that the cases of CSDH with even multiple chambers can be also treated with multiple burr holes.

In addition, the authors suggest that it is necessary to investigate further more about recurrence rate according to the density of hematoma.

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