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A comparative study of chronic subdural hematoma in three age ranges: Below 40 years, 41–79 years, and 80 years and older

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ABSTRACT

Objective: To investigate clinical characteristics and outcomes of chronic subdural hematomas (CSDHs) in different age ranges.

Patients and methods: A retrospective collection of data from CSDH patients ≤40 years, 41–79 years, and ≥80 years of age between August 2011 and May 2017 was performed. The differences and similarities of clinical data and outcomes among three groups were analyzed.

Results: A total of 1118 CSDH patients were included. We found that 64.5% patients had arachnoid cyst/ventriculoperitoneal shunt in patients ≤40 years, 4.3% in the 41–79 years group, and 3.2% in the ≥80 years group ($P < 0.001$). Headache was the most frequent symptom in the ≤40 years group (88.2%) and the 41–79 years group (60.9%), while the most frequent symptom in the ≥ 80 years group was limb weakness (80.4%). The history of head trauma was not significantly different between the three groups. After burr hole drainage craniostomy, the disappearance or alleviation of symptoms, duration of catheter drainage, and length of hospital stay were not significantly different, while the recurrence rate was also not significantly different between the three groups. Post-operation complications are an independent risk factor contributing to the death of patients of 41–79 years ($P < 0.001$, B = 3.140, Exp (B) = 23.103, 95% CI = 5.142–103.809) and of ≥ 80 years ($P = 0.001$, B = 2.831, Exp (B) = 16.970, 95% CI = 3.365–85.567). The history of antithrombotic drug was an independent risk factor of complications in patients of 41–79 years ($P = 0.042$, B = 1.341, Exp (B) = 3.823, 95% CI = 1.048–13.942) and patients of ≥ 80 years ($P = 0.026$, B = 1.399, Exp (B) = 4.052, 95% CI = 1.178–13.933), while complications were also an independent risk factor contributing to the outcome in patients of 41–79 years ($P < 0.001$, B = 2.254, Exp (B) = 0.314, 95% CI = 0.089–1.103) and patients of ≥ 80 years ($P = 0.006$, B = 2.074, Exp (B) = 7.953, 95% CI = 1.791–35.313). In the ≤40 years group, all patients had a good outcome (MRS score 0–3), while 98.2% (851/867) of the cases in the 41–79 years group and 94.3% (149/158) of the cases in the ≥ 80 years group saw a good outcome ($P = 0.001$).

Conclusions: Our results clearly display the common and different clinical data of CSDH in all age ranges, which is crucial to improve the management and treatment of patients with CSDH.

1. Introduction

Chronic subdural hematoma (CSDH) is a relatively frequent disease among the elderly. The incidence of CSDH is 3.4/100,000 people annually in patients younger than 65 years, 58.1/100,000 for those aged 65 years and older, and 127.1/100,000 in the age group over 80 years [1–4]. Therefore, age is an important non-neurological factor that affects patients with CSDH. Schoedel Petra et al. found that older patients experienced a significantly higher reoperation rate and a significantly longer hospital stay [5]. MunozBendix Christopher et al. have also discovered that elderly patients > 85 years suffered from a significantly higher complication rate compared to patients < 85 years [6]. However, J. Bartek et al. found that there was no significant difference in recurrence rates, resulting in reoperation between the ≥ 90

Abbreviations: CSDH, chronic subdural hematoma; AC, arachnoid cyst; V-P shunt, Ventriculoperitoneal shunt; MRS, modified Rankin Scale

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years and < 90 years groups, and there was also no significant difference in the overall complication rate or the rate of severe complications between the age groups [7]. Therefore, the question whether age alone is a contraindication for surgery in patients with CSDH is still controversial. We aim to investigate the clinical profile of patients with CSDH in different age ranges, because few studies have focused on this topic.

To compare the clinical characteristics, recurrence, and outcome of patients with CSDH in all age ranges, we reviewed 1118 CSDH patients. Our study provides clinical evidence for the effective management of patients with CSDH.

2. Material and methods

2.1. Patients

Data on 1118 surgical patients with CSDH at the Department of Neurosurgery in our hospital from August 2011 to May 2017 were collected. Patients were treated with burr-hole craniotomy and a drainage system. Age, gender, personal history, clinical history, symptoms, CT scan, duration of catheter drainage, length of hospital stay, and complications were collected from the medical records. The hematoma volumes were calculated by the Coniglobus formula. The follow-up was carried out by two independent neurosurgeons through interviewing the patient or a family member by phone. Six months after each patient was discharged, the modified Rankin scale (MRS) score was used to analyze the outcome in patients with CSDH [8]. Informed consent from patients and ethics approval from the Institutional Research Ethics Committee were obtained.

2.2. Statistical analyses

During all the clinical characteristics, continuous variables were described by means (± standard deviations) and categorical variables were presented as numbers of patients (percentages). Relationships of clinical characteristics among three groups were assessed by chi-square test for frequency analyses and ANOVA for comparison of means. The association of clinical characteristics and death between 41–79 years patients and ≥ 80 years patients were analyzed by univariate and multivariate logistic regression analyses. Significance was set at p-value < 0.05, and all tests were two-tailed. These statistical analyses were performed by SPSS software version 17.0.0.

3. Results

3.1. The clinical characteristics of CSDH patients in three groups

As shown in Fig. 1, the age of the 1118 CSDH patients displays an obvious tendency; the numbers of young and extremely aged patients were much lower compared to middle and old patients. Therefore, we divided all patients into a ≤ 40 years group (n = 93, average 29.5 ± 7.9 years), a 41–79 years group (n = 867, average 63.9 ± 10.3 years), and a ≥ 80 years group (n = 158, average 83.8 ± 3.3 years). As shown in Table 1, the 41–79 years group accounted for 77.6% of the included patients, while the ≤ 40 years group was 8.3% and the ≥ 80 years group was 14.1%. Male predominance is obvious in all groups. The male/female ratio was the highest in the young patients (17.6:1), followed by the 41–79 years group (4.9:1) and the ≥ 80 years group (3.3:1) (P = 0.001), which was attributed to the relative increase of female patients with age. Smoking and drinking were not significantly different between the groups. Hypertension and diabetes, cardiac diseases, and brain infarction occurred most frequently in extremely aged patients, i.e., significantly more frequent than in the other age groups (P < 0.001). Then, we further analyzed the inter-group difference, and we found that the occurrence of hypertension and diabetes was significantly different between the ≤ 40 years group and the 41–79 years group (P < 0.001) and between the ≤ 40 years group and the ≥ 80 years group (P < 0.001). Cardiac diseases and brain infarction were not found in the ≤ 40 years group, and cardiac diseases occurred in 2.4% (22/867) of the cases in the 41–79 years group and in 5.7% (9/158) in ≥ 80 years group (P = 0.043), while brain infarction occurred in 11.7% (107/867) of the cases in the 41–79 years group and in 18.4% (29/158) in the ≥ 80 years group (P = 0.040). Preoperative antiplatelet and anticoagulant use is common in old people, and we found these drugs were used in 12.1% (105/867) of the cases in the 41–79 years group and in 12.7% (20/158) in the ≥ 80 years group, but this difference is not statistically significant. No patient had this history in the ≤ 40 years group. The occurrence of arachnoid cyst (AC)/ventriculoperitoneal (VP) shunt-associated CSDHs was significantly different between the three groups (P < 0.001). It mainly occurred in the ≤ 40 years group (64.5%), and this group showed a significant difference with the 41–79 years group (4.3%) (P < 0.001) or the ≥ 80 years group (3.2%) (P < 0.001), while we did not find a statistically significant difference in AC/VP shunt-associated CSDH occurrence between the 41–79 years group and the ≥ 80 years group. A history of head trauma was found in 59.1% (55/93) of the cases in the ≤ 40 years group, in 67.7% (587/867) in the 41–79 years group, and in 69.0% (109/158) in the ≥ 80 years group, but this difference is not statistically significant. In the ≤ 40 years group, headache was the most frequent symptom (88.2%), followed by dizziness (26.9%). In the 41–79 years group, headache was also the most frequent symptom (60.9%), and the second was limb weakness (55.4%). In the ≥ 80 years group, the most frequent symptom was limb weakness (80.4%), while headache was the second (30.4%). There was a significant difference in the occurrence of headache between the three groups (P < 0.001). The occurrence of dizziness was not different between the three groups. Limb weakness did show a significant difference between the three groups (P < 0.001). The left-side hematoma was the most frequent in all groups, followed by right-side and bilateral hematoma, but this difference is not statistically significant. As the brain atrophies with age, the preoperative hematoma volume was biggest in the ≥ 80 years group (112.7 ± 27.7 mL), followed by the 41–79 years group (98.4 ± 29.7 mL) and the ≤ 40 years group (91.5 ± 31.6 mL) (P < 0.001). The preoperative hematoma volume showed a significant difference between the ≤ 40 years group and the ≥ 80 years group (P < 0.001) and between the ≥ 80 years group and the 41–79 years group (P < 0.001), while no statistically significant difference was found between the ≤ 40 years group and the 41–79 years group.

3.2. Clinical characteristics of CSDH patients after surgery in three groups

After burr hole drainage craniostomy (Table 2), the reduction of the hematoma cavity was 66.5% ± 22.4% in the ≤ 40 years group, 60.1% ± 20.7% in the 41–79 years group, and 59.3% ± 19.5% in ≥ the 80 years group (P = 0.013). Furthermore, a significant difference was found when comparing the reduction of the hematoma cavity in the ≤ 40 years group to that in the 41–79 years group (P = 0.008) or the ≥ 80 years group (P = 0.011), but there was no statistically significant difference between the 41–79 years group and the ≥ 80 years group. The disappearance or alleviation of symptoms, duration of catheter drainage, and length of hospital stay were not significantly different between the three groups. The occurrence of complications was also not significantly different between the three groups (6.9%, 6.0%, and 9.5%, P = 0.261). One of the 93 cases (1.1%) required reoperation in the ≤ 40 years group; these numbers were 18/867 (2.1%) in the 41–79 years group and 2/158 (1.3%) in the ≥ 80 years group, and this difference is not statistically significant. In the ≤ 40 years group, though post-operation complications occurred in 7.5% (7/93) of the cases, all of them had a good outcome (MRS score 0–3). In the 41–79 years group, 98.2% (851867) of the cases had a good outcome and 1.9% (16/867) of the patients had a bad outcome (MRS score 4–6). In the ≥ 80 years group,

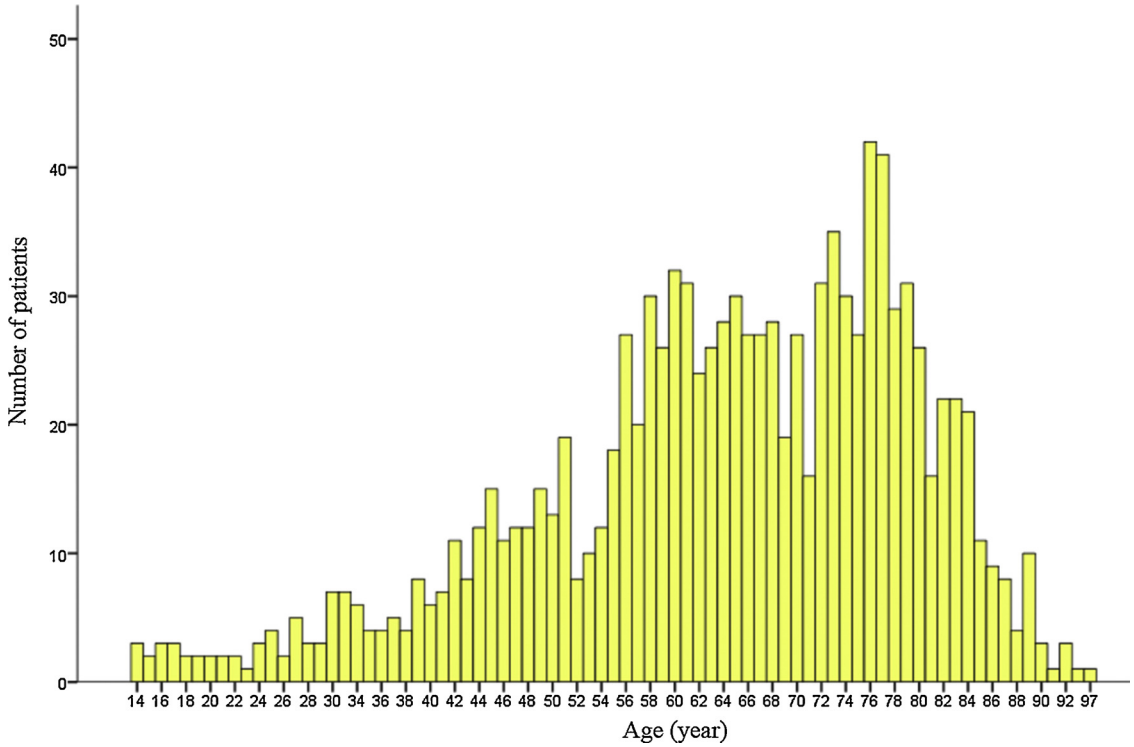

Fig. 1. The age distribution of 1118 CSDH patients. The age of 1118 CSDH patients distributed a nearly normal fashion, which young and extremely aged patients were much less compared to middle and old patients.

94.3% (149/158) of the cases had a good outcome and 5.7% (9/158) of the patients had a bad outcome. The total outcome showed a significant difference between the three groups ($P = 0.004$). The outcome of the ≥ 80 years group was poorer than that of the ≤ 40 years group ($P = 0.015$) and the 41–79 years group ($P = 0.004$), while a significant difference was not found between the ≤ 40 years group and the 41–79 years group. During the hospital stay, no mortality was noted in the ≤ 40 years group, three (0.3%) patients died in the 41–79 years group, and three (1.9%) patients died in the ≥ 80 years group ($P = 0.037$). The mortality rate was significantly different between the 41–79 years group and the ≥ 80 years group ($P = 0.019$). Further analysis revealed that three cases died from pneumonia in the 41–79 years group, while the causes of death of the three patients in the ≥ 80 years group were pneumonia, pulmonary embolism, and heart failure. At six months after discharge, six (0.7%) other patients died in the 41–79 years group (three cases from pneumonia, one case due to a heart attack, and two cases by a stroke) and four (2.6%) other patients in the ≥ 80 years group (two cases from pneumonia and two cases due to a heart attack)

Table 1
Relationship between clinical characteristics and groups of age in patients with chronic subdural hematoma.

Characteristics analyzed	Groups of age (n)			*p*
	≤40 yrs (93)	41-79 yrs (867)	≥80 yrs (158)	
Gender (Male:Female)	88:5	720:147	121:37	0.001
Personal / Past history				< 0.001
Smoking	19(20.4)	243(28.0)	36(22.8)	0.134
Drinking	14(15.1)	178(20.5)	23(14.6)	0.122
Hypertension	3(3.2)	324(37.4)	69(43.7)	< 0.001
Diabetes	1(1.1)	175(20.2)	45(28.5)	< 0.001
Cardiac diseases	0(0.0)	22(2.4)	9(5.7)	0.017
Brain infarction	0(0.0)	107(11.7)	29(18.4)	< 0.001
History of antithrombotic	0(0.0)	105(12.1)	20(12.7)	0.001
AC/V-P shunt n (%)	60 (64.5)	37 (4.3)	5 (3.2)	< 0.001
Symptoms				
Headache n (%)	82 (88.2)	528 (60.9)	48 (30.4)	< 0.001
Dizziness n (%)	25 (26.9)	256 (29.5)	35 (22.2)	0.159
Limb weakness n (%)	13 (14.0)	480 (55.4)	127 (80.4)	< 0.001
Dysphasia n (%)	0 (0.0)	89 (9.8)	22 (13.9)	0.001
Disturbance of consciousness n (%)	6 (6.5)	28 (3.2)	11 (7.0)	0.041
Head trauma event n (%)	55 (59.1)	587 (67.7)	109 (69.0)	0.216
Unilateral/bilateral hematoma				0.296
Left	39(41.9)	360(41.5)	57(36.1)	
Right	30(32.3)	278(32.1)	46(29.1)	
Bilateral	24(25.8)	229(26.4)	55(34.8)	
Preoperative volume (ML)	91.5 ± 31.6	98.4 ± 29.7	112.7 ± 27.7	< 0.001

Table 2
Relationship between clinical characteristics and groups of age in patients with chronic subdural hematoma after surgery.

Characteristics analyzed	Groups of age (n)			p
	≤40 yrs (93)	41-79 yrs (867)	≥80 yrs (158)	
Reduction of hematoma cavity (%)	66.5 ± 22.4	60.1 ± 20.7	59.3 ± 19.5	0.013
Symptom disappeared or alleviated (day)	2.3 ± 1.5	2.6 ± 2.0	2.9 ± 2.4	0.067
Duration of drainage catheter (day)	3.1 ± 1.2	3.4 ± 1.5	3.7 ± 1.5	0.099
Length of hospital stay (days)	7.5 ± 3.3	7.9 ± 4.0	8.1 ± 3.6	0.468
Recurrence requiring reoperation	1 (1.1)	18 (2.1)	2 (1.3)	0.649
Complications	7 (7.5)	52 (6.0)	15 (9.5)	0.262
Death (hospital stay)	0 (0.0)	3 (0.3)	3 (1.9)	0.037
Death (in six month)	0 (0.0)	6 (0.7)	4 (2.6)	0.045
Outcome (MRS)				0.004
0-3	93 (100)	851 (98.2)	149 (94.3)	
4-6	0 (0.0)	16 (1.8)	9 (5.7)	

Table 3
The causes of death in patients with CSDH during different periods among three groups.

Causes of death	Hospital stay			Discharge		
	≤40 yrs	41-79 yrs	≥80 yrs	≤40 yrs	41-79 yrs	≥80 yrs
Pneumonia		3	1		3	2
Pulmonary embolism			1			
Heart failure			1			
Heart attack					1	2
Stroke					2	

(P = 0.002), while no mortality occurred in the ≤ 40 years group (Table 3). Upon further analysis, we found that post-operation complications were an independent risk factor contributing to the death in patients of 41–79 years (P < 0.001, B = 3.140, Exp (B) = 23.103, 95% CI = 5.142–103.809) and patients of ≥ 80 years (P = 0.001, B = 2.831, Exp (B) = 16.970, 95% CI = 3.365–85.567; Table 4), while complications were also an independent risk factor contributing to the outcome in patients of 41–79 years (P < 0.001, B = 2.254, Exp (B) = 0.314, 95% CI = 0.089–1.103) and patients of ≥ 80 years (P = 0.006, B = 2.074, Exp (B) = 7.953, 95% CI = 1.791–35.313; Table 5). Otherwise, diabetes was another independent risk factor for the outcome in patients of 41–79 years (P = 0.035, B = 1.266, Exp (B) = 3.359, 95% CI = 0.562–20.084). Therefore, we further analyzed which factors could affect the occurrence of complications. As shown in Table 6, in the ≤ 40 years group, age was an independent risk factor for complications (P = 0.044, B = 0.513, Exp (B) = 1.671, 95% CI = 1.014–2.751). The history of antithrombotic drug was an independent risk factor of complications in patients of 41–79 years (P = 0.042, B = 1.341, Exp (B) = 3.823, 95% CI = 1.048–13.942) and patients of ≥ 80 years (P = 0.026, B = 1.399, Exp (B) = 4.052, 95% CI = 1.178–13.933), and the history of cardiac diseases was also an independent risk factor in patients of 41–79 years (P = 0.040, B = 2.021, Exp (B) = 7.547, 95% CI = 1.096–51.949) and patients of ≥ 80 years (P = 0.037, B = 1.666, Exp (B) = 5.293, 95% CI = 1.104–25.368). Finally, although we found that the history of antithrombotic drug could not affect the occurrence of recurrence in patients of 41–79 years, but it occurred relationships with the symptom disappeared or alleviated (P = 0.016) and length of hospital stay after surgery (P = 0.021), besides complications and outcome (Table 7).

Table 4
Univariate and multivariate logistic regression analyses of characteristics related to death in patients with chronic subdural hematoma.

Characteristics analyzed	41-79 yrs					≥80 yrs				
	p	B	Exp (B)	95% (CI)	p	p	B	Exp (B)	95% (CI)	p
Gender	0.050	0.688	1.989	0.431-9.188	0.378	0.666				
Age	0.021	0.069	1.071	0.975-1.177	0.153	0.104				
Smoking	0.068					0.659				
Drinking	0.217					0.595				
Hypertension	0.734					0.241				
Brain infarction	0.307					0.613				
History of antithrombotic	0.084					0.217				
Head trauma event	0.726					0.678				
Length of symptoms disappeared or alleviated	0.773					0.703				
Duration of drainage catheter	0.314					0.787				
Length of hospital stay	0.053					0.793				
Reduction of hematoma cavity	0.791					0.924				
Complications	< 0.001	3.140	23.103	5.142-103.809	< 0.001	0.002	2.831	16.970	3.365-85.567	0.001
Diabetes	0.087					0.193				
Unilateral/bilateral hematoma	0.254					0.423				
AC/VP shunt	1.000					1.000				
Headache	0.324					0.676				
Dizziness	0.728					1.000				
Limb weakness	0.312					0.624				
Dysphasia	0.609					0.057				
Disturbance of consciousness	0.031	1.652	5.219	0.645-42.236	0.121	0.403				
Cardiac diseases	0.020	1.363	3.907	0.442-34.555	0.220	0.342				
Preoperative volume	0.172					0.585				

Table 5
Univariate and multivariate logistic regression analyses of characteristics related to outcome in patients with chronic subdural hematoma.

Characteristics analyzed	41-79 yrs					≥80 yrs				
	p	B	Exp (B)	95% (CI)	*p*	*p*	B	Exp (B)	95% (CI)	*p*
Gender	0.167					1.000				
Age	0.864					0.204				
Smoking	0.259					1.000				
Drinking	0.053					0.359				
Hypertension	0.035	0.492	1.636	0.487-5.494	0.426	0.042	1.339	3.817	0.731-19.940	0.112
Brain infarction	0.009	0.426	1.531	0.415-5.646	0.522	0.368				
History of antithrombotic	0.033	0.328	1.388	0.357-5.386	0.636	0.089				
Head trauma event	0.668					0.460				
Length of symptoms disappeared or alleviated	0.963					0.983				
Duration of drainage catheter	0.432					0.930				
Length of hospital stay	0.096					0.683				
Reduction of hematoma cavity	0.755					0.974				
Complications	< 0.001	2.254	0.314	0.089-1.103	< 0.001	0.005	2.074	7.953	1.791-35.313	0.006
Diabetes	0.001	1.266	3.359	0.562-20.084	0.035	0.061				
Unilateral/bilateral hematoma	0.391					0.498				
AC/VP shunt	1.000					1.000				
Headache	0.003	−1.159	4.397	0.805-24.028	0.071	0.724				
Dizziness	0.420					1.000				
Limb weakness	0.107					1.000				
Dysphasia	0.396					0.113				
Disturbance of consciousness	0.012	1.212			0.184	0.121				
Cardiac diseases	0.006	1.481			0.087	0.418				
Preoperative volume	0.864					0.592				

4. Discussion

As the population age and the number of elderly patients increase, CSDH has become a common condition in neurosurgical practice. Therefore, most of the clinical studies on CSDH generally focused on the elderly. However, CSDH is also found in younger adults and infants, and a comparative investigation of the clinical features in different age ranges was lacking. Liliang Chou et al. compared the clinical presentations between the age ranges < 40 years and > 75 years, but they did not investigate patients aged 40–75 years [9]. Hiroyuki Toi et al. reported that patients below 40 years accounted for < 4.0% and patients over 80 years accounted for 45.3% of the 63,358 CSDH cases in Japan [10], while others reported percentages of 9%–30% and 7%–15%, respectively [9,11–13]. In our study, CSDH patients aged 41–79 years accounted for 77.6%, while patients ≤ 40 years were 8.3% and patients ≥ 80 years were 14.1%. This result is consistent with most previous reports, but the incidence of patients ≤ 40 years was higher and the incidence of patients ≥ 80 years was much lower than in the study by Hiroyuki Toi et al., which may be attributed to the graying society in Japan. The total male/female ratio ranges from 1.7:1 to 4.8:1 in different countries, which can reflect the different population structures in different societies [10,14–17]. However, other studies did not show a different ratio in different age ranges. In this study, the total male/female ratio was 4.9:1, while it was 17.6:1 in patients ≤ 40 years, 4.9:1 in patients aged 41–79 years, and 3.3:1 in patients ≥ 80 years. The percentage of female patients with CSDH displayed an obvious tendency of increasing with age, reflecting the demographics of our society.

A history of drinking is an obvious feature in younger patients with CSDH, while it is unusual in older patients [9,18]. In our study, 15.1% of the patients ≤ 40 years had a history of drinking, which was lower than in previous reports. Of the patients aged 41–79 years, 20.5% had a history of drinking, and of the patients ≥ 80 years, this percentage was 14.6%. These numbers are higher than those in Liliang Chou's study and other studies, which showed that a history of drinking was uncommon in older patients [9]. Furthermore, the difference between the three groups in our study was not statistically significant. Moreover, a history of smoking did not display distinctive characteristics in any age stage in our study. Many reports have found an association between the recurrence of CSDH and the use of oral antithrombotic drugs, but many of these findings are contradictory [10,19–23]. In our study, we did not find a history of oral antithrombotic agents in patients ≤ 40 years, and we neither found differences in the use of oral antithrombotic agents and in recurrence between patients aged 41–79 years and ≥ 80 years. However, our results found that, just like the history of cardiac diseases, a history of oral antithrombotic agents was an independent risk factor of complications in patients of 41–79 years and patients of ≥ 80 years. Otherwise, although a history of oral antithrombotic agents was not an independent risk factor of outcome in patients of 41–79 years, it occurred relationships with the outcome, the symptom disappeared or alleviated and length of hospital stay after surgery in patients of 41–79 years. All these results suggest that we should make more clinical cares to avoid the occurrence of complications for older patients with history of oral antithrombotic agents. Head trauma is an independent risk factor of CSDH in both younger and old patients; the incidence of trauma has been reported in 50%–75% of patients [6,9,24]. In our study, a head trauma event was found in 59.1% of the cases in the ≤ 40 years group, in 67.7% in the 41–79 years group, and in 69.0% in the ≥ 80 years group. Although the incidence of trauma increases with age, the difference is not statistically significant. This may be caused by old and very old patients with memory loss and their families not recalling or noticing slight traumas. CSDH patients with AC are often young patients [25,26], but it is not systematically reported. In our study, the occurrence of AC/VP shunt was 64.5% in patients ≤ 40 years, while it was only 4.3% in patients aged 41–79 years and 3.2% in patients ≥ 80 years, suggesting that AC/VP shunt is a prominent feature in young patients.

As the brain atrophies with age, older patients would have more intracranial capacity to compensate for the compression caused by the hematoma during its development. Therefore, older patients may have a bigger preoperative hematoma volume and suffer fewer symptoms caused by increasing intracranial pressure, such as headache and vomiting [27]. In our study, the preoperative hematoma volume was the biggest in patients ≥80 years, the second biggest in patients aged 41–79 years, and the smallest in patients ≤40 years. This is consistent with previous reports. Headache is the most common symptom in younger patients with CSDH as they tend to suffer increased intracranial pressure caused by CSDH [28,29], but Fogelholm et al. found

Table 6
Univariate and multivariate logistic regression analyses of characteristics related to complications in patients with chronic subdural hematoma.

Characteristics analyzed	≤40 yrs					41-79 yrs					≥80 yrs				
	p	B	Exp (B)	95% (CI)	*p*	*p*	B	Exp (B)	95% (CI)	*p*	*p*	B	Exp (B)	95% (CI)	*p*
Gender	1.000					0.002	−0.716	0.488	0.098-2.446	0.383	0.742				
Age	< 0.001	0.513	1.671	1.014-2.751	0.044	0.139					0.391				
Smoking	1.000					0.006	0.532	1.702	0.390-7.438	0.479	0.787				
Drinking	0.221					0.018	−19.743	0.001	0.078-7.345	0.998	0.130				
Hypertension	1.000					0.448					0.059				
Brain infarction	–					0.046	−1.322	0.267	0.029-2.439	0.242	0.308				
History of antithrombotic	–					0.039	1.341	3.823	1.048-13.942	0.042	0.026	1.399	4.052	1.178-13.933	0.026
Head trauma event	0.222					0.808					0.702				
Length of symptoms disappeared or alleviated	0.302					0.483					0.781				
Duration of drainage catheter	0.894					0.061					0.908				
Length of hospital stay	0.058					< 0.001	0.062	1.064	0.910-1.244	0.438	0.153				
Reduction of hematoma cavity	0.037	3.831	46.105	0.215-9897.209	0.162	0.356					0.521				
Diabetes	1.000					0.374					0.367				
Unilateral/bilateral hematoma	0.176					0.931					0.486				
AC/VP shunt	1.000					0.588					0.462				
Headache	0.541					0.434					0.391				
Dizziness	0.658					0.293					0.193				
Limb weakness	0.590					0.074					0.497				
Dysphasia	–					0.084					0.442				
Disturbance of consciousness	0.338					0.285					0.280				
Cardiac diseases	–					0.015	2.021	7.547	1.096-51.949	0.040	0.041	1.666	5.293	1.104-25.368	0.037
Preoperative volume	0.479					0.942					0.085				

Table 7
Univariate logistic regression analyses of characteristics related to history of antithrombotic in patients with chronic subdural hematoma.

Characteristics analyzed	41-79 yrs *p*	≥80 yrs *p*
Complications	0.039	0.026
Recurrence requiring reoperation	0.712	0.588
Outcome (MRS)	0.033	0.089
Reduction of hematoma cavity (%)	0.281	0.402
Symptom disappeared or alleviated (day)	0.016	0.848
Duration of drainage catheter (day)	0.064	0.539
Length of hospital stay (days)	0.021	0.336

that the occurrence of this symptom was not different compared with older patients [30]. Liliang Chou et al. found a higher incidence of headache in younger patients than in those over 75 years, but their results lacked a comparison with patients aged 40–75 years [9]. In our study, headache was the most common symptom in patients ≤ 40 years and 41–79 years, while it was the symptom with second-highest frequency in patients ≥ 80 years. This difference is statistically significant. The symptom with the second highest frequency was dizziness in patients ≤ 40 years and limb weakness in patients aged 41–79 years. The most frequent symptom in patients ≥ 80 years was limb weakness. Furthermore, after burr hole drainage craniostomy, the degree of reduction in hematoma cavity was the smallest in very old patients compared with other age ranges.

The recurrence of CSDH after surgical management ranges from 5 to 33% [31–35]. It was found that the recurrence rate in extremely old patients was almost as low as in younger patients in a study involving 75 CSDH patients [9]. However, others have found that a tendency toward a higher recurrence rate was seen with increasing patient age [5,10]. In our study, we found the recurrence rate was the lowest in patients ≤ 40 years (1.1%) and the highest in patients aged 41–79 years (2.1%). All these numbers are obviously lower than in previous reports. We did not find a statistical difference in recurrence rate between different age ranges.

The mortality rate after burr hole drainage craniostomy for CSDH is 2%–4% [11], but these results were examined on a relatively short term. In our study, we examined the functional status six months after discharge, and we found a mortality rate of 1.0% in patients aged 41–79 years and 4.4% in patients ≥ 80 years. A tendency toward a higher mortality rate was found with increasing patient age. Moreover, we found that post-operation complications were an independent risk factor contributing to death in patients aged 41–79 years and ≥ 80 years. Of the patients who died in the 41–79 years group, 77.8% died from pneumonia or heart disease. This number was 85.7% for patients ≥80 years. All these results suggest that avoiding or reducing the occurrence of complications, especially pneumonia and heart diseases, is important to decrease the mortality in older patients.

CSDH has been regarded as a chronic disease with a good outcome, which has been found from 71.6% to 88.3% [10,16,17,36]. However, as many chronic diseases (such as hypertension, diabetes, and cardiac diseases) are common in the older population, age is regarded as an important risk factor in the outcome of CSDH. Hiroyuki Toi et al. found that 71.6% of the CSDH patients had a good outcome, and the percentage of poor outcomes tended to be higher in elderly patients [10]. In our study, histories of hypertension, diabetes, cardiac diseases, and brain infarction are common in older patients, especially in extremely aged patients. We also found that the percentage of good outcomes showed a tendency to decrease with age. Yet, 94.3% of the cases had a good outcome in patients ≥ 80 years, and 98.2% of the cases had a good outcome in patients aged 41–79 years, which was much higher than in previous reports. These results show that age is not an absolute deciding factor in the outcome of CSDH, and burr hole drainage craniostomy is an effective and safe operation for almost all CSDH cases,

including the extremely old patients. Finally, we found that complications were an independent risk factor contributing to the outcome in patients of 41–79 years and patients of ≥ 80 years, while diabetes was another independent risk factor for the outcome in patients of 41–79 years. All these results suggest that avoiding the complications after surgery is important to improve the outcome in older patients, and controlling the blood sugar level could gain a benefit for patients of 41–79 years.

5. Conclusions

Our study has provided a clear overview of the common and different clinical features of CSDH in three age ranges. Male predominance is an obvious appearance in all groups, and the male/female ratio was the highest in patients ≤40 years. The AC/VP shunt was a noteworthy feature in patients ≤40 years. Headache was the most common symptom in patients ≤40 years and 41–79 years, while the most frequent symptom in the ≥ 80 years group was limb weakness. A history of head trauma was not significantly different between the three age groups. The recurrence rate was also not significantly different between the three groups. The history of oral antithrombotic agents and cardiac diseases were independent risk factors of complications in patients of 41–79 years and patients of ≥ 80 years. Post-operation complications are an independent risk factor contributing to the death and outcome of patients aged 41–79 years and ≥ 80 years. All of the patients ≤ 40 years, 98.2% of the patients aged 41–79 years, and 94.3% of the patients ≥ 80 years had a good outcome. All these results are crucial for the development of better management and treatment strategies for CSDH patients.

Disclosure

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

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