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Research Article

Clinical Characteristics and Short-term Prognosis of Butterfly-Aneurysmal Subarachnoid Hemorrhage

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Abstract

Objectives: To investigate the clinical characteristics and short-term prognosis of butterfly-aneurysmal subarachnoid hemorrhage.

Materials and methods: We retrospectively reviewed the data of adult patients who underwent microsurgical clamping of aneurysmal subarachnoid hemorrhage at the First Affiliated Hospital of Xiamen University between January 2017 and May 2022 for complications and prognosis. Multivariate logistic regression analyses were used to explore the variables related to the prognosis of butterfly-aneurysmal subarachnoid hemorrhage. SPSS 20.0 software was used for statistical analysis.

Results: A total of 380 cases of aneurysmal subarachnoid hemorrhage were analyzed, which included 71 cases of butterfly-aneurysmal subarachnoid hemorrhage (18.68%). Among them, 78.87% were mild, and 60.56% occurred in females. Most of the cases were anterior and posterior communicating aneurysms. The overall prognosis was good (Glasgow Outcome Scale 4–5, 77.46%) with a mean postoperative duration of hospital stay of 2 weeks. The major complications were pneumonia (21.13%), cerebral infarction (22.54%), and acute hydrocephalus (12.67%). Univariate and multivariate logistic regression analyses showed that pneumonia (OR [95% CI]: 95.513 [9.254–985.831], P<0.001) and cerebral infarction (OR [95% CI]: 28.486 [2.842–285.506], P=0.004) were associated with the short-term prognosis. Chronic hydrocephalus had an incidence of 30.99%, which was almost asymptomatic.

Conclusions: The overall prognosis of butterfly-aneurysmal subarachnoid hemorrhage was generally good in this study. Severe aneurysmal subarachnoid hemorrhage coexisting with severe pneumonia and extensive cerebral infarction were the main factors associated with mortality. The prevention and enhanced management of complications may further improve the prognosis of butterfly-aneurysmal subarachnoid hemorrhage.

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Keywords: Aneurysm; Butterfly; Subarachnoid Hemorrhage; Prognosis; Complications.

Introduction

Aneurysmal subarachnoid hemorrhage (aSAH) accounts for approximately 85% of spontaneous subarachnoid hemorrhages, with a mean annual incidence of 9.1 per 10000 people-year [1]. It has an acute onset and poor prognosis, with 15-30% and 25-50% of patients dying before and after admission, respectively. This makes it a cerebrovascular disease that significantly endangers human health [2].

The prognosis of aSAH has been extensively studied and associated with factors including hemorrhage volume [3], age [4], Hunt-Hess scale score [5], aneurysm characteristics [6], and anemia [7]. Most prognostic factors have been established; however, there is controversy about the hemorrhage volume. The Fisher and Hidra scores provide a semi-quantitative classification of the degree of hemorrhage in general [8-10]. Computerized methods are more accurate for calculating hemorrhage volume but are not suitable for various other applications [11]. Although aneurysms typically present in one cistern, hemorrhage severity is more variable and may involve only one or all cisterns. For aSAH with the same degree of hemorrhage, the characteristics of the aneurysms also differ significantly. Classifying aSAH based on the number of cisterns involved would result in too many classification entries, which would make it difficult to determine the clinical characteristics of every grade of aSAH. Moreover, there is no absolute correlation between the Fisher and Hunt-Hess scale scores for aSAH [12]. Therefore, the clinical characteristics and prognosis of aSAH based on the number of cisterns remain elusive.

At our medical center, a type of aSAH called the butterfly-aneurysmal subarachnoid hemorrhage (BaSAH), which could involve multiple cisterns (bilateral lateral fissure cisterns, ambient cisterns, suprasellar cisterns, basal cisterns, and dispensable anterior longitudinal cisterns), was encountered (Figure 1). It has significantly different clinical characteristics and prognoses. To further understand this type of aSAH, this study reviewed data from the last 5 years to analyze the clinical characteristics and prognosis of BaSAH, which may help improve the clinical treatment of aneurysmal subarachnoid hemorrhage.

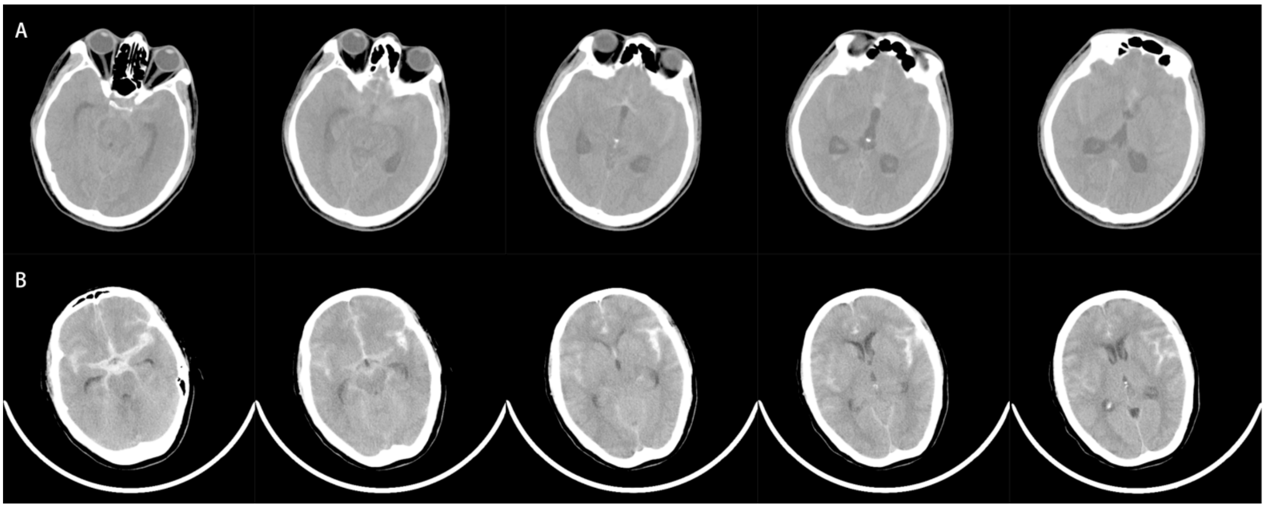

Table 1: Butterfly-aneurysmal subarachnoid hemorrhages in bilateral lateral fissure, ambient, suprasellar, basal, and dispensable anterior longitudinal cisterns. **(A)** No Cast cisterns. **(B)** Cast cisterns.

Methods

Patient selection

Data on the cases of aSAH in the First Hospital of Xiamen University from January 2017 to May 2022 were retrospectively analyzed. The inclusion criteria were spontaneous aneurysmal subarachnoid hemorrhage, excluding cases associated with trauma, arteriovenous malformation, and moyamoya disease; microscopic craniotomy clamping in all patients; extensive bilateral subarachnoid hemorrhage on cranial computed tomography scans containing bilateral lateral fissure cisterns, ambient cisterns, suprasellar cisterns, and basal cisterns (dispensable anterior longitudinal cisterns). The exclusion criteria were large hematoma in the parenchyma and ventricle clot; history of use of oral anticoagulants; combination of interventional embolization and microscopic craniotomy; lesions of important organs; and age <18 years.

Data collection criteria

All patients underwent cranial Computed Tomography Angiography to verify the diagnosis of an aneurysm. Grades 1–3 based on the Hunt and Hess classification were categorized as mild aSAH (maSAH), while grades 4–5 were categorized as severe aSAH (saSAH). Grades 1–3 were associated with poor prognoses, while grades 4–5 were associated with good prognoses. The diagnosis of pneumonia was based on clearly defined imaging changes and positive bacterial cultures. Patients with cerebral infarction required new hypodense foci on cranial CT. Hydrocephalus was diagnosed based on an Evans index index >0.3. Aneurysms were classified based on size as follows: small, <5 mm; medium, 5–15 mm; large, 15–25 mm; and giant, >25 mm. Cast cisterns hemorrhage was defined as cisterns filled with a significant blood clot.

Statistical methods

SPSS software (version 20.0; IBM Corp., Armonk, New York, USA) was used for data analysis. Continuous data were compared with using the independent t-test. If Levene's test results showed equal variances, the t-test results in the "Equal variances assumed" row were read. If the variances were not equal, the t-test results in the "Equal variances not assumed" row were read. Categorical values were analyzed using Fisher's exact test. Variables with P<0.05 from the univariate analysis were used for the multivariable logistic regression analysis. The variables were considered Statistical significance was set at P<0.05.

Results

Basic information

Seventy-one (18.68%) cases of BaSAH were included from 380 cases of aSAH (Table 1). Among them, 60.56% occurred in females. The ages of the patients ranged from 22 to 87 years old (median, 56 years; mean, 56 years). Most cases of BaSAH were associated with anterior communicating aneurysms (28 [39.44%]) and posterior communicating aneurysms (27 [38.01%]), followed by the middle cerebral artery (10 [14.08%]), anterior choroidal artery (4 [5.63%]), and ophthalmic artery segment (2 [2.82%]). There were 33 cases (46.48%) of small aneurysms and 38 cases (53.52%) of medium aneurysms. Most forms of hemorrhage manifest as cast cisterns hemorrhage (84.51%), and maSAH makes up the majority (78.87%).

Table 1: Basic clinical information.

Variable	Number
Total	71/380 (18.68%)
Gender	
Male	28 (39.44%)
Female	43 (60.56%)
Age	22–87 (median: 56; mean: 56)
Position	
AcoA	28 (39.44%)
AchA	4 (5.63%)
MCA	10 (14.08%)
PcoA	27 (38.01%)
Ophthalmic	2 (2.82%)
Size	
Small	33 (46.48%)
Middle	38 (53.52%)
Cast cisterns	
Yes	60 (84.51%)
No	11 (15.49%)
Hunt-Hess scale score	
maSAH	56 (78.87%)
saSAH	15 (21.27%)

Complications and prognosis

Major complications include pneumonia (21.13%), cerebral infarction (22.54%), and hydrocephalus (acute, 12.67%; chronic, 30.99%;). The postoperative duration of hospital stay ranged from 2 to 54 days (median, 12 days; mean, 14 days). Sixteen cases had a poor prognosis (Glasgow Outcome Scale 1–3), and 55 cases had a good prognosis (Glasgow Outcome Scale 4–5) (Table 2).

Table 2: Complications and prognosis.

Variable	Incidence
Pneumonia	15 (21.13%)
Cerebral infarction	16 (22.54%)
Urinary infection	4 (5.6%)
Hydrocephalus	
Acute	9 (12.67%)
Chronic	22 (30.99%)
Duration of postoperative hospital stay	2–54 days (median:12; mean:14)
GOS	
1	8
2	1
3	7
4–5	55

Table 3: Univariate analysis of short-term prognosis.

	Good	Poor	P-value
Gender			
Female	32	11	0.446
Male	23	5	
Age (mean)	55	59	0.361
Position			
AcoA	23	5	0.058
Other	15	1	
PcoA	17	10	
Size			
Small	23	10	0.144
Medium	32	6	
Cast cisterns			
No	9	2	0.523
Yes	46	14	
Hunt and Hess scale score			
maSAH	49	7	<0.001
saSAH	6	9	
Pneumonia			
No	52	4	<0.001
Yes	3	12	
Cerebral infarction			
No	49	6	<0.001
Yes	6	10	
Hidra score (mean)	17	20	0.009
Acute Hydrocephalus			
No	38	9	0.250
Yes	6	3	

Univariate and multifactorial analyses of short-range prognosis

A total of 10 variables were included in the univariate analysis (Table 3). The Hunt and Hess scale score (p<0.001), pneumonia (p<0.001), cerebral infarction (p<0.001), and Hidra score (p=0.009) were strongly associated with prognosis. Multivariate logistic regression analysis of the four prognostic factors showed that pneumonia (odds ratio [OR]: 95.513; 95% CI: 9.254–985.831; p<0.001) and cerebral infarction (OR: 28.486; 95% CI: 2.842–285.506; p=0.004) significantly affected prognosis(Table 4). Further analysis revealed that saSAH was strongly associated with pneumonia and cerebral infarction (p<0.05).

Table 4: Multivariate logistic regression analysis.

	OR (95% CI)	P-value
Pneumonia	95.513 (9.254-985.831)	**<0.001**
Cerebral infarction	28.486 (2.842-285.506)	**0.004**

Table 4: Factor of complications.

	Pneumonia			Cerebral infarction		
	No	Yes	P-value	No	Yes	P-value
Gender						
Female	32	11	0.372	34	9	0.688
Male	24	4		21	7	
Position						
AcoA	23	5	0.093	21	7	0.193
Other	15	1		15	1	
PcoA	18	9		19	8	
Size						
Small	27	6	0.571	23	10	0.144
Middle	29	9		32	6	
Cast cisterns						
No	10	1	0.437	8	3	0.702
Yes	46	14		47	13	
Hunt-Hess scale score						
maSAH	49	7	<0.001	49	7	<0.001
saSAH	7	8		6	9	
Age (mean)	56	57	0.792	56	57	0.855
Hidra (mean)	17	20	0.023	17	19	0.219

Discussion

This study initially investigated the aSAH with microscopic cranial clamping of aneurysms. The incidence, clinical characteristics, complications, and prognoses of BaSAH were analyzed. The BaSAH was predominantly mild and prevalent in women, with a predominance of anterior and posterior communicating aneurysms. The overall prognosis was good, with a mean postoperative duration of hospital stay of 2 weeks. The factors affecting the short-term prognosis are pneumonia and cerebral infarction. In addition to that, the development of chronic hydrocephalus remains a challenging problem.

Most BaSAH had a good prognosis, and only 6 cases were saSAH among them. There were 3 cases of pneumonia and 6 cases of cerebral infarction mainly with minor cerebral ischemia. The average duration of hospital stay was 24 days for 3 patients with pneumonia and 13 days for patients with cerebral infarction. Correspondingly, the average duration of hospital stay was 12 days for maSAH with a good prognosis. Thus, pneumonia was the main factor associated with a prolonged hospital stay in the good prognosis group. Reducing the incidence of pneumonia could further shorten the duration of hospital stay and reduce costs in good prognosis group.

There were 8 dead cases, which the mean age of the patients was 53 years (only 2 cases were older than 60 years), which shows that age was not a factor affecting mortality. This is inconsistent with the reports of previous studies [13]. Previous studies also reported that mortality after aSAH was positively correlated with the Hunt-Hess scale score grade [14]. Pneumonia accounted for most of deaths, which suggests that pneumonia is an important factor influencing mortality; most case of pneumonia were severe pneumonia requiring tracheotomy. Several studies have also reported the impact of pneumonia on the prognosis of aSAH [15-17]. Six patients had posterior communicating aneurysms, which had a worse prognosis than other aneurysms [6-18]. Cerebral infarction was also an important cause of death [19,20]. Almost all of the cases of cerebral infarction in the death group were extensive relative to those in the good prognosis group.

In addition to pneumonia and cerebral infarction, some older women have urinary tract infections, which are almost controlled quickly and do not affect the prognosis and postoperative hospital stay. Another complication that cannot be ignored is hydrocephalus [21]. Hydrocephalus is classified as acute (<3 days), subacute (3-14 days), or chronic (>14 days) [22,23]. The acute hydrocephalus of BaSAH were usually mild and do not need lateral ventricular drainage although some previous studies have reported that 48% of patients with acute hydrocephalus require lateral ventricular drainage [24,25]. All cases of acute hydrocephalus had resolved on the first day of postoperative CT, which may have been due to intraoperative endplate fistula and lumbar cistern drainage. Although the incidence of chronic hydrocephalus was high, the majority of hydrocephalus cases were asymptomatic based on telephone follow-up.

Although this study facilitates a preliminary understanding of BaSAH, it had limitations, especially the experience of clinicians. It is an important factor affecting prognosis. Intraoperative injury to blood vessels during the separation of the lateral fissure, inappropriate pulling of brain tissue, and suboptimal clamping may increase the risk of complications. A prospective, multicenter, and large sample study is recommended for further analysis. It is hoped that more studies will be conducted to classify aSAH in more detail and investigate the key factors affecting prognosis to guide better clinical treatment.

The overall prognosis of butterfly-aneurysmal subarachnoid hemorrhage was generally good in this study. Severe aneurysmal subarachnoid hemorrhage coexisting with severe pneumonia and extensive cerebral infarction were the main factors associated with mortality. The prevention and enhanced management of complications may further improve the prognosis of butterfly-aneurysmal subarachnoid hemorrhage.

Declarations

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Author contributions: LW and WJ designed this study. WJ and WP were responsible for interpretation of data. JY, ZY and X were responsible for the analysis of data. . LW wrote the first draft of this manuscript. TG, SF and ZX did a critical revision of the final manuscript. All authors listed have made a substantial contribution to the work.

Data availability statement: Requests to access the dataset may be sent to the corresponding author.

Declaration of interest: All authors have no competing interest (eg. employment, consultancies honoraria, stock ownership or option, grants, contracts, patents received or royalties) to declare.

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