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Risk factors for multiple intracranial aneurysms rupture: A retrospective study

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ABSTRACT

Background and purpose: The presence of predicting the rupture risk of intracranial aneurysms has recently generated considerable controversy. We retrospectively investigated the risk factors for multiple intracranial aneurysms related to rupture.

Methods: Between July 2007 and July 2011, 134 patients with 294 aneurysms were identified after review. Every patient had two or more aneurysms. Univariate and multivariate logistic regression models were used to analyze the risk factors for multiple intracranial aneurysms with age, gender, site and size.

Results: 134 patients were divided into three groups according to patient age category (<45, 45–65, >65 years of age). The incidence of aneurysms ruptured in the second group was significantly higher. Three groups showed significant difference ($P = 0.001$ versus >65 years of age). Thirteen of 35 AComA aneurysms were ruptured, accounting for 26% of all ruptured aneurysms, and the rate of rupture at AComA aneurysms in patients was 37.1%. The rate of aneurysm rupture in the AComA was significantly higher than that in other sites ($P = 0.001$). In all 294 aneurysms, 88.1% of the aneurysms were 5 mm or less, of which 58.2% were less than 3 mm. In the ruptured aneurysms, 68% were 5 mm or less.

Conclusions: Our study reveals the pattern of ruptured multiple intracranial aneurysms, in terms of age, size and location of aneurysms. Age, size, and site of aneurysm should be considered in the decision whether to treat an unruptured aneurysm or not. Especially, in cases of multiple aneurysm, the AComA aneurysm is most prone to hemorrhage.

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1. Introduction

Intracranial aneurysms are relatively common. Approximately 2% of adults harbor an unruptured aneurysm [1,2]. Ruptured intracranial aneurysm is the most common cause of subarachnoid hemorrhage (SAH), and can cause significant morbidity and mortality. The incidence of SAH in western populations is about 10–15 per 100 000 persons per year [3,4]. With the ongoing improvement of imaging techniques, the chance that an asymptomatic aneurysm is detected has increased, and multiple aneurysms are more and more. Multiple intracranial aneurysms have been investigated in some previously published studies, and depending on completeness of the diagnostic procedures, 20–34% were shown to have multiple intracranial aneurysms, which are associated with a less favorable outcome than single-aneurysm cases are after SAH, although most of these studies were based on hospitalized patients [5–9].

Although predicting the rupture risk of intracranial aneurysms has recently generated considerable controversy, most clinical studies showed that risk factors for rupture of intracranial aneurysms are older age, female gender, size, location of the aneurysm and so on. But the risk factors for rupture of multiple aneurysms are not well known because only very few studies have used multivariate statistics to reveal independent risk factors [5,6].

This study was designed to evaluate the role of age, gender, site of aneurysms and size of aneurysms, as independent risk factors for rupture of multiple intracranial aneurysms in patients. These patients are usually studied carefully for the presence of multiple aneurysms.

2. Materials and methods

2.1. Patients

This was a retrospective study of Chinese patients in Shanghai sixth hospital. All intracranial aneurysms available on our archived database, dated between July 2007 and July 2011, were reviewed. Because of the requirement of 3D images (MRA, DSA or CTA), 294 aneurysms from 134 patients were identified after review. Every patient had two or more aneurysms. Of these aneurysms, 50 were ruptured and 244 were unruptured. These patients were examined

Abbreviations: SAH, subarachnoid hemorrhage; AComA, anterior communicating artery; ICA, internal carotid artery; MCA, middle cerebral artery; ACA, anterior cerebral artery; V-BA, vertebral-basilar artery.

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Table 1
Characteristics of patients and aneurysms.

Category	Unruptured	Ruptured	Total	χ^2	P
	Number of aneurysms (*n*)				
Gender					
Female	147 (60.2%)	34 (68.0%)	181 (61.6%)	1.075	0.300
Male	97 (39.8%)	16 (32.0%)	113 (38.4%)		
Age category, y					
<45	30 (12.3%)	9 (18%)	39 (13.3%)		
45–65	94 (38.5%)	30 (60%)	124 (42.2%)	13.812	0.001
>65	120 (49.2%)	11 (22%)	131 (44.5%)		
Size of aneurysm					
<3 mm	171 (70.1%)	0 (0%)	171 (58.2%)		
3–5 mm	54 (22.1%)	34 (68%)	88 (29.9%)	102.53	<0.001
>5–10 mm	15 (6.2%)	12 (24%)	27 (9.2%)		
>10 mm	4 (1.6%)	4 (8%)	8 (2.7%)		
Location of aneurysm					
ICA C7	58 (23.8%)	21 (42%)	79 (26.9%)		
AComA	22 (9.0%)	13 (26.0%)	35 (11.9%)		
MCA1–2	27 (11.1%)	5 (10.0%)	32 (10.9%)		
ICA C6	43 (17.6%)	4 (8.0%)	47 (16.0%)	29.059	<0.001
ICA C4–5	49 (20.1%)	0 (0.0%)	49 (16.7%)		
ACA 2–3	11 (4.5%)	1 (2.0%)	12 (4.1%)		
V-BA	11 (4.5%)	3 (6.0%)	14 (4.8%)		
Others	23 (9.4%)	3 (6.0%)	26 (8.8%)		

at our hospital for possible neurovascular diseases or were imaged during endovascular treatment.

Characteristics of patients and aneurysms are summarized in Table 1. There were 50 men and 84 women with a mean age of 62.08 years (range, 21–87 years).

2.2. Definitions and judgment of ruptured aneurysms

Intracranial aneurysms were defined as (1) a protrusion from the side wall or bifurcation of the cerebral arteries without the artery emerging at its top; (2) an infundibulum with a maximum diameter >3 mm.

2.3. Image review

Three observers (M.H.L., H.Q.T., and H.T.L., with 18, 10, and 6 years of experience, respectively, in neurointerventional radiology) were blinded to all clinical and 3D images results. They analyzed all the 3D images datasets independently on an offline-workstation from multiple on-screen viewing angles with the use of the single artery highlighting approach. The source images and MIPs were presented on-screen, thus allowing for the appropriate threshold of the window width and level to be adjusted to differentiate the smaller aneurysms with infundibula. For interobserver discrepancies in the detection of intracranial aneurysms, consensus was achieved or a majority decision was obtained.

Confidence in diagnosing aneurysms was assessed using a previously described 5-point scale as follows: 5, aneurysm definitely absent; 4, aneurysm probably absent; 3, uncertain; 2, aneurysm probably present; and 1, aneurysm definitely present. Studies with one or more aneurysms that were identified as probably or definitely present were considered positive; all others were negative. The location of the aneurysms was classified as follows (segments of the internal carotid artery according to Bouthillier): (1) internal carotid artery communicating (ICA C7); (2) anterior communication artery (AComA); (3) middle cerebral artery 1–2 (MCA1–2); (4) internal carotid artery ophthalmic (ICA C6); (5) internal carotid artery cavernous and clinoid (ICA C4–C5); (6) anterior cerebral artery 2–3 (ACA 2–3); (7) vertebral basilar artery (V-BA); and (8) other sites. Aneurysm size was recorded as the maximum 2D angiographic dimension: (1) <3 mm, (2) 3–5 mm, (3) >5–10 mm, or (4) >10 mm.

2.4. Statistical analysis

The data were expressed as mean ± standard deviation (SD) and processed with the statistical software SPSS13. Quantitative and qualitative data were analyzed with independent-sample *t* test and the Chi-square test, respectively. Logistic regression was used to analyze the factors for IAN. A *P* value less than 0.05 was considered statistically significant.

3. Results

A total 294 aneurysms from 134 patients were identified after review. Every patient had two or more aneurysms. Of these aneurysms, 50 were ruptured and 244 were unruptured. The ruptured rate of aneurysms was 17%. Patient and aneurysm characteristics are summarized in Table 1. We performed univariate analyses of potential predictors of multiple aneurysm ruptured as the unit of observation.

There were 50 (37.3%) men and 84 (62.7%) women with a mean age of 62.08 years (range, 21–87 years), of which 50 were complicated by SAH or cerebral hemorrhage, 34 were women, accounting for 62.7%. However, there is no significant difference between men and women ($P = 0.300$, $\chi^2 = 1.075$).

134 patients were divided into three groups according to patient age category (<45, 45–65, >65 years of age). The incidence of patients with multiple aneurysm increased progressively with age, but incidence of aneurysms ruptured in the second group (45–65 years of age) was significantly higher, accounting for 60% in all 50 ruptured aneurysms (Fig. 1). Three groups showed significant difference ($P = 0.001$ versus >65 years of age).

Thirteen of 35 AComA aneurysms were ruptured, accounting for 26% of all ruptured aneurysms, while AComA aneurysms only was accounting for 11.9% of total aneurysms, and rate of rupture at AComA aneurysms in patients was 37.1% (Fig. 1). However, the rupture rate in the ICA C7, V-BA and MCA1–2 was 26.6%, 21.4% and 15.6%, respectively. The rate of aneurysm rupture in the AComA was significantly higher than that in other sites. We performed univariate analyses of potential predictors of multiple aneurysm ruptured as the unit of observation (Table 2, Fig. 2). Location of aneurysms on the AComA was significantly more likely to rupture ($P < 0.05$ versus others).

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