ORIGINAL ARTICLE

Size, location, and multiplicity of ruptured intracranial aneurysms in the Hong Kong Chinese population with subarachnoid haemorrhage

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Objective To review the pattern of ruptured intracranial aneurysms in terms of size, location, and the prevalence of multiple aneurysms in the Hong Kong Chinese population with subarachnoid haemorrhage.

Design Retrospective study.

Setting Three public hospitals in Hong Kong.

Patients A total of 267 Chinese patients with subarachnoid haemorrhage from ruptured intracranial aneurysms between July 1998 and June 2002 were reviewed retrospectively.

Results The patients had a mean age of 59 (range, 13-96) years, with a female-to-male ratio of 2:1. Concerning the age at presentation, males presented with ruptured intracranial aneurysms at a younger age (P=0.001) than females. Ruptured aneurysms were more commonly located in the anterior than posterior circulation (84% vs 16%). The posterior communicating artery (26%) and anterior communicating artery (22%) were the most common sites of rupture. As a whole, 64% of the aneurysms had a size of 5 mm or less. The anterior communicating artery had a higher proportion with a size of 5 mm or less compared to other locations (P<0.05). In this cohort, the prevalence of multiple aneurysms was 17%. There was no significant difference in the prevalence of multiple aneurysms between men and women (P=0.30). In patients with multiple aneurysms, the sizes of ruptured aneurysms were greater than those of the largest unruptured aneurysms (P<0.001). When compared with the group with single aneurysms, patients with multiple aneurysms had a smaller proportion of small aneurysms, sized 5 mm or less (P<0.05).

Conclusions The pattern of ruptured intracranial aneurysms in the Hong Kong Chinese population was different from western and Japanese populations. Although the distribution of locations for ruptured aneurysms was similar, Hong Kong Chinese had a larger proportion of small aneurysms sized 5 mm or less. The prevalence of multiple aneurysms in Hong Kong is comparable to that in the Japanese population, but lower than that in the western populations.

Key words
Aneurysm, ruptured; Intracranial aneurysm; Subarachnoid hemorrhage

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Introduction

Ruptured intracranial aneurysm is the most common cause of subarachnoid haemorrhage (SAH), and can cause significant morbidity and mortality.[1,2] The incidence of SAH in western populations is about 10 to 15 per 100 000 persons per year.[3,4] About 80% of such patients are shown to have ruptured aneurysms radiologically.[5] The prevalence of asymptomatic intracranial aneurysms is estimated to be about 2%.[6] Understanding of the pattern of intracranial aneurysms is helpful in the management of this disease. The epidemiology of intracranial aneurysms in western populations is well reported in the literature, and includes the size, location, and prevalence of multiple aneurysms among patients with ruptured intracranial aneurysms.[6-10] Many studies even attempted to determine whether there is a critical size at which an aneurysm was likely to rupture and thus warrant treatment.[11] Unlike Caucasian and Japanese populations,[12,13] few studies describing the

pattern of intracranial aneurysms in the Chinese population have been published.[14,15] The purpose of our study was to review the pattern of ruptured intracranial aneurysms, in terms of size, location, and the prevalence of multiple aneurysms in a Hong Kong Chinese population. We hope the results will lay the foundation for future studies regarding the pattern of intracranial aneurysms in the Chinese population.

Methods

This was a retrospective study of Chinese patients with ruptured intracranial aneurysms between July 1998 and June 2002, which involved admissions for spontaneous SAH. These patients were admitted to three neurosurgery centres (Prince of Wales Hospital, Queen Elizabeth Hospital, and Queen Mary Hospital) in Hong Kong; SAH was diagnosed by brain computed tomography. They all had digital subtraction angiography (DSA) to look for intracranial aneurysms. One Chinese patient had no aneurysm detected with DSA. Data pertaining to 13 patients of other ethnic groups were excluded from this series. Therefore, 267 Chinese patients with ruptured intracranial aneurysms (281 admissions for spontaneous SAH) were eventually included in the series. In each case, the size and location of the ruptured aneurysm were recorded (Table 1). The size of each aneurysm was measured by DSA. The largest diameter was measured through the long axis of the aneurysm. When multiple aneurysms were present, the one responsible for rupture was determined by the computed tomographic SAH pattern, angiographic findings, or operative findings.

Results

Of the 267 patients included in our series, data pertaining to the age and size of the aneurysm were missing in a female patient. The patients in our series ranged in age from 13 to 96 years with a mean age of 59 years (standard deviation [SD], 14 years). There was a 67% (178/267) female predominance (Table 2); in women, the mean age was 61 (SD, 14) years, whereas in the 89 men it was 55 (SD, 12) years. Males presented with ruptured intracranial aneurysms at a younger mean age than females (mean age difference, 6 years; 95% confidence interval [CI], 3-10 years; P=0.001). There was no significant difference in the size of the ruptured aneurysms (*t* test, P=0.21) in men (mean size, 6.3 mm) and women (mean size, 5.6 mm).

Most of the aneurysms (224/267, 84%) were located in the anterior circulation. The two most common sites of rupture were the posterior communicating artery (70/267, 26%) and anterior communicating artery (60/267, 22%). Only 16% (43/267) of the aneurysms were in the posterior circulation;

香港蛛網膜下出血的華籍病人，其顱內動脈瘤破裂的大小、位置及多發性

目的 探討蛛網膜下出血的香港華籍病人，其顱內動脈瘤破裂的大小、位置及多發性。

設計 回顧研究。

安排 香港三間公營醫院。

患者 回顧1998年7月至2002年6月期間，共267位因顱內動脈瘤破裂而出現蛛網膜下出血的華籍病人。

結果 病人平均年齡59歲（介乎13至96歲之間），男女比例為1:2。男性顱內動脈瘤破裂的病發年齡比女性早（P=0.001）。前循環破裂動脈瘤（84%）較後循環破裂動脈瘤（16%）常見。後交通動脈（26%）及前交通動脈（22%）是最普遍的破裂位置。總括來說，64%動脈瘤為5 mm或以下。與其他位置比較，前交通動脈瘤多為5 mm或以下（P<0.05）。多發動脈瘤方面，本研究的現患率為17%，男性與女性患者的現患率並無顯著分別（P=0.30）。多發動脈瘤患者中，破裂的動脈瘤較最大而未破裂的動脈瘤為大（P<0.001）。與單發動脈瘤患者比較，多發動脈瘤患者有5 mm或以下動脈瘤的比例較少（P<0.05）。

結論 香港華籍患者的顱內動脈瘤情況與西方及日本患者不同。雖然破裂動脈瘤的位置分佈相似，香港患者的動脈瘤多為5 mm或以下。香港華籍患者的多發動脈瘤現患率與日本患者相近，卻比西方國家為低。

TABLE 1. Size and location of ruptured intracranial aneurysms

Location*	Size (mm)						Total
	≤5	6-10	11-15	16-20	21-25	>25	
Anterior circulation (84%)							
PComA	43	20	5	2	0	0	70
AComA	45	14	1	0	0	0	60
MCA	24	11	2	2	0	1	40
ICA†	14	5	0	3	0	1	23
OphtA	11	4	2	1	1	0	19
ACA	8	3	0	0	0	0	11
Posterior circulation (16%)							
BA	8	6	0	1	0	0	15
VA	1	6	0	0	0	0	7
PCA	6	0	1	0	0	0	7
PICA	5	1	1	0	0	0	7
SCA	3	2	0	0	0	0	5
AICA	2	0	0	0	0	0	2
Total	170	72	12	9	1	2	266

* PComA denotes posterior communicating artery, AComA anterior communicating artery, MCA middle cerebral artery, ICA internal carotid artery (including any aneurysm located in the intracranial portion of ICA), OphtA ophthalmic artery, ACA anterior cerebral artery, BA basilar artery, VA vertebral artery, PCA posterior cerebral artery, PICA posterior inferior cerebellar artery, SCA superior cerebellar artery, and AICA anterior inferior cerebellar artery

† Missing data for one case

TABLE 2. Age and sex distribution of patients with ruptured intracranial aneurysms

Sex	Age (years)									Total
	1-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	
Female*	1	1	7	38	27	47	47	8	1	177
Male	0	2	8	20	26	26	5	2	0	89
Total	1	3	15	58	53	73	52	10	1	266

* Missing data for one case

TABLE 3. Point prevalence of multiple aneurysms

Sex	Single aneurysm	Multiple aneurysms	Total
Female	145	33	178
Male	77	12	89
Total	222	45	267

TABLE 4. Proportion of small aneurysms (sized ≤5 mm) in patients with multiple and single aneurysms*

Size of aneurysm (mm)	Multiple aneurysms	
	Yes	No
≤5	23	147
>5	22	74

* Missing data for one case with single aneurysm

the basilar artery being the most frequent site of rupture (15/267, 6%) in this region.

The majority of the ruptured aneurysms were small. In all, 91% (242/266) of the aneurysms were 10 mm or less, whilst 64% (170/266) were 5 mm or less. Only 1% (two patients) had giant aneurysms (sized >25 mm). Statistical analysis showed that rupture at the anterior communicating artery involved a higher proportion of aneurysms of size 5 mm or less compared to all other locations (*Z* test, P<0.05).

The point prevalence of multiple aneurysms was 17%; of the 267 patients, 45 had two or more aneurysms diagnosed (Table 3). There was no significant difference in the proportion of multiple aneurysms in men and women (Pearson Chi squared test, P=0.30).

The *Z* test was conducted for the proportions of small ruptured aneurysms (sized ≤5 mm) between patients having single and multiple aneurysms (Table 4), which indicated that cases with single aneurysms had a larger proportion that were small (P<0.05). As for cases with multiple aneurysms, the ruptured aneurysms (mean size, 6.8 mm) were larger than the largest unruptured aneurysms (mean size, 3.9 mm) [P<0.001; 95% CI, 1.9-4.0 mm].

Discussion

Our study revealed the epidemiology of ruptured intracranial aneurysms in the Hong Kong Chinese population with SAH. There was a female predominance of patients with ruptured intracranial aneurysms, with a female-to-male ratio of 2:1. This pattern of female predominance has also been noted in studies from the West,[11] Japan,[16] and Taiwan.[15]

Our study demonstrated that male patients tended to present with ruptured aneurysms at a younger age. Nevertheless, there was no significant difference in the size of ruptured aneurysms in men and women. This difference in the peak age of incidence may be attributed to the lifestyles and other environmental differences between men and women.

Concerning the location of ruptured aneurysms, the majority were located in the posterior and anterior communicating arteries, which is similar to the pattern reported in western and Japanese populations.[8,16] Such findings are also consistent with previous literature from Hong Kong[14] and Taiwan,[15] which revealed a high proportion of anterior and posterior communicating artery aneurysms in the Chinese population.

As for the size of ruptured aneurysms, 64% (170/266) of the Chinese patients with SAH had small ruptured aneurysms (sized ≤5 mm). Previous study in the Chinese population also demonstrated a high proportion of such small aneurysms of size 5 mm or less.[17] This pattern was different from that in western and Japanese populations, in whom it was reported that only around 25 to 35% of ruptured intracranial aneurysms had a size of 5 mm or less.[8,16,18] Our series demonstrated a significantly larger proportion of aneurysms of 5 mm or less (170/266, 64%) than that reported in other populations. The point prevalence of giant aneurysms in our series (2/266, 1%) was similar to that reported in the Japanese population (1%).[16] However, the point prevalence of giant aneurysms in our Chinese cohort was significantly less than the figure of approximately 4% published in literature from the West.[8] The observed difference in the size of ruptured aneurysms among racial-ethnic groups can be due to genetic differences. Nevertheless, in contrast to Caucasian populations, the Japanese share the same Mongoloid origin with Chinese. Therefore, other factors, such as lifestyles

and other environmental factors, may contribute to these differences.

Notably, the percentage of small aneurysms (especially those ≤5 mm) rupturing in the anterior and posterior communicating arteries was high. In our series, aneurysms of anterior communicating artery were significantly associated with a small size of 5 mm or less compared to those in other locations. This can be explained by the relatively smaller thickness and diameter of the anterior communicating artery, which limits the size of the aneurysm at the time of rupture.

Many series, including our own, have demonstrated that the majority of ruptured aneurysms are less than 10 mm in diameter.[7,19] Some authors therefore argue that the risk of rupture for small aneurysms was high. However, we cannot determine the risk of rupture of small aneurysms unless we know the prevalence of small unruptured aneurysms. Screening for asymptomatic cerebral aneurysms is not routinely undertaken in Hong Kong. Our study simply examined ruptured aneurysms in a population with an unknown number of unruptured aneurysms. Furthermore, we do not know how many patients with ruptured aneurysms did not seek medical attention. Hence, the risk of rupture of those unruptured aneurysms cannot be extrapolated from the data of patients with ruptured aneurysms.

The point prevalence of multiple aneurysms in our series (45/267, 17%) was comparable to that in the Japanese population reported as around 15%,[10] whilst some literature describing western populations reported it to be 30%.[9,20,21] Many studies have listed the risk factors of multiple aneurysms, such as smoking, hypertension, and family history of cerebrovascular diseases.[20,21] Thus, the difference in the prevalence of multiple aneurysms may be related to the prevalence of risk factors in various populations. In our series, there was no significant difference in the proportion of multiple aneurysms between men and women, which is contrary to the general finding that female gender is a risk factor for multiple aneurysms.[9,21] However, as our series did not consider other risk factors for multiple aneurysms, a confounding effect cannot be excluded.

Concerning the size of multiple aneurysms, not surprisingly aneurysms of larger diameter are more likely to rupture. Our study also revealed that a larger proportion of patients had small aneurysms among those with single than multiple aneurysms. We speculate that the walls of aneurysms in patients with a single aneurysm are weaker than in patients with multiple aneurysms. Therefore, they may rupture before they become large or the rupture occurs before eruption of any new aneurysm.

Conclusions

Our study reveals the pattern of ruptured intracranial aneurysms, in terms of size, location, and the point prevalence of multiple aneurysms in a Hong Kong Chinese population. It helps to lay the foundation for future studies on intracranial aneurysms in the Chinese population. It also demonstrates that the pattern of ruptured intracranial aneurysms in Hong Kong Chinese population differed from that in western and Japanese populations. Although the locational distribution of ruptured aneurysms was similar, the Hong Kong Chinese population had a larger proportion of small aneurysms of size of 5 mm or less. The prevalence of multiple aneurysms in Hong Kong is comparable to that in the Japanese population, but lower than that in western populations.

References

1. Fogelholm R, Hernesniemi J, Vapalahti M. Impact of early surgery on outcome after aneurysmal subarachnoid hemorrhage. A population-based study. Stroke 1993; 24:1649-54.
2. Broderick JP, Brott TG, Duldner JE, Tomsick T, Leach A. Initial and recurrent bleeding are the major causes of death following subarachnoid hemorrhage. Stroke 1994;25:1342-7.
3. Pakarinen S. Incidence, aetiology, and prognosis of primary subarachnoid haemorrhage. A study based on 589 cases diagnosed in a defined urban population during a defined period. Acta Neurol Scand 1967;43(Suppl 29):1S-8S.
4. Phillips LH 2nd, Whisnant JP, O'Fallon WM, Sundt TM Jr. The unchanging pattern of subarachnoid hemorrhage in a community. Neurology 1980;30:1034-40.
5. Cioffi F, Pasqualin A, Cavazzani P, Da Pian R. Subarachnoid haemorrhage of unknown origin: clinical and tomographical aspects. Acta Neurochir (Wien) 1989;97:31-9.
6. Rinkel GJ, Djibuti M, Algra A, van Gijn J. Prevalence and risk of rupture of intracranial aneurysms: a systematic review. Stroke 1998;29:251-6.
7. Dickey P, Nunes J, Bautista C, Goodrich I. Intracranial aneurysms: size, risk of rupture, and prophylactic surgical treatment. Conn Med 1994;58:583-6.
8. Forget TR Jr, Benitez R, Veznedaroglu E, et al. A review of size and location of ruptured intracranial aneurysms. Neurosurgery 2001;49:1322-6.
9. Juvela S. Risk factors for multiple intracranial aneurysms. Stroke 2000;31:392-7.
10. Kaminogo M, Yonekura M, Shibata S. Incidence and outcome of multiple intracranial aneurysms in a defined population. Stroke 2003;34:16-21.
11. Unruptured intracranial aneurysms—risk of rupture and risks of surgical intervention. International Study of Unruptured Intracranial Aneurysms Investigators. N Engl J Med 1998;339:1725-33.
12. Ujiie H, Sato K, Onda H, et al. Clinical analysis of incidentally discovered unruptured aneurysms. Stroke 1993;24:1850-6.

13. Nakagawa T, Hashi K. The incidence and treatment of asymptomatic, unruptured cerebral aneurysms. J Neurosurg 1994;80:217-23.
14. So SC, Ngan H, Ong GB. Intracranial aneurysms causing subarachnoid haemorrhage in the Chinese. Surg Neurol 1979;12:319-21.
15. Howng SL, Hung TP, Kwan AL, Lin CL. Intracranial aneurysm in Taiwan [in Chinese]. J Formos Med Assoc 1995;94(Suppl 2):73S-80S.
16. Osawa M, Hongo K, Tanaka Y, Nakamura Y, Kitazawa K, Kobayashi S. Results of direct surgery for aneurysmal subarachnoid haemorrhage: outcome of 2055 patients who underwent direct aneurysm surgery and profile of ruptured intracranial aneurysms. Acta Neurochir (Wien) 2001;143:655-64.
17. Yu SC, Chan MS, Boet R, Wong JK, Lam JM, Poon WS. Intracranial aneurysms treated with Guglielmi detachable coils: midterm clinical and radiological outcome in 97 consecutive Chinese patients in Hong Kong. AJNR Am J Neuroradiol 2004;25:307-13.
18. Ohashi Y, Horikoshi T, Sugita M, Yagishita T, Nukui H. Size of cerebral aneurysms and related factors in patients with subarachnoid hemorrhage. Surg Neurol 2004;61:239-47.
19. Baumann F, Khan N, Yonekawa Y. Patient and aneurysm characteristics in multiple intracranial aneurysms. Acta Neurochir Suppl 2008;103:19-28.
20. Qureshi AI, Suarez JI, Parekh PD, et al. Risk factors for multiple intracranial aneurysms. Neurosurgery 1998;43:22-7.
21. Ellamushi HE, Grieve JP, Jäger HR, Kitchen ND. Risk factors for the formation of multiple intracranial aneurysms. J Neurosurg 2001;94:728-32.