Article published online: 2022-09-22

ORIGINAL ARTICLE

The impact of size and location on rupture of intracranial aneurysms

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ABSTRACT

Objective: For effective management of patients with unruptured intracranial aneurysms, prognostic criteria for rupture, of which aneurysm size, location, and multiplicity are key factors. The aim of this study is to determine the correlation between the aneurysm size, location, and multiplicity, and their effect on aneurysmal rupture.

Materials and Methods: Eighty one patients with diagnosis of intracranial aneurysms were managed at our center from January 2008 through July 2011. The characteristics of aneurysms, such as size, location, multiplicity, and presentation were retrospectively reviewed from their charts and radiological findings.

Results: Eighty one patients harboring 104 aneurysms were diagnosed, of them 45 were males (55.5%) and 36 were females (44.5%). Seventy-six patients (94%) presented with subarachnoid hemorrhage (SAH) due to ruptured aneurysm. Thirty-three patients who were presented with SAH (43%) had their ruptured aneurysm located at the anterior communicating artery with a mean size 5.8 mm. Most of the small (<7 mm) ruptured aneurysms were located at the anterior communicating artery, distal anterior cerebral arteries, posterior communicating arteries, and internal carotid artery bifurcation (51%, 13%, 11%, and 11%), respectively. There were 24 small unruptured aneurysms, 10 of them (42%) located at the middle cerebral arteries, while only 2 of them (8%) located at the anterior communicating artery.

Conclusions: The aneurysm size and location play a substantial role in determining the risk of rupture. The most common location of rupture of small aneurysms was the anterior communicating artery, while the middle cerebral artery was the commonest site for small unrupured aneurysms.

Key words: Aneurysm location, aneurysm size, intracranial aneurysms, multiple aneurysms, ruptured aneurysms

Introduction

Subarachnoid hemorrhage (SAH) from rupture of an intracranial aneurysm is a devastating event with a mortality of up to 50%.[1-3] The life threatening and debilitating sequelae of SAH may be prevented if the aneurysm can be occluded before rupture. For effective management of patients with unruptured aneurysms, prognostic criteria for the risk of rupture are needed of which aneurysm size, location, and multiplicity are key prognostic factors.

Access this article online	
Quick Response Code:	Website: www.asianjns.org
	DOI: 10.4103/1793-5482.144159

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Data from retrospective International Study of Unruptured Intracranial Aneurysms (ISUIA) calculated a much lower risk of rupture (0.05/year) of aneurysms less than 10 mm in diameter when the patient is asymptomatic.[4] Data from prospective ISUIA study showed a risk of rupture of 0.52% for aneurysms 7-12 mm in diameter of the anterior circulation and 2.9% for aneurysms located in posterior circulation in same size category.[5] Other studies have suggested that there is a critical size for aneurysm rupture, ranging from 4-10 mm.[6-10]

Other factors related to the rupture of aneurysms are shape,[11-14] volume,[15] and flow dynamics.[16]

Knowing the critical size of an aneurysm at specific location at which the incidence of rupture increases may help to identify the unruptured ICA that are likely to bleed.

The aim of the study was to review our patient population with intracranial aneurysms to determine the most common size of ruptured aneurysms and whether there is a critical size of the aneurysms at a specific location at which the incidence of rupture increases.

Materials and Methods

Epidemiological retrospective review of the medical charts and imaging findings of all patients admitted with the diagnosis of intracranial aneurysms to our hospital from January 2008 through July 2011. The size of the aneurysm was measured using the largest diameter measurement based on the long or perpendicular axis of the aneurysm. In most cases, the size was measured on the angiogram. In some cases, it was measured on computed tomography angiography (CTA). When there is suspicion of aneurysm thrombosis the size was measured on high resolution thin cuts computed tomography (CT) or magnetic resonant imaging (MRI).

The aneurysm sizes were divided into three categories: (1) smaller than 7 mm in diameter; (2) between 7-12 mm; and (3) larger than 13 mm in diameter.

In patients with multiple aneurysms, the ruptured aneurysm was confirmed by blood distribution on CT, aneurysm morphology, and finally intraoperative findings.

The aneurysm locations were classified as follows: (1) anterior communicating artery (AComA); (2) middle cerebral artery (MCA) all sites; (3) posterior communicating artery (PComA); (4) distal anterior cerebral artery (DACA); (5) anterior choroidal artery (AChA); (6) internal carotid artery bifurcation (ICB); (7) ophthalmic segment (OphthA); and 8) vertebro-basilar system (VB).

The cavernous segment aneurysms were excluded from the study.

Patients were categorized according to their presentation into: SAH group (ruptured group) and non-SAH Group (unruptured group).

The correlation between the aneurysm size and location was evaluated by one-way analysis of variants. All statistical analyses were performed using the Chi-square test. $P < 0.05$ was considered significant.

Results

There were 81 patients admitted with the diagnosis of intracranial aneurysms, of them 45 patients (55.5%) were males, age ranging in between 15-75 years (mean age, 58 years), and 36 patients (44.5%) were females, age ranging in between 16-74 years (mean 61 years).

The total number of aneurysms harbored by these patients were 104 aneurysms, of which 76 aneurysms were ruptured with a mean size 6.5 mm (range from 2-17 mm) and 33 aneurysms were unruptured with a mean size of 8.3 mm (range from 4-25 mm) [Table 1].

Seventy-six patients (94%) presented with SAH due to rupture of intracranial aneurysms (ruptured group) and 5 patients (6%) presented with manifestations other than SAH (unruptured group) [Table 2].

Seventeen patients had multiple aneurysms (21%) harboring a total of 39 aneurysms, of them, 16 patients (94%) presented with SAH due to rupture of an aneurysm [Table 3].

Table 1: Total aneurysms number according to mean size, location and presentation

Presentation Location	Total ans.				
	Ruptured	Mean size (mm)	Unruptured	Mean size (mm)	No.
AComA	33	5.8	3	8	36
MCA	10	9.3	11	5.7	21
PComA	9	7.6	1	5	10
DACA	9	6	2	3	11
AChA	-	-	4	3.5	4
ICB	7	5.9	1	5	8
Ophth	3	5.3	2	5	5
VB	5	6	4	14.5	9
Total	76	6.5	28	6.2	104

AComA – Anterior communicating artery; MCA – Middle cerebral artery; PComA – Posterior communicating artery; DACA – Distal anterior cerebral artery; AChA – Anterior choroidal artery; ICB – Internal carotid bifurcation; Ophth – Ophthalmic segment; VB – Vertebrobasilar system; ans. – Aneurysms; No. – Number

Table 2: Presentation of the 5 patients in the unruptured group

Ans. locations	Ans. size (mm)	Presentation
Lt. MCA	20	TIA and stroke
AComA	17	Visual deterioration
Lt. Ophth	6	Associated with left frontal AVM
Lt. PCA	33	Rt. sided hemiparesis
Rt. PICA	13	Ataxia and lower cranial nerves dysfunction

Lt. MCA - Left middle cerebral artery; AComA – Anterior communicating artery; Lt. Ophth – Left ophthalmic segment; lt. PCA – Left posterior cerebral artery; Rt. PICA – Right posterior inferior cerebellar artery; Ans – Aneurysms; No. – Case number

Table 3: Patients with multiple aneurysms presentation, size and location

	Presentation				
	Ruptured aneurysm (Ans. No.)	Unruptured aneurysms (Mean size) (mm)	Total Ans location Ans. (No.)	Mean size (mm)	No.
AComA	5	4.4	2	3.5	7
MCA	2	11.5	10	4.4	12
PComA	5	7	1	5	6
DACA	3	6	2	3	5
AChA	-	-	4	3.5	4
ICB	-	-	1	5	1
Ophth	-	-	1	4	1
VB	1	5	2	6	3
Total	16	6.5	23	4.3	39

For definition of location refer to Table 1

Size, location, and presentations

The locations of all aneurysms and their mode of presentation are shown in Table 1.

Out of the 76 patients, who presented with SAH, 33 patients (43%) had their ruptured aneurysms located at the AComA. With a mean size of 5.8 mm, while only 10 patients of the ruptured group (13%) had their ruptured aneurysms located at the MCA with a mean size of 9.3 mm.

Of the 34 patients that had their aneurysms located at the AComA 33 (97%) presented with SAH and only one patient had a large unruptured aneurysm presenting by visual deterioration as the aneurysm was compressing the optic chiasm [Table 4].

Tables 5 and 6 showed the relation between the aneurysms locations, sizes, and their presentations.

Out of the 76 ruptured aneurysms, there were 47 (62%) smaller than 7 mm in diameter, of them 24 patients (51%) has their aneurysms located at the AcomA and only 3 of them (6.3%) located at the MCA [Table 5].

There were a total of 28 unruptured aneurysms, 24 of them (78%) were smaller than 7 mm in diameter, 10 of them (42%) located at the MCA and only 2 of them (6%) were located at the AComA [Table 6].

A total of 21 aneurysms located at the MCA, 10 of them (48%) presented as ruptured aneurysms with a mean size of 9.3 mm, while 11 aneurysms were unruptured with a mean diameter of 5.7 mm.

The mean sizes of aneurysms according to locations and presentations are shown in [Table 1].

The mean size of ruptured aneurysms at the AcomA were smaller than ruptured aneurysms located at other sites, but this difference was not statistically significant. However, of ruptured aneurysms smaller than 7 mm in diameter, aneurysms located at the AComA were most frequent, and this was statistically significant ($P < 0.001$).

Table 4: Presentation of patients according to aneurysm location

Location*	Presentations: Ruptured group (%)	Unruptured group (%)	Total no. Of patients (%)
AComA#	33 (43)	1 (12.5)	34 (42)
MCA	10 (13)	1 (12.5)	11 (13)
PComA	9 (12)	-	9 (11)
DACA	9 (12)	-	9 (11)
AChA	-	-	-
ICB	7 (9)	-	7 (9)
Ophth	3 (4)	1 (12.5)	4 (5)
VB	5 (7)	2	7 (9)
Total	76 (100)	5 (100)	81 (100)

*For definition of location refer to Table 1, #significant difference ($P<0.05$)

Table 5: Number of the ruptured aneurysms according to size and location

Location*	Size of ruptured aneurysm: <7 mm	7-12 mm	>13 mm	Total ans. No.
AComA#	24	7	2	33
MCA	3	5	2	10
PComA	5	3	1	9
DACA	6	2	1	9
AChA	-	-	-	-
ICB	5	2	-	7
Ophth	2	1	-	3
VB	2	2	1	5
Total (%)	47 (62)	22 (29)	7 (9)	76 (100)

For definition of location refer to Table 1. <7 mm – less than 7 mm; >13 mm – More than 13 mm; ans. – Aneurysms; No – Number; Statistically significant ($P<0.001$)

Table 6: Number of the unruptured aneurysms according to size and location

Location*	Size of unruptured aneurysm: <7 mm	7-12 mm	>13 mm	Total ans. No.
AComA	2	-	1	3
MCA	10	-	1	11
PComA	1	-	-	1
DACA	2	-	-	2
AChA	4	-	-	4
ICB	1	-	-	1
Ophth	2	-	2	
VB	2	-	2	4
Total (%)	24 (78)	-	4 (22)	28 (100)

For definition of location and size refer to Table 1

Discussion

Intracranial aneurysms are relatively common, occurring in an estimated 0.2% to 9% of the general population,[9,17] Of these, unruptured intracranial aneurysms (UIA) constitute 2-5%.[18] Because of the grave effect of aneurysmal SAH, and a lack of understanding the natural history of these lesions, the management of UIA is controversial.[10,19,20]

Although the prevention of hemorrhage has been advocated in recent times as the most effective strategy aimed at lowering mortality rates, management decisions require an accurate assessment of the risk of various treatment options compared with the natural history of the UIA.[21,22] The natural history of the UIA and treatment outcomes are influenced by factors such as previous aneurysmal SAH, age of patients, aneurysm characters such as size, location, and morphology, and experience of the treating team.

Recent studies have indicated that intracranial aneurysm size may be a primary determinant of rupture probability,[23] reporting critical sizes at which the incidence of rupture increases are 4-10 mm. Zacks *et al*. stated that unruptured aneurysms <10 mm have a good prognosis without surgical treatment[24] and Wiebers *et al*. claim that there is a critical diameter of 10 mm below which aneurysms rarely rupture.[19]

According to retrospective ISUIA data,[4] the rate of rupture of aneurysms less than 10 mm in diameter was less than 0.05% per year in patients with no SAH history and 0.5% per year in patients with previous history of SAH. Additionally, in prospective ISUIA results,[5] the annual rupture rates for patients without a history of SAH with aneurysms located in the anterior circulation were 0% for aneurysms less than 7 mm and 0.5% for those ranging from 7-12 mm in diameter. They reported that the annual rate for posterior circulation were 0.5% and 2.9% for the same size categories, respectively.

However, Juvela *et al*.[25,26] reported that 142 patients harboring 181 aneurysms followed over a 20-year period showed a 1.3% annual risk of rupture in previously unruptured aneurysms. Yonekura[27] observed the natural history of small unruptured aneurysms (<5 mm in diameter) without surgical treatment and found that the annual rupture rate was 0.8% for 380 aneurysms followed-up for a mean of 13.8 months. These findings support our published opinion from previous study that small aneurysms (less than 6 mm) are not innocuous and hazardous and they warrant treatment before rupture.[3]

In our study, the mean size of ruptured aneurysms according to their locations were 5.8 mm in the AcomA, 9.3 mm in the MCA, 7.6 mm in the PcomA, 6 mm in the DACA, 5.7 in the ICB, and 6 mm in the VB system. These results contradict the ISUIA results that small aneurysms are safe and tend not to rupture easily.

Kassel and Torner found that 13% of ruptured aneurysms were less than 5 mm, while 57% were between 5 and 10 mm in diameter and they concluded that the unruptured aneurysms less than 10 mm in diameter could not be considered innocuous and operation should be considered for lesions more than 5 mm in diameter.[7]

Ohashi *et al*. analyzed 280 patients with ruptured aneurysms and found that 208 (74.3%) aneurysms were smaller than 10 mm in diameter, and 73 aneurysms (26.1%) were smaller than 5 mm in diameter.[28] In our study, 64 of ruptured aneurysms (84%) were less than 10 mm in diameter and 47 aneurysms (63%) were smaller than 7 mm in diameter.

In this study, there were 76 patients out of 81 (94%) with ruptured aneurysms, among them 33 patients had their ruptured aneurysms located at the AComA (43%) as compared with other sites; the difference was statistically significant ($P < 0.001$).

Of these ruptured 76 aneurysms, 47 (62%) were smaller than 7 mm in diameter and 69 (91%) were smaller than 12 mm in diameter. The ruptured AComA aneurysms less than 7 mm in diameter were much more common than aneurysms at other locations, where 24 aneurysm out of 33 (72%) were less than 7 mm in diameter; but the difference was statistically insignificant.

Most of our small ruptured aneurysms located at the AComA indicating that the AComA is the most dangerous site for aneurysm rupture, and it is recommended that AComA aneurysm of any size should be considered for surgical or endovascular treatment when discovered. Also, most of the aneurysms located at the DACA, PComA, and ICB (67%, 56%, and 71%) respectively, presented as a ruptured aneurysms while they are smaller than 7 mm in diameter.

Joo *et al*. in their study concluded that the majority of aneurysm rupture before reaching 7 mm (71.8%) and 10 mm (87.9%) in diameter, and the most frequent site of ruptured aneurysms is the AComA.[29]

In this study, 42% of the small unruptured aneurysms located at the MCA is considered a benign site for a small aneurysm and this may be attributed to intraaneurysmal hemodynamic stress, which is more in the AComA than MCA.[30,31]

Ebina and Ferguson[12,32] suggested that certain aspects of MCA morphology predispose this location to the formation of large aneurysms. Qureshi *et al*.[33] reported that MCA aneurysms were larger than aneurysms at other locations and Joeng YG *et al*. found that ruptured aneurysms in the AComA were smaller than those in the MCA.[34]

Forget *et al*.[18] noted that 94.4% of ruptured aneurysms of the AcomA were less than 10 mm and 44% were less than 5 mm in diameter; this is in agreement with our results where 91% of ruptured aneurysms at the AComA were less than 10 mm in diameter and 73% were less than 7 mm in diameter. The diameter of the AcomA and DACA is smaller than that of the MCA; therefore, aneurysms located in the AComA and DACA may bleed before they reach a large size.[28]

Some authors have suggested that aneurysms shrink after rupture. Wiebers *et al*.[5] noted aneurysmal shrinkage after rupture, so the calculated size of ruptured aneurysm does not truly reflect their sizes before rupture, but recently Kotaoka *et al*.[35] analyzed histological findings for both ruptured and unruptured aneurysms and concluded that there is no evidence to suggest that aneurysm shrink after rupture supporting our believe that small aneurysms can rupture.

Rehman *et al*. concluded that size ratio, which is the ratio between the aneurysm size and parent artery diameter calculated from the 2- or 3- dimensional angiogram, correlates with intracranial aneurysm rupture status.[36] Also, Dieky and Kailasnath in their diameter-cube hypothesis reported that the size-specific rupture probability of an aneurysm varies as the third power of the aneurysm diameter and concluded that all aneurysms have definite risk of rupture and deserve consideration for treatment.[15]

In our study, 17 patients (21%) had multiple aneurysms, 16 of them (94%) presented with SAH, in 12 of these 16 patients (75%) the ruptured aneurysms were less than 7 mm in diameter and 5 of them (42%) located at the AComA. In all patients with multiple aneurysms presented with SAH, all the 23 unruptured aneurysms except one were less than 7 mm in diameter and 10 of them (43%) located at the MCA. This may indicate that in patients with multiple unruptured aneurysms, the small aneurysms should not be considered as the benign ones specially if located on hemodynamic stress location like ACmoA and DACA.

Conclusions

Our data showed that the majority of aneurysm had ruptured while they are small in size and there was no size threshold beyond which the incidence of rupture of aneurysm is increasing.

The majority of the small ruptured intracranial aneurysm located at the AComA and DACA that should be considered as dangerous locations for aneurysm rupture due to hemodynamic stress and unruptured aneurysms of any size at these locations should be considered for treatment.

Although the aneurysm size is a key factor in determining the risk of rupture, other factors such as aneurysm location and multiplicity should be considered for treatment strategies of unruptured intracranial aneurysms.

We cannot consider small aneurysms are safe lesions and they should be considered for treatment specially those locate at areas of hemodynamic stress.

References

1. Broderick JP. Stroke trends in Rochester, Minnesota, during 1945 to 1984. Ann Epidemiol 1993;3:476-9.
2. 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.
3. Orz Y, Kobayashi S, Osawa M, Tanaka Y. Aneurysm size: A prognostic factor for rupture. Br J Neurosurg 1997;11:144-9.
4. 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.
5. Wiebers DO, Whisnant JP, Huston J 3rd, Meissner I, Brown RD Jr, Piepgras DG, *et al*. Unruptured intracranial aneurysms: Natural history, clinical outcome, and risks of surgical and endovascular treatment. Lancet 2003;362:103-10.
6. Crompton MR. Mechanism of growth and rupture in cerebral berry aneurysms. Br J Neurosurg 1966;1:1138-42.
7. Kassell NF, Torner JC. Size of intracranial aneurysms. Neurosurgery 1983;12:291-7.
8. Locksley HB. Natural history of subarachnoid hemorrhage, intra- cranial aneurysms and arteriovenous malformations. J Neurosurg 1966;25:321-68.
9. McCormick WF, Acosta-Rua GJ. The size of intracranial saccular aneurysms: An autopsy study. J Neurosurg 1970;33:422-7.
10. Wiebers DO, Whisnant JP, O'fallon WM. The natural history of unruptured intracranial aneurysm. N Engl J Med 1981;304:696-8.
11. Asari S, Ohmoto T. Natural history and risk factors of unruptured cerebral aneurysms. Clin Neurol Neurosurg 1993;95:205-14.
12. Ferguson GG. Physical factors in the initiation, growth, and rupture of human intracranial aneurysms. J Neurosurg 1972;37:666-77.
13. Park SD, Won YS, Kwon YJ, Yang JY, Choi CS. Angiographic characteristics of the intracranial saccular aneurysms to predict the rupture. Korean J Cerebrovasc Surg 2007;9:87-93.
14. Rohde S, Lahmann K, Beck J, Nafe R, Yan B, Raabe A, *et al*. Fourier analysis of intracranial aneurysms: Towards an objective and quantitative evaluation of the shape of aneurysms. Neuroradiology 2005;47:121-6.
15. Dickey P, Kailasnath P. The diameter-cube hypothesis: A new biophysical model of aneurysm rupture. Surg Neurol 2002;58:166-73.
16. Kiyohara Y, Ueda K, Hasuo Y, Wada J, Kawano H, Kato I, *et al*. Incidence and prognosis of subarachnoid hemorrhage in a Japanese rural community. Stroke 1989;20:1150-5.
17. Atkinson JL, Sundt TM Jr, Houser OW, Whisnant JP. Angiographic frequency of anterior circulation intracranial aneurysms. J Neurosurg 1989;70:551-5.
18. Forget TR Jr, Benitez R, Veznedaroglu E, Sharan A, Mitchell W, Silva M, *et al*. A review of size and location of ruptured intracranial aneurysms. Neurosurgery 2001;49:1322-5; discussion 1325-6.
19. Wiebers DO, Whisnant JP, Sundt TM, O'Fallon WM. The significance of unruptured intracranial saccular aneurysms. J Neurosurg 1987;66:23-9.
20. Weibers DO, Torres VE. Screening for unruptured intracranial aneurysms in autosomal dominant polycystic kidney disease. N Engl J Med 1992;327:953-5.
21. Broderick JP, Brott TG. Initial and recurrent bleeding are the leading cause of death following subarachnoid hemorrhage. Stroke 1994;25:1342-7.
22. Orz YI, Hongo K, Tanaka Y, Nagashima H, Osawa M, Kyoshima K, *et al*. Risks of surgery for patients with unruptured intracranial aneurysms. Surg Neurol 2000;53:1-29.
23. Kyriacou SK, Humphrey JD. Influence of size, shape and properties on the mechanics of axisymmetric saccular aneurysms. J Biomech 1996;29:1015-22.
24. Zacks DJ, Russel DB, Miller JD. Fortuitously discovered intracranial aneurysms. Arch Neurol 1980;37:39-41.
25. Juvela S, Porras M, Heiskanen O. Natural history of unruptured intracranial aneurysms: A long-term follow-up study. J Neurosurg 1993;79:174-82.
26. Juvela S, Porras M, Poussa K. Natural history of unruptured intracranial aneurysms: Probability of and risk factors for aneurysm rupture. J Neurosurg 2000;93:379-87.
27. Yonekura M. Small unruptured aneurysm verification (SUAVe Study, Japan)-interim report. Neurol Med Chir (Tokyo) 2004;44:213-4.
28. 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;61:239-45.
29. Joo SW, Lee SI, Noh SJ, Jeong YG, Kim MS, Jeong YT. What is the significance of a large number of ruptured aneurysms smaller than 7 mm in diameter? J Korean Neurosurg Soc 2009;45:85-9.
30. Ljunggren B, Saveland H, Brandt L, Zygmunt S. Early operation and overall outcome in aneurysmal subarachnoid hemorrhage. J Neurosurg 1985;62:547-51.
31. Shaker LN, Heros RC. Origin, growth and rupture of saccular aneurysm: A review. Neurosurgery 1981;8:248-60.
32. Ebina K, Shimizu T, Sohma M, Iwabuchi T. Clinicostatistical study on morphological risk factors of middle cerebral artery aneurysms. Acta Neurochir (Wien) 1990; 106: 153-9.
33. Qureshi AI, Sung GY, Suri MF, Straw RN, Guterman LR, Hopkins LN. Factors associated with aneurysm size in patients with sub- arachnoid hemorrhage: Effect of smoking and aneurysm location. Neurosurgery 2000;46:44-50.
34. Jeong YG, Jung YT, Kim MS, Eun ChK, Jang SH. Size and location of ruptured intracranial aneurysms. J Korean Neurosurg Soc 2009;45:11-5.

35. Kataoka K, Taneda M, Asai T, Yamada Y. Difference in nature of ruptured and unruptured cerebral aneurysms. Lancet 2000;355:203.
36. Rahman M, Smietana J, Hauck E, Hoh B, Hopkins N, Siddiqui A, *et al*. Size ratio correlates with intracranial aneurysm rupture status: A prospective study. Stroke 2010;41:916-20.

How to cite this article: Orz Y, AlYamany M. The impact of size and location on rupture of intracranial aneurysms. Asian J Neurosurg 2015;10:26-31.
Source of Support: Nil, **Conflict of Interest:** None declared.