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Original Research Article

Anterior Communicating Artery Aneurysm Clipping: Experience at a Tertiary Care Center with Respect to Intraoperative Rupture

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Abstract

Aim: The aim of the present study was to evaluate various factors (size, wall morphology, and fundus direction) associated with intraoperative rupture (IOR) of Acomm aneurysm.

Methods: This was a retrospective study conducted at the IGIMS, Patna, India. Data were collected from medical records of the department for the period of 24 months. We reviewed the case of 20 operated patients diagnosed to have ruptured Acomm aneurysm.

Results: The mean age of patients was 59.2 ± 6.24. Of 20 patients, 9 (45%) were male and 11 (55%) were female. All the patients underwent surgical clipping of the ruptured Acomm aneurysm. According to Hunt and Hess grade, majority of the patients were under grade 2. 80% had headache and 55% had surgical timing >14 days. Patients in whom unilateral and bilateral A1 visualized were 5 and 14, respectively. A2 was visualized unilaterally in 1 patient and bilaterally in 20 patients. However, A1 and A2 of both sides were found intraoperatively in all cases. Aneurysm neck width was classified into <4 mm or ≥4 mm sizes and this difference was statistically not significant. Aneurysmal dome size was divided into three categories and this correlation came to be significant. Aneurysmal wall was simple or smooth and multilobed or irregular and this difference was statistically significant. Aneurysm direction was classified into anterior, superior, posterior, and inferior based on CTA and intraoperative findings and these differences in IOR were found to have statistical significance. In our study, proximal A1 was clipped bilaterally, unilaterally and no clipping was done. Patients with bilaterally clipped A1 experienced no IOR, while in unilaterally clipped aneurysm and these values were statistically significant on correlation. In our study, 1 patient belonged to age group <20 years, 3 patients from ≥20 to 39 years of age group, 8 patients from ≥40 to 59 years of age group, and 8 patients from ≥ 60 years of age group. Although correlation these findings were not significant.

Conclusion: We concluded that various factors remarkably associated with increased risk of IOR are: Aneurysm size >4 mm, multilobulated or irregular aneurysm wall, posteriorly and/or inferiorly directed aneurysms.

Keywords: Aneurysm fundus direction, anterior communicating artery aneurysm, Glasgow outcome score, intraoperative rupture, temporary clipping

Introduction

AcoA aneurysms are the most common intracranial aneurysms, accounting for 23–40% of intracranial aneurysms and 12–15% of unruptured aneurysms, and are the most common type of intracranial aneurysm in patients under 30 years old. [1-3] AcoA aneurysms are more likely to rupture than are other types of intracranial aneurysms due to their anatomical and hemodynamic characteristics. [3,4] The international study of unruptured intracranial aneurysms (ISUIA) reports that smaller anterior circulation intracranial aneurysms are associated with lower risks of rupture and that the risk of rupture is <1% per year for anterior circulation aneurysms with a diameter < 7mm. [2,5-7] However, a large number of recent studies have found that AcoA aneurysms <7mm still have a very high risk of rupture, accounting for approximately 40% of all ruptured intracranial aneurysms. [6,8]

Bijlenga et al [9] found that the risk of rupture risk for more than 900 cases of AcoA aneurysms with a size of 4–7mm was similar to that for posterior circulation aneurysms. In a study of 200 cases of ruptured aneurysms, Lee et al [10] found that 47% were small aneurysms (<5mm) and that the most common rupture site was in the AcoA. The further in-depth study found that for microaneurysms (<3mm), the rupture occurred more frequently in patients with hypertension combined with AcoA aneurysms. Therefore, for AcoA aneurysms, regardless of rupture and size, active intervention should be conducted once they are discovered.

At present, with the development of endovascular interventional techniques and interventional materials, increasingly more intracranial aneurysms can be embolized by endovascular techniques or treated with flow diverters; however, endovascular treatment cannot be performed due to the complex structure of AcoA aneurysms, such as a poor aspect ratio (dome/neck), inability to place catheters, and influencing blood flow in collateral blood vessels. Moon et al [11] reviewed the long-term prognosis of AcoA aneurysms included in the Barrow Ruptured Aneurysm Trial (BRAT). After randomization, 91 patients (70%) with AcoA aneurysms were included in the clipping group, and 39 patients (30%) were included in were embolization group. In the embolization group, 16.9% of the patients crossed over from this group to the surgical clipping group due to embolization difficulties. No patients were transferred from surgical clipping to coiling embolization. There was no significant difference in clinical outcomes between the 2 groups after 1–3 years of follow-up (once per year). However, the retreatment rate for the surgical clipping group was superior to that for the embolization group. Among them, 3 patients (3.3%) have retreated in the clipping group, and 3 patients (7.7%) have retreated in the coiling embolization group.

The aim of the present study was to evaluate various factors (size, wall morphology, and fundus direction) associated with intraoperative rupture (IOR) of Acomm aneurysm.

Materials and Methods

This was a retrospective study conducted at the IGIMS, Patna, India. Data were collected from medical records of the department for the period of 24 months . We reviewed the case of 20 operated patients diagnosed to have ruptured Acomm aneurysm.

Our study included all patients with ruptured Acomm aneurysm who received clipping as method of treatment. Exclusion criteria were: Patient with multiple aneurysms, patients who were hospitalized due to trauma, patients who were diagnosed with IA but did not receive surgical treatment.

We collected data on the following variables at the time of presentation: Age, gender, comorbidities (hypertension, diabetes mellitus, end-stage renal disease [ESRD], and cerebrovascular accident), Glasgow coma scale (GCS), Hunt and Hess Grade, Glasgow outcome score (GOS), and various factors related to Acomm aneurysm morphology.

Three-dimensional computed tomography angiography (CTA) was done in all patients in whom SAH was seen on conventional computed tomography (CT) scan. The morphological details of the aneurysm and circle of Willis were depicted from CT angiography such as size, neck width, wall morphology, and fundus direction.

Statistical Analysis

The data were summarized using medians/mean for continuous variables, and counts and percentages for categorical variables. Differences of significance in categorical variables were evaluated using Chi-square test. The data collected were statistically analyzed using GraphPad Prism version 8.0.0 program $P < 0.05$ was considered statistically significant.

Results

Table 1: Patient characteristics

Gender	**N (%)**
Male	9 (45)
Female	11 (55)
Hunt and Hess grade	
Grade 1	5 (25)
Grade 2	8 (40)
Grade 3	5 (25)
Grade 4	1 (5)
Grade 5	1 (5)
Symptoms	
Headache	16 (80)
Seizures	3 (15)
Altered sensorium	11 (55)
Surgical timing (days)	
0-3	7 (35)
4-14	2 (10)
>14	11 (55)

The mean age of patients was 59.2 ± 6.24. Of 20 patients, 9 (45%) were male and 11 (55%) were female. All the patients underwent surgical clipping of the ruptured Acomm aneurysm. According to Hunt and Hess grade, majority of the patients were under grade 2. 80% had headache and 55% had surgical timing >14 days.

Table 2: Computed tomography angiography findings

	Unilateral	Bilateral	None
A1 visualized	5	14	
A2 visualized	1	20	

Patients in whom unilateral and bilateral A1 visualized were 5 and 14, respectively. A2 was visualized unilaterally in 1 patient and bilaterally in 20 patients. However, A1 and A2 of both sides were found intraoperatively in all cases. Unilateral nonvisualization of A1 or A2 in few cases in preoperative CTA may be due to vasospasm.

Table 3: Aneurysm characteristics (with respect to intraoperative rupture)

	Intraoperative rupture (*n*=5)	**No intraoperative rupture (*n*=15)**	***P***
Neck width			
<4 mm	1	4	0.2290
≥4 mm	4	11	
Aneurysm size			
<4 mm	0	7	0.0460
>4‑10 mm	4	7	
>10 mm	1	1	
Aneurysm wall morphology			
Simple/smooth	1	13	0.0018
Multilobed/irregular	4	2	
Fundus direction			
Anterior	1	8	0.0115
Superior	1	6	
Posterior	2	0	
Inferior	1	1	
Proximal clipping of A1			
Not done	4	1	0.0055
Unilateral	1	8	
Bilateral	0	6	

Aneurysm neck width was classified into <4 mm or ≥4 mm sizes and this difference was statistically not significant. Aneurysmal dome size was divided into three categories and this correlation came to be significant. Aneurysmal wall was simple or smooth and multilobed or irregular and this difference was statistically significant. Aneurysm direction was classified into anterior, superior, posterior, and inferior based on CTA and intraoperative findings and these differences in IOR were found to have statistical significance. In our study, proximal A1 was clipped bilaterally, unilaterally and no clipping was done. Patients with bilaterally clipped A1 experienced no IOR, while in unilaterally clipped aneurysm and these values were statistically significant on correlation.

Table 4: Risk of intraoperative aneurysm rupture

	Intraoperative rupture (*n*=5)	**No intraoperative rupture (*n*=15)**	***P***
Age (years)			
<20	0	1	0.8220
≥20‑39	1	2	
≥40‑59	1	7	
≥60	3	5	
Gender			
Male	1	8	0.5175
Female Comorbidity	4	7	
Hypertension	3	10	0.6769
Diabetes	2	3	0.9230
Previous history of CVA	1	2	0.9409
ESRD	1	1	0.5590
GOS			
5	0	8	0.0007
4	1	7	
3	2	0	
2	1	0	
1	1	0	

In our study, 1 patient belonged to age group <20 years, 3 patients from ≥20 to 39 years of age group, 8 patients from ≥40 to 59 years of age group, and 8 patients from ≥ 60 years of age group. Although correlation these findings were not significant.

Discussion

The anterior communicating artery (Acomm) is one of the most common locations for intracranial aneurysm (IA). They account for approximately 10% of unruptured aneurysms, [12] and as high as 45% of ruptured aneurysms. [13] The Acomm aneurysm is considered to be at increased risk for rupture and therefore necessitates aggressive management. [14] Rupture of aneurysm results into subarachnoid hemorrhage (SAH) formation. Rupture of Acomm aneurysm may also produce basal frontal hematoma and intraventricular hemorrhage.

The mean age of patients was 59.2 ± 6.24. Of 20 patients, 9 (45%) were male and 11 (55%) were female. Chee et al [15] found almost similar results with 42.9% males, 57.1% females and mean age 51 ± 11.82 years. All the patients underwent surgical clipping of the ruptured Acomm aneurysm. According to Hunt and Hess grade, majority of the patients were under grade 2. 80% had headache and 55% had surgical timing >14 days. Patients in whom unilateral and bilateral A1 visualized were 5 and 14, respectively. A2 was visualized unilaterally in 1 patient and bilaterally in 20 patients. However, A1 and A2 of both sides were found intraoperatively in all cases. Aneurysm neck width was classified into <4 mm or ≥4 mm sizes and this difference were statistically not significant. Pang et al [16] found that the risk of rupture tended to increase as the size of the IA increased.

Aneurysmal dome size was divided into three categories and this correlation came to be significant. Aneurysmal wall was simple or smooth and multilobed or irregular and this difference was statistically significant. Aneurysm direction was classified into anterior, superior, posterior, and inferior based on CTA and intraoperative findings and these differences in IOR were found to have statistical significance. In our study, proximal A1 was clipped bilaterally, unilaterally and no clipping was done. Kim MC et al [17] found in his study that smooth aneurysm wall was observed in 38 aneurysms (44%) in the ruptured group and 25 aneurysms (57%) in the unruptured group. Patients with irregular walled aneurysm resulted into 48 (56%) ruptured and 19 (43%) unruptured cases; thus, it can be inferred that smooth wall was more frequently associated with unruptured than with ruptured aneurysms (57% vs. 44%). Although Matsukawa et al [18] found that an anterior direction of the aneurysm dome around the Acomm aneurysm was related to high rupture rate.

Patients with bilaterally clipped A1 experienced no IOR, while in unilaterally clipped aneurysm and these values were statistically significant on correlation. In our study, 1 patient belonged to age group <20 years, 3 patients from ≥20 to 39 years of age group, 8 patients from ≥40 to 59 years of age group, and 8 patients from ≥ 60 years of age group. Although correlation these findings were not significant. Suzuki et al [19] was the first to classify the relationship between bilateral A2 of superiorly projecting AcoA aneurysms with the open A2 plane side (when the pterional approach is used on this side, A2 on this side near the aneurysm body is located more posteriorly than the contralateral A2) and the closed A2 plane side (when the pterional approach is used on this side, A2 on this side near the aneurysm body is located more anteriorly than the contralateral A2). It is very difficult to expose the aneurysm neck during an operation on the closed A2 plane side, and it may be necessary to remove the gyrus rectus and pull the A2 segment during the operation, which may easily lead to a residual aneurysm neck and more postoperative complications. In subsequent studies, Hyun et al [20] also proposed a relationship between bilateral A2 and concluded that surgery on the closed A2 plane side may be associated with more postoperative complications, and the use of the open A2 plane side for the operation may be easier and safer for exposing the aneurysm neck and may reduce postoperative complications.

Conclusion

We concluded that various factors remarkably associated with increased risk of IOR are: Aneurysm size >4 mm, multilobulated or irregular aneurysm wall, posteriorly and/or inferiorly directed aneurysms. We encourage temporary clipping of both A1 in Acomm aneurysms as there is less chance of IOR and better outcome. Although the incidence of IOR may never be completely abolished by identifying the various risk factors responsible for IOR, the surgeon can anticipate and be better prepared to deal with it.

References

1. Froelich S, Cebula H, Debry C, Boyer P. Anterior communicating artery aneurysm clipped via an endoscopic endonasal approach. Operative Neurosurgery. 2011 Jun 1;68:ons 31 0-6.
2. UCAS Japan Investigators. The natural course of unruptured cerebral aneurysms in a Japanese cohort. New England Journal of Medicine. 201 2 Jun 28;366(26):2474-82.
3. Wong H, Banfield J, Hughes N, Shankar JJ. Are anterior communicating aneurysms truly anterior communicating aneurysms? An observational study. World Neurosurgery. 201 9 May 1;125:e1089-92.

4. Matsukawa H, Uemura A, Fujii M, Kamo M, Takahashi O, Sumiyoshi S. Morphological and clinical risk factors for the rupture of anterior communicating artery aneurysms. Journal of neurosurgery. 2013 May 1;118(5):978-83.
5. Dehdashti AR, Chiluwal AK, Regli L. The implication of anterior communicating complex rotation and 3-dimensional computerized tomography angiography findings in surgical approach to anterior communicating artery aneurysms. World neurosurgery. 2016 Jul 1;91:34-42.
6. Wilson ML, Fleming KA, Kuti MA, Looi LM, Lago N, Ru K. Access to pathology and laboratory medicine services: a crucial gap. The Lancet. 2018 May 12;391(10133):1927-38.
7. Ivan ME, Safaee MM, Martirosyan NL, Rodríguez-Hernández A, Sullinger B, Kuruppu P, Habdank-Kolaczkowski J, Lawton MT. Anatomical triangles defining routes to anterior communicating artery aneurysms: the junctional and precommunicating triangles and the role of dome projection. Journal of neuros-urgery. 2019 Apr 5;132(5):1517-28.
8. Zheng J, Guo Z, Xu R, He Z, Sun X. Microsurgical treatment for patients with fenestrated anterior communicating artery aneurysms. World Neurosurgery. 2019 May 1; 125:e807-11.
9. Bijlenga P, Ebeling C, Jaegersberg M, Summers P, Rogers A, Waterworth A, Iavindrasana J, Macho J, Pereira VM, Bukovics P, Vivas E. Risk of rupture of small anterior communicating artery aneurysms is similar to posterior circulation aneurysms. Stroke. 2013 Nov;44(11):3018-26.
10. Lee GJ, Eom KS, Lee C, Kim DW, Kang SD. Rupture of very small intracranial aneurysms: incidence and clinical characteristics. Journal of cerebrovascular and endovascular neurosu - rgery. 2015 Sep 1;17(3):217-22.
11. Moon K, Levitt MR, Almefty RO, Nakaji P, Albuquerque FC, Zabramski JM, McDougall CG, Spetzler RF. Treatment of ruptured anterior communicating artery aneurysms: equipoise in the endovascular era?. Neurosur-gery. 2015 Oct 1;77(4):566-71.
12. Wiebers DO. Unruptured intracranial aneurysms: natural history, clinical outcome, and risks of surgical and endovascular treatment. The Lancet. 2003 Jul 12;362(9378): 103-10.
13. Molyneux A. International Subarachnoid Aneurysm Trial (ISAT) of neurosurgical clipping versus endovascular coiling in 2143 patients with ruptured intracranial aneurysms: a randomised trial. The Lancet. 2002 Oct 26; 360(9342):1267-74.
14. Greving JP, Wermer MJ, Brown RD, Morita A, Juvela S, Yonekura M, Ishibashi T, Torner JC, Nakayama T, Rinkel GJ, Algra A. Development of the PHASES score for prediction of risk of rupture of intracranial aneurysms: a pooled analysis of six prospective cohort studies. The Lancet Neurol-ogy. 2014 Jan 1;13(1):59-66.
15. Chee LC, Siregar JA, Ghani AR, Idris Z, Rahman NA. The factors associated with outcomes in surgically managed ruptured cerebral aneurysm. The Malaysian journal of medical sciences: MJMS. 2018 Feb;25(1):32.
16. Pang PK, Chan KY, Zhu XL, Datta NN, Ur Rehman S, Htun Aung T, Poon CY, Kwok JC. Use of elective temporary clips in preventing intraoperative cerebral aneurysm rupture. Annals of the College of Surgeons of Hong Kong. 2004 May;8(2):44-8.
17. Kim MC, Hwang SK. The rupture risk of aneurysm in the anterior communicating artery: a single center study. Journal of Cerebrovascular and Endovascular Neuros-urgery. 2017 Mar;19(1):36-43.
18. Matsukawa H, Uemura A, Fujii M, Kamo M, Takahashi O, Sumiyoshi S. Morphological and clinical risk factors for the rupture of anterior communicating artery aneurysms. Journal of neurosurgery. 2013 May 1;118(5):978-83.
19. Suzuki M, Fujisawa H, Ishihara H, Yoneda H, Kato S, Ogawa A. Side selection of pterional approach for anterior communicating artery aneurysms–surgical anatomy and strategy. Acta neurochirurgica. 2008 Jan;150:31-9.
20. Hyun SJ, Hong SC, Kim JS. Side selection of the pterional approach for superiorly projecting anterior communicating artery aneurysms. Journal of Clinical Neuroscience. 2010 May 1; 17(5):592-6.