DOI: 10.21608/pajn.2025.325991.1151

Original Article

Microsurgical and Endovascular Management of Ruptured Anterior Communicating Artery Aneurysms: Single-center Study

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Received: 4 October 2024 / **Accepted:** 9 March 2025 / **Published online:** 15 June 2025

BACKGROUND: Treatment of ruptured anterior communicating artery (AcomA) aneurysms is still challenging.

OBJECTIVE: We report our experience with management of ruptured AcomA aneurysms, discussing factors controlling selection of management strategy and analyzing radiological and clinical outcomes.

PATIENTS AND METHODS: This retrospective analysis included 72 patients with ruptured AcomA aneurysms treated at our institute between July 2013 and July 2023. Patients were divided into two groups according to the treatment modality used: Group A; microsurgical clipping group, and Group B; endovascular coiling group.

RESULTS: This study included 72 patients, 29 (40%) of them were micro-surgically clipped (group A) and 43 (60%) were endovascularly coiled (group B). At admission, intracerebral hematoma (ICH), intraventricular hemorrhage (IVH) and hydrocephalus were more predominant in group A. One patient experienced rebleeding 3 days after microsurgical clipping from an aneurysm remnant (reclipping was done with a fatal outcome). Chronic hydrocephalus requiring permanent ventriculo-peritoneal (VP) shunt occurred in 2 cases (7%) in group A and 7 patients (16%) in group B. Good recovery was reported in 22 patients (76%) in group A and 28 patients (65%) in group B. Early postoperative computerized tomography angiography (CTA) revealed complete aneurysm occlusion in (97%) of patients in group A and (81%) in group B. Stability of occlusion was reported at 100% in group A and 80% in group B.

CONCLUSION: Management of ruptured AcomA aneurysms is still challenging, but satisfactory outcome results can be achieved in centers with the availability of both endovascular coiling and microsurgical clipping facilities, besides adequate neuro-intensive care management and early rehabilitation.
KEYWORDS: Anterior communicating artery aneurysms, Endovascular coiling, Microsurgical clipping.

INTRODUCTION

The anterior communicating artery (AcomA) is the most common site for ruptured intracranial aneurysms accounting for more than one third of aneurysmal subarachnoid hemorrhage (SAH).[1] The reported rates of combined morbidity and mortality following rupture of AcomA aneurysms are greater than that for other locations and ranges between 10% and 40%.[2] Surgical approaches to treat AcomA aneurysms are typically challenged by location into the interhemispheric fissure, relation to the diencephalon and perforating arteries besides the frequent anomalies of the AcomA complex.[2,3] Advances in the microsurgical techniques greatly improved the surgical outcome of AcomA aneurysm clipping.[3-5] Although the obviously less invasive endovascular treatment of intracranial aneurysms is gaining more acceptance as a simpler alternative to the more stable surgical clipping, coiling of some AcomA aneurysms can be technically demanding especially when aneurysm size is small < 3 mm, neck is wide, morphology is complex, incorporation of AcomA and/or presence of acute vessel angles.[1,6-8]

In this study, we present our single institution practice of microsurgical and endovascular management in 72 patients who presented with ruptured AcomA aneurysms. We will discuss the factors controlling the choice of management strategy, analyze treatment results, and review the radiological and clinical outcomes of our patients.

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PATIENTS AND METHODS

This is a retrospective study of the collected data of 72 patients with ruptured AcomA aneurysms treated at our institute between July 2013 and July 2023. The Tanta University's institutional review board (IRB) and the local ethical committee approved the study (approval code: 34049/8/20). We included only patients with complete documentations and neuroimages. An informed consent form was obtained from each patient's guardian before the operation, and each patient was informed of the study's purpose, the details of the procedure, and the advantages and disadvantages of the procedure.

We allocated the patients into two groups according to the treatment modality applied to secure the ruptured AcomA aneurysm: group A; microsurgical clipping group and group B; endovascular coiling group. Hunt and Hess classification,[9] was used to record the clinical status of the patients at admission. Patients presenting in Hunt and Hess grades (I, II or III) were considered good grade patients. Patients presenting in Hunt and Hess grades (IV or V) were considered poor grade patients. Fisher scale,[10] was used to describe the extent of SAH in the admission computerized tomography (CT) of the brain.

Cerebral CTA was performed for all patients at admission and was the basis for the diagnosis and analysis of the aneurysm characteristics and intracerebral vessels. After initial stabilization, all patients were given routine medical treatment for SAH including Calcium channel blocker (Nimodipin), analgesics, gastric prophylaxis, anticonvulsant drugs, and intravenous (IV) fluids. Poor-grade patients were admitted to the intensive care unit (ICU). External ventricular drain (EVD) was inserted for patients with poor clinical grade and those with ventricular dilatation before endovascular coiling. Ventricular dilatation in patients planned for microsurgical clipping was managed by preoperative EVD in three patients, Intraoperative fenestration of the lamina terminalis was performed in all group A patients, and a lamina terminalis tube was inserted in 10 cases.

Our practice is to actively secure the ruptured aneurysm (whether coiling or clipping) within the 1st 72 hours after the ictus for patients with good clinical grade. Patients with a poor clinical grade are managed initially conservatively and reconsidered for active management once there is acceptable clinical improvement. All patients were admitted to the ICU after securing the aneurysm (coiling or clipping) until they were clinically stable. Patients were usually discharged from the ICU to the general ward at the end of the 2nd or 3rd post-bleeding week.

Angiographic analysis

Preoperative CTA with 3 dimensional (3D) reconstruction was carefully evaluated with special emphasis on factors that affect the selection and planning of treatment modality, such as anatomical features and anomalies of the anterior communicating artery complex (A1s, A2s, AcomA and recurrent arteries of Heubner), dominance and difference in size of A1 vessels. In addition, the AcomA aneurysm was judiciously assessed with distinctive assessment of the dome projection relative to the A2s, the largest diameter of the aneurysm sac, the neck size, the dome-to-neck ratio, and the aspect (height-to-neck) ratio. Aneurysms were classified according to their size as small (<7 mm), medium (7-12 mm), large (>12 <25 mm) and giant (> 25 mm). Aneurysms were also classified according to the dome projection in relation to the A2s plane as anterior, posterior, superior (between A2s) and inferior. For complex aneurysms protruding into more than one direction, the main projection direction was considered.

Choice of treatment modality

The initial decision about the more suitable treatment modality was taken by the neurovascular team based on several factors including patient state and aneurysm characteristics. This initially chosen treatment modality was recommended and explained to the patients and/or their families. The ultimate choice of treatment modality was based on the neurovascular team recommendation, patient will, and socioeconomic factors. Factors that were in favor of endovascular coiling included age > 60 years, medical comorbidities, current use of blood thinners, small aneurysm neck (< 4 mm), dome projection behind the A2s plane, dome-to-neck ratio > 2 and aspect ratio > 2. Factors that were in favor of microsurgical clipping: clipping included age< 60 years, low surgical risk, presence of ICH exerting mass effect, severe vessel tortuosity, low-riding AcomA < 10 mm from planum sphenoidale, large aneurysm neck (> 4mm), dome projection in front of A2s plane, dome-to-neck ratio < 2, aspect ratio < 2, very small aneurysms < 3 mm and aneurysms with size > 10 mm. Microsurgical clipping was used to secure 29 ruptured AcomA aneurysms (group A). Endovascular coiling was used to secure 43 ruptured AcomA aneurysms (group B).

Microsurgical clipping

All patients were operated upon through the lateral supraorbital approach in supine position.

merge with previous sentence in single paragraphskin incision was made 1 cm behind the hairline from midline to 1 cm above the zygoma. The subperiosteal dissection of a single layer skin muscle flap was done. One burr hole was placed under the anterior border of the temporalis muscle along the superior temporal line, and then craniotomy flap was fashioned and elevated. Following opening the dura, cerebrospinal fluid (CSF) was liberated form the basal cisterns and then from lamina terminalis to relax the brain. If more space was needed, some of the ICH away from the aneurysm can be removed. The A1s were dissected to gain proximal control before aneurysm manipulation. Under high magnification, a precise dissection of the aneurysm neck was performed. When necessary, bipolar shaping of the aneurysm neck can be performed under temporary clipping.

The residual ICH can be removed after finishing the clipping and checking the vessel patency. Occasionally, a small blood clot was left behind so as not to injure the underlying perforators. It had been our practice since July 2016 to insert a silicon tube inside the third ventricle through the fenestrated lamina terminalis and attach it to the EVD system to continue draining bloody CSF from the ventricles to the outside of the body. Follow-up CT brain was performed early after surgery to evaluate for hemorrhage, ventricular size, or other findings.

Side of the approach

The proper selection of the side of the approach is one of the critical prerequisites for safe microsurgical clipping of the ruptured AcomA aneurysm. The main factors that affected our selection of the side of the approach were the dome projection direction, the location of the dominant A1, the morphology of the A2 planes and the side of the ICH if present. It is beneficial to advance toward the aneurysm from the contralateral side of the dome projection so that the neck can be dealt with before being confronted with the usually ruptured dome. Selecting the side of the dominant A1 secures early proximal control of the principal afferent vessel as the contralateral A1 can be obscured by the aneurysm dome, especially the inferiorly projecting one. Choosing the side of the more posteriorly located A2 is advantageous (except for posteriorly projecting aneurysm) as the A2s plane becomes more open and the aneurysm neck is better exposed. Approaching the aneurysm from the side of the ICH, if present, gives more space for clipping after evacuation of the hematoma and avoids the bilateral injury to the gyrus rectus. Careful flexible evaluation of

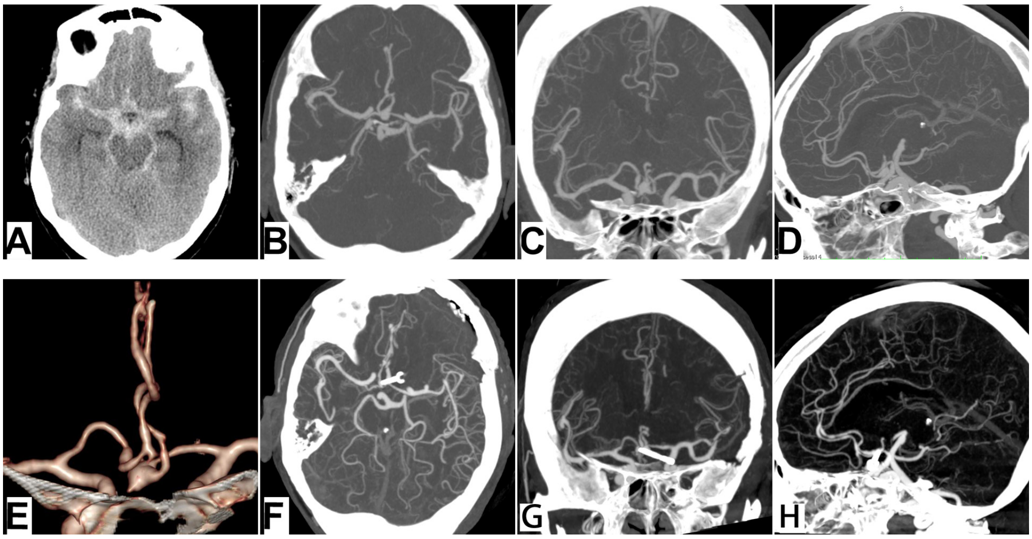

Fig 1: Illustrative case 1. (A): Admission CT brain Showing Fisher grade III SAH. Preoperative CTA axial (B): Coronal (C): Sagittal (D): And 3D reconstruction (E): Views demonstrating the ruptured small AcomA aneurysm which has a wide neck and irregular configuration. Post-operative CTA axial (F): Coronal (G): And sagittal (H): Views showing complete clipping of the ruptured AcomA aneurysm through left lateral supraorbital approach.

these factors together in the preoperative CT and 3D CTA was performed for every case. (Fig. 1).

Endovascular technique (EVT):

General anesthesia was administered to all patients. During the procedure, heparin was only added to the flushing solutions (2500 IU heparin/1000ml 0.9% saline) of the guiding catheter and microcatheter. Activated clotting time was sustained 2-3 folds of the natural value. In all patients, a transfemoral approach with a double-wall puncture was used. Initial cerebral angiography was performed with high-resolution digital biplane fluoroscopy and road mapping using a 5-F diagnostic catheter (Boston Scientific, Bern) to determine the best projection for defining the aneurysmal neck and its relationship to the anterior cerebral arteries and adjacent arterial branches.

A 6-F guiding catheter (Guider soft tip; Stryker) was then guided into the cervical carotid artery. Next, a steam-shaped microcatheter (Excelsior SL-10; Stryker or Echelon; Covidien) was installed coaxially through the guiding catheter and then directed into the aneurysm using a 0.010- or 0.014-inch guide microwire (Transend; Stryker or Traxcess; Microvention). To achieve acceptable opacification of the aneurysm lumen, a framing coil was first placed, and then sequentially smaller filling coils were inserted. Coils were chosen based on the size and shape of the aneurysms. **(Fig. 2).**

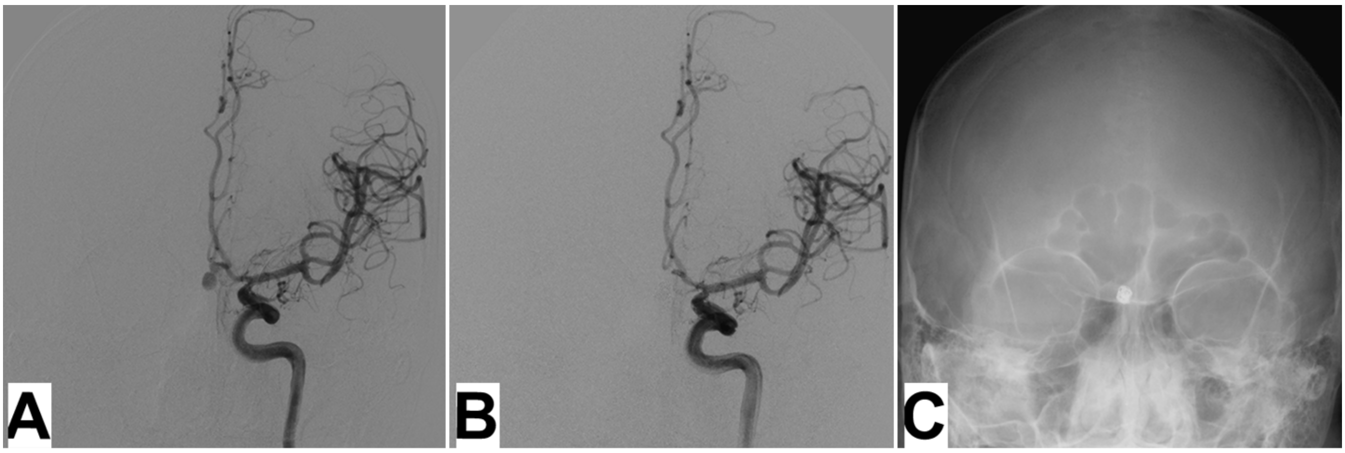

Fig 2: Illustrative case 2. (A): Left carotid angiogram anteroposterior (A-P) view Showing the ruptured 5 mm AcomA aneurysm. (B): Post-coiling left carotid angiogram A-P view: Showing complete exclusion of the AcomA aneurysm from circulation with patent AcomA and bilateral anterior cerebral arteries. (C): Fluoroscopic image Showing the coil mass.

Outcome assessment

We used the Glasgow outcome Scale (GOS)[11] for the clinical evaluation of patients at the outpatient clinic 3 months after the securing of the aneurysm. Cerebral digital subtraction angiography (DSA) for endovascular cases or day 2 CTA for microsurgery cases were used for radiological evaluation of the degree of aneurysm occlusion, parent vessel patency, and any vasospasm. Angiographic reevaluation (CTA for clipped aneurysms and magnetic resonance angiography (MRA) or DSA for coiled aneurysms) was scheduled at 3, 6, and 12 months after management to reveal the stability of occlusion. We used the Raymond-Roy occlusion grading[12] to score the degree of angiographic occlusion of the aneurysm in the DSA, MRA or CTA. Class I; complete obliteration of both the aneurysm fundus and neck, Class II; fundus obliteration with residual neck filling, and Class III; residual fundus filling. **(Figs. 3,4)**

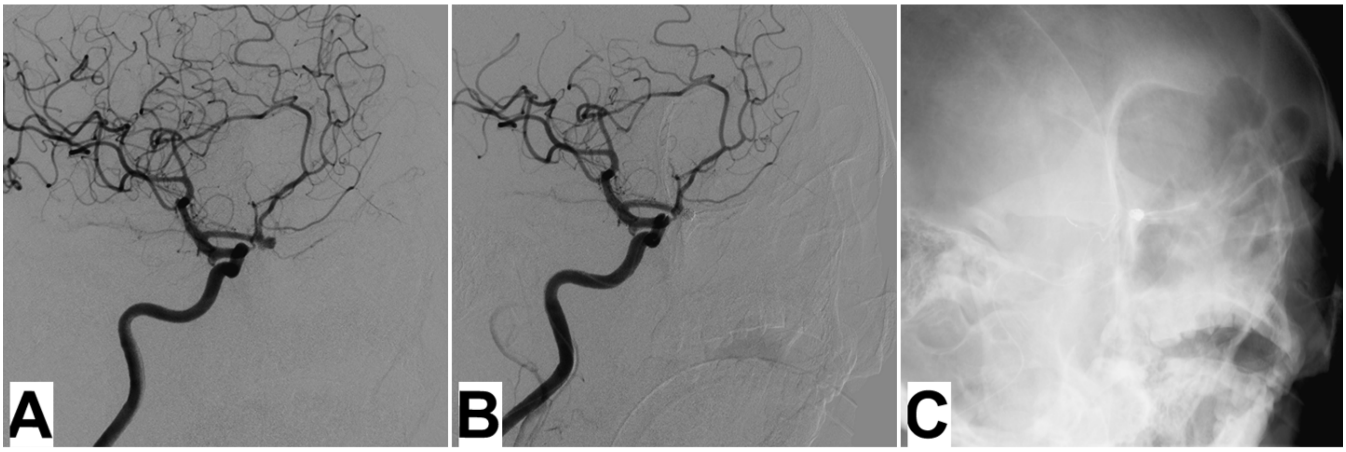

Fig 3: Illustrative case 3. A): Right carotid angiogram working view Showing the ruptured 4 mm AcomA aneurysm. (B): Post-coiling right carotid angiogram working view Showing complete exclusion of the AcomA aneurysm from circulation with patent AcomA and bilateral anterior cerebral arteries. (C): Fluoroscopic image working view Showing the coil mass.

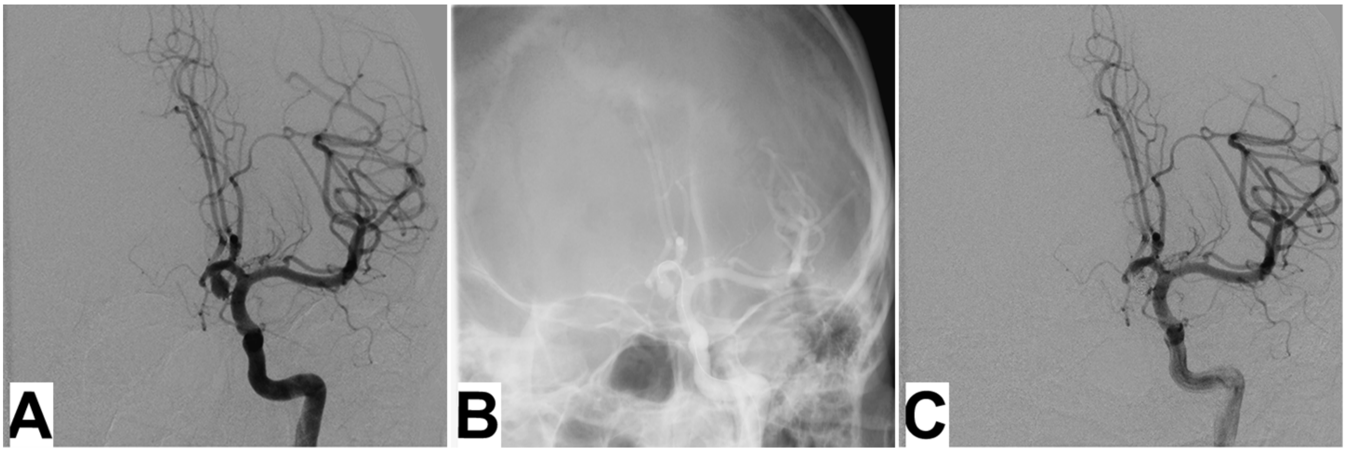

Fig 4: Illustrative case 4. (A): Left carotid angiogram working view Showing the ruptured 6 mm AcomA aneurysm. (B): Road map image Showing the microcatheter inside the aneurysm.(C): Post-coiling left carotid angiogram working view Showing complete exclusion of the AcomA aneurysm from circulation with patent AcomA and bilateral anterior cerebral arteries.

Statistical Analysis

Statistical package for social sciences (SPSS) 20.0 software (SPSS Inc., Chicago, IL, USA) was used for the statistical analysis. The data was presented as mean ± standard deviation (SD).Numerical data were tested using Student's t tests, and categorical data were tested using Chi-square tests. Statistical significance was defined as a P-value less than 0.05.

RESULTS

From July 2013 to May 2020, 87 patients underwent securing of their ruptured AcomA aneurysm at our institution. Complete data and angiographic images were available for 72 patients, all of whom were included in this study. Overall, 29 (40%) of the ruptured AcomA aneurysms were micro-surgically clipped (group

A) and 43 (60%) ruptured AcomA aneurysms were endovascularly coiled (group B). Patients in groups A and B had a mean age of 49.1±7.1 years, and 54.6±11.2 years, respectively.

There were 11 men (38%) and 18 women (62%) in group A, while there were 17 men (40%) and 26 women (60%) in group B. Sixty-nine percent of the patients treated with microsurgical clipping had Hunt and Hess grades I & II, while seventy-five percent of patients treated with endovascular coiling had Hunt and Hess grades II & III **(Table 1).**

Aneurysms in group A were mostly of medium size (52%) while in group B were mostly of small size (56%). In group A, the most common aneurysm dome projection was anterior (55%), whereas in group B, the most common dome projection was superior (35%). group A's admission CT brain showed higher rates of IVH, ICH, and hydrocephalus than group B **(Table 2).**

Procedure-related complications occurred in 10 cases (34%) in group A and in seven cases (16%) in group B. In group A, seven patients (24%) experienced intraoperative rebleeding from the aneurysm during dissection around the aneurysm neck without worse sequelae, one patient (3%) experienced rebleeding 3 days after clipping from the aneurysm remnant (reclipping was done with fatal outcome), and two patients (7%) developed infarction in the territory of the recurrent artery of Heubner with moderate disability in one patient and severe disability outcome in the other patient. Two patients had a superficial wound infection that resolved with appropriate antibiotics. In group B, two patients (5%) experienced intraoperative aneurysm perforation without worse sequelae, one patient (2%) had intraprocedural thromboembolic events that were managed with moderate disability outcome, and four patients (9%) developed groin hematomas that were managed conservatively without sequalae.

Post-procedure seizure occurred in two cases (7%) in group A and in three cases (7%) in group B. Symptomatic vasospasm (evidenced by development of new neurologic symptoms) occurred in 7 cases (24%) in group A and in 6 cases (14%) in Group B. Chronic hydrocephalus requiring permanent VP shunt developed in 2 cases (7%) in group A and in 7 cases (16%) in group B. We summarized the measured Glasgow outcome score at the 3-month follow-up in both groups in **(Table 3).**

Angiographic outcome

The early postoperative CTA in group A revealed residual fundus filling (class III) in one patient (3%). Unfortunately, the patient deteriorated on the third postoperative day due to rebleeding from the aneurysm remnant and was re-operated for clipping with fatal outcome. All the remaining 28 (97%) patients in group A showed (class I) complete angiographic occlusions in the early postoperative CTA which remained stable in all the 25 surviving patients (100%) in the follow-up CTA at 3-6 months. Early angiographic outcome in group B revealed total occlusion (class I) in 30 cases (81%), residual neck filling (class II) in 10 cases (12%), and residual fundus filling (class III) in 3 cases (7%). Angiographic follow-up (at 3-6 months) for the surviving 40 patients of group B revealed stable occlusion grade in 32 patients (80%), further thrombosis in 2 patients (5%) and recanalization in 6 patients (16%) with no hemorrhagic complications so far.

Table 1: Baseline patient characteristics

		Group A (n=29)		Group B (n=43)		Total (n=72)	
		n.	%	n.	%	n.	%
Gender	Male	11	38%	17	40%	28	39%
	Female	18	62%	26	60%	44	61%
Medical comorbidities & special habits	Hypertension	7	24%	10	23%	17	24%
	Diabetes	4	14%	8	19%	12	17%
	Ischemic heart disease	0		2	5%	2	3%
	Renal disease	2	7%	0		2	3%
	Smoking	6	21%	12	28%	18	25%
Hunt and Hess grade	Grade I	6	21%	4	9%	10	14%
	Grade II	14	48%	17	40%	31	43%
	Grade III	4	14%	15	35%	19	26%
	Grade IV	5	17%	7	16%	12	17%
Age (mean ± standard deviation)		49.1 ± 7.1 years		57.3± 11.2 years		54.6± 10.7 years	

Table 2. Admission CT findings and aneurysm angiographic characteristics

		Group A (n=29)	Group B (n=43)	Total (n=72)
Intracerebral hematoma		11 (38%)	4 (9%)	15 (21%)
Intraventricular hemorrhage		7 (24%)	1 (2%)	8 (11%)
Hydrocephalus		13 (45%)	6 (14%)	19 (26%)
Fisher grade	Grade I	0	4 (9%)	4 (6%)
	Grade II	4 (14%)	10 (23%)	14 (19%)
	Grade III	10 (34%)	20 (47%)	30 (42%)
	Grade IV	15 (52%)	9 (21%)	24 (33%)
Aneurysm Projection	Anterior	16 (55%)	11 (26%)	27 (38%)
	Superior	10 (34%)	15 (35%)	25 (35%)
	Posterior	1 (3%)	13 (30%)	14 (19%)
	Inferior	2 (7%)	4 (9%)	6 (8%)
Aneurysm size	Small (<7 mm)	9 (31%)	24 (56%)	33 (46%)
	Medium (7-12 mm)	15 (52%)	18 (42%)	33 (46%)
	Large ((>12-<25 mm)	5 (17%)	1 (2%)	6 (8%)
	Giant (≥ 25 mm)	0	0	0

Table 3. Glasgow outcome score at 3 months follow-up

	Group A (n=29)		Group B (n=43)		Total (n=72)	
	n.	%	n.	%	n.	%
Good recovery	22	(76%)	28	(65%)	50	69%
Moderate disability	2	(7%)	8	(19%)	10	14%
Severe disability	1	(3%)	3	(7%)	4	6%
Vegetative	0	(0%)	1	(2%)	1	1%
Death	4	(14%)	3	(7%)	7	10%

DISCUSSION

While endovascular coiling is often recommended as the primary treatment,[13] we did not follow this conventional prioritization and instead based our choice between coiling and clipping on various factors related to aneurysm, patient, and socioeconomic considerations. In this report, we presented the management of 72 ruptured AcomA aneurysms at our institute from July 2013 to July 2023. Of these, 29 underwent microsurgical clipping (group A) and 43 underwent endovascular coiling (group B). The aim of this paper was not to compare the two modalities but to explore the outcomes of integrating both approaches for managing ruptured AcomA aneurysms.

At our institute, we have implemented a protocol for the early active treatment of ruptured intracranial aneurysms, including those affecting the AcomA, in patients who are clinically fit within the first 72 hours onset. This approach reduces the risk of aneurysm rebleeding, which can have severe or fatal consequences. Additionally, after securing the ruptured aneurysm, maintaining higher blood pressure levels can help prevent or manage vasospasm and secondary cerebral ischemia. Early active treatment is commonly favored in clinical practice.[14,15] Furthermore, we initiated rehabilitation for motor and cognitive impairments soon after securing the aneurysm. It has been shown that early physiotherapy and rehabilitation can improve functional outcomes after aneurysmal subarachnoid hemorrhage.[16-19]

In our study, we found that the mean Hunt and Hess grade for patients undergoing microsurgical clipping (group A) was slightly lower than that for those undergoing endovascular coiling (group B), but this difference was statistically insignificant (p=0.754). This suggests our preference for endovascular coiling in cases of ruptured AcomA aneurysms where patients present with poorer clinical conditions, provided the socioeconomic conditions allow for it. This approach agrees with a recent study from the Czech Republic, where a statistically significant difference in the Hunt and Hess grades was observed between microsurgery and endovascular treatments for AcomA aneurysms, reflecting their policy to prioritize endovascular treatment for AcomA aneurysms in poor clinical conditions.[14]

In group A, we encountered untimely aneurysm rebleeding in seven cases (24%) while dissecting around the aneurysm neck. To manage this, we employed direct suction and applied a small cottonoid over the bleeding point. Temporary clipping of the A1s was then performed, followed by completion of dissection around the aneurysm neck to allow the application of a pilot clip proximal to the bleeding point under direct visual control. The clipping process then continued until the final clip was applied. In the literature, the rate of intraoperative aneurysm rupture during surgical clipping of ruptured AcomA aneurysms varies up to 20%, depending mainly on the aneurysm size and the surgical approach used.[20,21]

In group B, all patients underwent simple coiling without the use of stents or balloon assistance to reduce the risk of thromboembolism during the acute phase. We encountered one case (1%) of thromboembolism during the coiling procedure, where we continued aneurysm packing until complete occlusion was achieved, followed by intraarterial infusion of tirofban until the flow was fully restored. The patient experienced moderate weakness in the lower limb postoperatively, which gradually improved with physiotherapy. In the literature, the reported rates of intra-procedure thromboembolic complications range from 5% to 28%. In addition, total recanalization was achieved in 40% of cases with the use of tirofban injection and mechanical thrombectomy.[22-24]

In Group B, two cases (5%) experienced intraprocedural aneurysm perforation. In the first instance, perforation occurred during the deployment of the framing coil, which was detected by the coil being visualized outside the aneurysm. The treatment involved partially withdrawing and readjusting the coil, followed by rapid dense coil packing until contrast leakage ceased. Blood pressure was modestly lowered, protamine sulfate was infused to reverse the effects of heparin, and intracranial pressure (ICP) was decreased by opening the already inserted external ventricular drain (EVD). In the second case, perforation was diagnosed post-procedure via extra-aneurysmal contrast leakage on CT scan. The patient received IV mannitol for 24 hours to lower the ICP. Both patients recovered gradually without permanent neurological consequences. In the literature, the rate of intraprocedural aneurysm rupture varies (between 2.3% and 8%,), with higher rates in ruptured aneurysms, leading to increased morbidity and mortality.[24,25]

In this series, microsurgical clipping achieved the initial complete occlusion of AcomA aneurysms in 97% of cases, which remained stable in all cases (100%) at 3-6 months follow-up. Endovascular coiling resulted in initial complete occlusion in 81% of the cases. At 3-6 months follow-up, additional aneurysm thrombosis occurred in 5% of the coiled aneurysms, while aneurysm recanalization was observed in 15% of the cases. For incompletely coiled or recanalized AcomA aneurysms, conservative management with further angiographic follow-up was preferred. No rebleeding from these aneurysms has occurred thus far.

Aneurysm recurrence after coiling can result from coil migration into the intra-aneurysmal thrombus, coil compaction, or true aneurysmal growth. The recurrence rate was higher for ruptured aneurysms compared with unruptured ones, with over half of the coiled ruptured aneurysms experiencing recanalization in some series, particularly with extended follow-up. The management of these refilling aneurysms varies, ranging from conservative approaches to active retreatment with recoiling or surgical clipping. There are no set criteria for retreatment, and decisions are made on a case-by-case basis. Reported retreatment rates in the literature range from 3.5% to 34%.[26-28]

In this series, a good outcome (Glasgow lower casescore of 4 or 5) was achieved in 60 cases (83%), with no significant difference between group A (microsurgical clipping) and group B (endovascular coiling) (83% in group A, 84% in group B; p value=0.9540). All these cases had a preoperative status of Hunt and Hess grade 1-3. Poor outcome (GOS score of 1-3) occurred in 12 patients (17%), with no significant difference between both groups (17% in group A, 16% in Group B; p value=0.9173). All these casas had a preoperative status of Hunt and Hess grade 4.

The authors believe that the final outcome after treatment of ruptured intracranial aneurysms is influenced by various factors beyond the treatment modality itself. Adverse effects of SAH, IVH, ICH, vasospasm, hydrocephalus, and/or delayed cerebral ischemia are major contributors to an unfavorable outcome. Additionally, the expertise of the vascular neurosurgeon, the neuro-interventionist, and the intensive care unit (ICU) management team also play significant roles in determining the final outcome.

The outcome of treating ruptured AcomA aneurysms was generally favorable in approximately 78% of patients, regardless of whether microsurgery or endovascular treatment was utilized.[29] Some studies have reported a higher incidence of favorable outcomes with microsurgery compared to endovascular treatment,[14,30] whereas others have found the opposite.[31,32] However, these studies typically rely on general outcome measures like the Glasgow Outcome Scale (GOS) and/or modified Rankin scale (mRS), which may not adequately detect neuropsychological deficits. The International Subarachnoid Aneurysm Trial (ISAT) revealed cognitive impairment in one-third of patients with a favorable outcome according to the mRS, with such deficits more common after microsurgery due to frontal lobe retraction and gyrus rectus dissection.[33]

In a recent comparative study comparing the outcomes of endovascular and surgical treatments for ruptured AcomA aneurysms, Harris et al.[13] found no statistically significant differences in post-procedure seizures, vasospasm, or the need for cerebrospinal fluid (CSF) diversions. Similarly, in our series, we did not observe significant differences between group A and group B concerning post-procedure seizures or vasospasm, which we attributed to SAH rather than the treatment procedure itself. However, we did find a significant difference in the need for permanent ventriculoperitoneal (VP) shunts ($p = 0.0476$). During the microsurgical clipping of ruptured AcomA aneurysms, as well as all other ruptured anterior circulation aneurysms, we adopted several measures such as washing the cisternal SAH, opening the lamina terminalis for the drainage of bloody CSF from the ventricles, and leaving a silicon tube inside the third ventricle for the external drainage of bloody CSF from the ventricles since July 2016. These steps were believed to effectively reduce arachnoid scarring, consequently reducing the occurrence of chronic shunt-dependent hydrocephalus after aneurysmal SAH.[34]

AcomA aneurysms pose significant challenges for microsurgical treatment due to their deep location and complex relationships with the surrounding vessels and perforators. Anatomical variations and rotations are common, often leading to intraoperative confusion. Different projections of the aneurysm dome present specific surgical challenges: The posterior dome projection complicates the dissection of AcomA perforators, while the superior projection challenges the identification and dissection of the contralateral A2. The inferior projection risks sac avulsion with frontal lobe retraction and may obscure the contralateral A1, requiring careful clipping. The anterior projection typically obscures the contralateral A1-A2 junction, further complicating the dissection.[35,36] Similarly, AcomA aneurysms present challenges for endovascular coiling due to concerns regarding costs, long-term durability, and risks of recurrence and rebleeding. In addition, endovascular coiling may not be suitable as the sole treatment option in certain cases, such as those with space-occupying intracerebral hemorrhage (ICH).

Recent advancements in neurosurgical aids (As the indocyanine-green video-angiography), endovascular devices, and intensive care management protocols have contributed to a reduction in mortality rates among patients treated for aneurysmal SAH.[37,38] It is believed that both high-quality microsurgical clipping and endovascular coiling of intracranial aneurysms should be available in any center aiming to actively treat such conditions. Additionally, high-quality neuro-intensive care management and early rehabilitation are deemed essential for salvaging and improving the functional outcomes of aneurysmal SAH patients, irrespective of the chosen treatment modality.

The limitations of our study include its retrospective nature and single-center design. The choice of treatment modality was influenced by socioeconomic factors and patient preferences, introducing bias. The study sample size was somewhat small. To draw more generalizable conclusions, larger sample sizes from multicenter prospective studies are necessary.

CONCLUSION

The management of ruptured AcomA aneurysms is still challenging, but satisfactory outcome results can be achieved in centers with the availability of both endovascular coiling and microsurgical clipping facilities besides the adequate neuro-intensive care management and the early rehabilitation.

List of Abbreviations

AcomA: Anterior communicating artery.
CSF: Cerebrospinal fluid.
CT: Computerized tomography.
CTA: Computerized tomography angiography.
DSA: Digital subtraction angiography.
EVD: External ventricular drainage.
GOS: Glasgow outcome score.
ICH: Intracerebral hematoma.
ICU: Intensive care unit.
IRB:Institutional review board.
IV: Intravenous.
IVH: Intraventricular hemorrhage.
MRA: Magnetic resonance angiography.
MRS: Modified Rankin Scale.
SAH: Subarachnoid hemorrhage.

Disclosure

The authors report no conflict of interest in the materials or methods used in this study or the findings specified in this manuscript.

Funding

The authors received no financial support for the

research, authorship, and/or publication of this paper.

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