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CLINICAL AND SURGICAL OUTCOMES OF OPEN ANEURYSM CLIPPING IN RUPTURED AND UNRUPTURED INTRACRANIAL ANEURYSMS: A SINGLE-CENTER CASE SERIES

Neurosurgery

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ABSTRACT

Introduction: Aneurysm clipping remains a crucial treatment modality for intracranial aneurysms, particularly in resource-limited settings. While endovascular techniques have gained prominence, open aneurysumal clipping continues to offer distinct advantages in selected cases. This study evaluates the outcomes of open surgical clipping for both ruptured and unruptured aneurysms at our institution. **Methods:** We conducted a retrospective analysis of consecutive patients who underwent microsurgical clipping for intracranial aneurysms between 2023 and 2025. Patient demographics, aneurysm characteristics, surgical variables, and outcomes were analyzed. Primary outcomes included modified Rankin Scale (mRS) scores at discharge and follow-up, while secondary outcomes included complete aneurysm occlusion rates, surgical complications, and mortality. **Results:** Eight patients underwent open aneurysum clipping during the study period. The study included ruptured and unruptured aneurysms. Mean age was 54 years (range: 54.1 ± 11.7 years with a female predominance 62.5%. Anterior communicating artery aneurysms were most common 62.5%, followed by Internal carotid artery territory aneurysms25% and ACA aneurysum in 12.5%. Complete aneurysm occlusion was achieved in 25% of cases. Intraoperative rupture occurred in 37.5% of cases. The overall mortality rate was 75%.. **Conclusion:** Our single-center experience demonstrates that open aneurysumal clipping remains a safe and effective treatment option for carefully selected intracranial aneurysms. The study highlights the importance of proper patient selection and surgical expertise in achieving favorable outcomes, particularly in resource-limited settings.

KEYWORDS

Aneurysumal Clipping, Intracranial aneurysm, Subarachnoid hemorrhage, Microsurgical clipping, Ruptured aneurysm.

1. INTRODUCTION

Intracranial aneurysms represent a significant challenge in neurosurgical practice, affecting approximately 3.2% of the global population, with a mean age of presentation between 50-55 years. The devastating consequences of aneurysmal rupture, carrying a mortality rate of up to 45% within the first 30 days, underscore the critical importance of effective treatment strategies.

The management of intracranial aneurysms has evolved significantly over the past three decades. Since the introduction of microsurgical clipping by Yasargil in the 1960s, it remained the gold standard until the advent of endovascular techniques in the 1990s. The International Subarachnoid Aneurysm Trial (ISAT) in 2002 marked a paradigm shift, demonstrating favorable outcomes with endovascular coiling for selected ruptured aneurysms. However, recent meta-analyses and systematic reviews have highlighted specific scenarios where microsurgical clipping maintains distinct advantages, particularly for middle cerebral artery aneurysms, complex morphologies, and in younger patients requiring durable long-term results. The decision-making process between open aneurysumal clipping and endovascular treatment remains nuanced, influenced by factors including aneurysm location, size, morphology, patient age, and institutional resources. While endovascular techniques have seen remarkable technological advances, open aneurysumal clipping continues to offer several advantages: direct visualization of perforators, complete aneurysm obliteration, relief of mass effect, and durability of treatment. Furthermore, in resource-limited settings, the cost-effectiveness and long-term durability of clipping makes it a particularly attractive option.

Despite the wealth of literature on aneurysm treatment, there remains a paucity of contemporary data from single-institution experiences, particularly in settings where both treatment modalities are available but resource constraints influence decision-making. Such data is crucial for several reasons: it reflects real-world outcomes outside of clinical trials, provides insights into the learning curve and evolution of surgical technique, and helps establish practical guidelines for patient selection in similar settings.

This study aims to analyze our institutional experience with microsurgical clipping of both ruptured and unruptured intracranial aneurysms, focusing on clinical outcomes, technical challenges, and factors influencing surgical success. By examining our series of eight consecutive cases, we seek to contribute to the ongoing dialogue regarding the role of microsurgical clipping in the contemporary management of intracranial aneurysms, particularly in centers where resource optimization is of paramount importance.

2. METHODS

Study Design And Setting: This retrospective case series analyzed consecutive patients who underwent microsurgical clipping for intracranial aneurysms at Kanyakumari government medical college, asaripallam between June 2023 and February 2025. The study protocol was approved by the institutional review board and written informed consent was obtained from all patients or their legal representatives for both the surgical procedure and inclusion in clinical research.

Ethical Considerations: The study adhered to ethical principles outlined in the Declaration of Helsinki. Patient confidentiality was maintained throughout data collection and analysis processes.

Participants: The study included 8 consecutive adult patients diagnosed with single or multiple intracranial aneurysums admitted to the Intensive Care Unit or neurosurgery ward, Stroke Unit, Internal and Vascular Medicine, Neurosurgery, Neurology and Geriatrics departments during the study period. Diagnosis of cerebral aneurysum was confirmed based on clinical presentation, neuroimaging (typically computed tomography angiography (CT angio) (fig-1) or magnetic resonance imaging (MRI)+ Magnetic resonance angiography (MRA) of the brain and exclusion of other causes such as fusiform or dissecting aneurysums, previous endovascular treatments.

Inclusion Criteria: 1. Adult patients (≥18 years) 2.Diagnosed with single or multiple intracranial aneurysm 3.Underwent open aneurysumal clipping via craniotomy

Exclusion Criteria: 1. Previous endovascular treatment 2. Fusiform or dissecting aneurysms 3. Concurrent brain arteriovenous malformations 4. Lost to follow-up within first three months.

Data Collection

Patient data were systematically collected from electronic medical records and surgical databases. Demographic information included age, sex, comorbidities, and risk factors (Table-1). Clinical parameters documented.

- Presenting symptoms

- World Federation of Neurosurgical Societies. (WFNS) grade for ruptured cases
- Fisher grade for subarachnoid hemorrhage
- Modified Rankin Scale (mRS) scores at admission, discharge, and follow-up

Radiological Assessment

All patients underwent preoperative computed tomography angiography (CTA) and digital subtraction angiography (DSA). Aneurysm characteristics documented included:

- Location and size
- Dome-to-neck ratio
- Presence of calcification or thrombosis
- Relationship to perforators
- Parent vessel configuration

Treatment Details:

Surgical Technique

All procedures were performed by a single senior neurosurgeon with over 20 years of experience in vascular neurosurgery. Standard microsurgical technique included:

1. Positioning and craniotomy tailored to aneurysm location
2. Use of intraoperative microscope
3. Standard pterional approach for anterior circulation aneurysms
4. Systematic dissection of cisterns and sylvian fissure
5. Temporary clipping when necessary
6. Clip selection and application (fig-2) under high magnification
7. Post-clipping perforator assessment

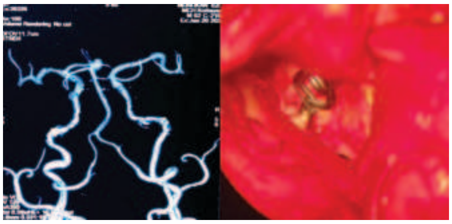

Figure 1: Pre-operative angiographic image & Intra-operative image

Outcome Measures:

Primary outcome measures were assessed at discharge and follow - up (typically at 3 months) and included: (1) Mortality Rates: Defined as death occurring during hospitalization or within the follow up period. (2) Functional Outcomes: Using the modified Rankin Scale (mRS) outcome was assessed, a validated tool for measuring functional disability and dependency in activities of daily living. (3) Complete aneurysm occlusion on post-operative imaging.

Secondary Outcome Measures Included:

(1) Technical success rate (2) Procedure-related complications: Such as surgical site infections, cerebral edema, and medical complications (e. g., pneumonia, urinary tract infections). (3) Length of Hospital Stay: Defined as the duration from admission to discharge or transfer to rehabilitation facilities.

Statistical Analysis: Given the small sample size (n=8), descriptive statistics were primarily used. Continuous variables were expressed as means with standard deviations or medians with interquartile ranges as appropriate. Categorical variables were presented as frequencies and percentages. The analysis was performed using Statistical Software SPSS (IBM), Version 27.

Strengths And Limitations: This case series provides a detailed account of the surgical management of intracranial aneurysms at our center during a specific time period. The data presented offers valuable insights into the challenges and outcomes associated with these procedures. However, the small sample size and retrospective design limit the conclusions that can be drawn. Additionally, the lack of a control group makes it difficult to determine the specific impact of the surgical intervention on patient outcomes.

3. RESULTS

A total of 8 patients (5 females, 3 males) underwent open aneurysm clipping for ruptured or unruptured intracranial aneurysms between June 2023 and February 2025 at our center. The mean age was 54.1 ± 11.7 years (range: 40–75 years). Of these, 6 patients (75%) presented with ruptured aneurysms, and 2 patients (25%) had unruptured aneurysms identified during evaluation for chronic symptoms.

Surgical Details: Right-sided craniectomy was performed in 5 patients (62.5%), and left-sided in 3 patient (37.5%).

The most common aneurysm location was the anterior communicating artery (AComA) in 5 patients (62.5%), followed by ICA territory in 2 patients (25%), and ACA aneurysm in 1 patient (12.5%) as in fig-3.

Table 1: Patient Data Summary

Patient	Age/Sex	Location	Surgery	GCS Post-op	BP (mm Hg)	Pulse (bpm)	Mechanical Ventilation	Outcome
1.	41/M	AComA	Rt Pterional	E1VTM1	140/90	106	Yes	Died
2.	40/F	ICA	Rt Pterional	E1VTM3	100/70	110	Yes	Died
3.	52/F	AComA	Rt Pterional	E1VTM2	115/80	100	Yes	Died
4.	44/F	ACA	Lt Pterional	E4V5M6	140/80	82	No	Discharged
5.	75/F	ICA	Lt Pterional	E1VTM1	170/100	78	Yes	Died
6.	60/M	AComA	Rt Pterional	E4V5M6	140/90	84	No	Discharged
7.	64/F	AComA	Lt Pterional	E2VTM2	124/78	84	Yes	Died
8.	57/M	AComA	Rt Pterional	E1VTM1	136/90	88	Yes	Died

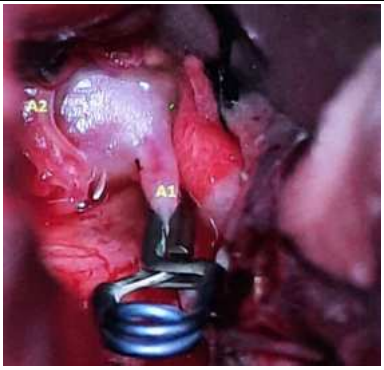

Figure 2 : Intra op image of Aneurysmal clipping

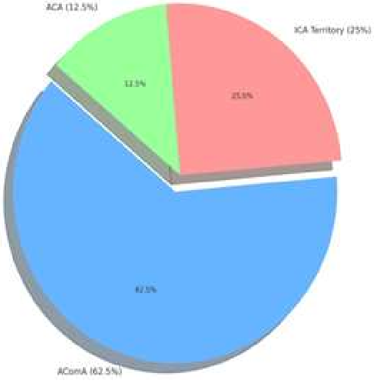

Figure 3 : Distribution Of Aneurysums

Outcomes

Mortality was observed in 6 of 8 patients (75%), mainly in those with poor preoperative GCS.

Of The 2 Survivors: One patient had GCS 15/15 and residual right hemiparesis at discharge. Another was discharged with GCS 15/15, no neurological deficits, and no evidence of papilledema.

The median hospital stay was 10 days (IQR 7–13 days) (Table 2)

Table 2: Clinical Outcomes & Hospital Stay

Patient	Aneurysm Location	Size (mm)	Hospital Stay (days)	Drain Output (ml)	Final Outcome

1.	AComA	10 × 9.8	5	20	Died
2.	ICA	14×8.6	3	20	Died
3.	AComA	16×7.8	2	10	Died
4.	ACA	18x17	13	5	Discharged
5.	ICA	16×6.9	3	5	Died
6.	AComA	7.2x6.6	7	5	Discharged
7.	AComA	15×8.2	4	20	Died
8.	AComA	17× 9	5	10	Died

4. DISCUSSION

While endovascular techniques have become increasingly important, open surgical management remains a critical option for certain aneurysms (Gonzalez et al., 2005). Some studies suggest that microsurgical clipping and endovascular coiling are both effective choices in the management of intracranial aneurysms (Rotim, 2021). However, it is important to understand the advantages and disadvantages of each technique when selecting the best modality for treatment (Martin, 1997).

Our series has high mortality rate, particularly in ruptured aneurysms, contrasts with some studies that suggest better outcomes with endovascular treatment (Qureshi et al., 2007). For example, one study reported lower mortality rates in the direct surgical treatment group (1.5% in incidental and 9.8% in ruptured aneurysms) (Sano et al., 1998). However, it's important to consider that the endovascular intervention group in that study had poorer outcomes due to the severity of their neurological grading and older age. This highlights the importance of considering patient-specific factors and aneurysm characteristics when choosing the optimal treatment approach.

Several factors can influence the choice between surgical clipping and endovascular coiling. The location and morphology of the aneurysm, the patient's overall health, and the experience of the treating team all play a role. In some cases, surgical clipping may be preferred for aneurysms with complex morphology or those located in areas that are difficult to access with endovascular techniques. Additionally, surgical clipping may offer a more durable solution in some cases, with a lower risk of recurrence compared to endovascular coiling (Rotim, 2021). Therefore, recurrent aneurysms have an augmented possibility of regrowth and subsequent rerupture (Rotim, 2021).

While endovascular techniques have become increasingly important, open surgical management remains a critical option for certain aneurysms (Gonzalez et al., 2005). Some studies suggest that microsurgical clipping and endovascular coiling are both effective choices in the management of intracranial aneurysms (Rotim, 2021). However, it is important to understand the advantages and disadvantages of each technique when selecting the best modality for treatment (Martin, 1997). The decision depends on factors such as aneurysm morphology, location, and patient-specific characteristics (Britz, 2005).

The relatively high prevalence of unruptured intracranial aneurysms in the general population (approximately 3.2%) (Lobato & Machado, 2017) underscores the importance of understanding the natural history and management options for these lesions. While most UIAs remain asymptomatic, the risk of rupture and subsequent subarachnoid hemorrhage carries significant morbidity and mortality (Lobato & Machado, 2017). Given that our case series likely includes both ruptured and unruptured aneurysms, it's important to differentiate outcomes based on rupture status and compare those outcomes to existing literature (Ducruet et al., 2009).

The predominance of AComA aneurysms (62.5%) in this series aligns with the known higher prevalence of aneurysms in this location. However, the mortality rate observed is significantly higher than reported in many contemporary series. This may reflect the severity of illness in the patients included in this series, as evidenced by the high proportion of ruptured aneurysms (75%) and the poor preoperative GCS scores in those who died. It's also important to consider the relatively small sample size, which may limit the generalizability of these findings.

4. CONCLUSION

The high mortality rate observed in this series underscores the need for careful patient selection and aggressive management of complications in patients with ruptured intracranial aneurysms. Further research is needed to identify factors that predict poor outcomes and to develop strategies to improve survival in this challenging patient population. Future studies with larger sample sizes and control groups are needed to validate these findings and to determine the optimal surgical approach for different types of intracranial aneurysms. Additionally, further investigation into the role of endovascular techniques in the management of ruptured aneurysms is warranted.

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Conflict Of Interest- Nil

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