# **Original Research Article**

DOI: http://dx.doi.org/10.18203/2349-2902.isj20181449

# A study of outcome of surgical management of ruptured intracranial aneurysms

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Received: 08 March 2018 Accepted: 19 March 2018

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# **ABSTRACT**

**Background:** The present study is a retrospective analysis of collected data of consecutive cases with ruptured intracranial aneurysms treated at two centres. The clinical outcome and associated complications were graded using the modified Rankins scale.

**Methods:** A total of 48 patients of ruptured intracranial aneurysms were managed between January 2014 and August 2017. All forty eight patients underwent clipping. All the 48 patients who were consequently treated with surgery for intracranial aneurysm were analysed.

**Results:** Of the total of 48 patients, Six patients died in the post-operative period while the remaining 42 patients were available for a minimum followup of 6 months duration. the post operatives outcomes matched the presenting Hunt and Hess grade in 80% patients.

**Conclusions:** Surgical outcome of ICA Aneurysm is generally good. Poor results are mainly related to poor aneurysm grade, atherosclerotic intracranial carotid artery, and severe vasospasm. ACOM aneurysm in spite of being very common the outcome of patients with ACOM aneurysms remains not so good. In patients with MCA aneurysm the post-operative outcome is significantly better if surgery is undertaken earlier.

Keywords: Intracranial Aneurysms, Outcome of clipping ruptured aneurysms

# INTRODUCTION

When more than one procedure is performed for the same condition, then it is unlikely that one procedure is clearly the superior one. Intracranial aneurysms can be occluded using direct surgical techniques, endovascular approaches, combined surgical and endovascular indirect procedures or techniques such revascularization procedures or parent vessel occlusion.

There are two ideal and equal goals in the treatment of patients with intracranial aneurysms. The first is complete, permanent occlusion of the aneurysm sac. The second goal is optimal preservation or restoration of the patients neurological function.<sup>1</sup>

The optimal treatment strategy is best handled by a team of neurovascular and endovascular surgeons to select an occlusion strategy that is suited to the patient and the aneurysm.

The present study is a retrospective analysis of collected data of consecutive cases with ruptured intracranial aneurysms treated at two centres. The clinical outcome and associated complications were graded using the modified Rankins scale.

The aims and objectives of the present study are to observe and compare clinical outcome of patients undergoing surgical management for ruptured intracranial aneurysms. All patients were followed up for a minimum period of 6 months to study the efficacy, complications of this procedures.

#### **METHODS**

### Inclusion criteria

 All patients diagnosed to have a ruptured intracranial aneurysm were included.

#### Exclusion criteria

 Patients diagnosed with more than one aneurysm were excluded.

A total of 48 patients of ruptured intracranial aneurysms were managed between January 2014 and August 2017. All forty eight patients underwent clipping. All the 48 patients who were consequetively treated with surgery for intracranial aneurysm were analysed. These patients had presented with headache and SAH sue to aneurysmal rupture, with or without intraperenchymal hemorrhage and the diagnosis was confirmed on imaging.

The decision regarding surgical approach to resorted to was decided based on computed tomographical angiography and resources available. A standard pterional approach was used for 47 patients. One patient with vertebral artery aneurysm was operated by extreme lateral suboccipital approach.

All patients received nimodepine (oral or injectible) after diagnosis of Aneurysm. Dextran was given for 7 days to

all patients after clipping of aneurysm, while nimodepine was given for a total of three weeks.

#### **RESULTS**

A total of 48 patients presented with ruptured intracranial aneurysms between January 2014 and August 2017, have been included in the study. Six patients died in the post-operative period while the remaining 42 patients were available for a minimum followup of 6 months duration.

The largest group amongst the aneurysms was the ICA group and the ACOM group with 16 patients each.

In the ICA group nine aneurysms were located on the PCOM segment aneurysm while 7 were located in the paraclinoid segment of ICA.

The ICA subgroup represented the youngest group with a mean age of 45.4 years and a female preponderance with a male to female ration of 1;3. There were no mortalities in this group.

In the post communicating segment subgroup (PCOM) the male female ratio was 1:8. Three patients presented in HH grade 2 and all had a fair outcome. Five patients came in HH grade 3; of which four had a fair outcome while one patient who was a female aged 30 years with severe vasospasm had a poor outcome. One patient in HH grade 4 with a large temporal lobe hematoma had a fair outcome despite having a poor presentation, Pneumonia and transient hyponatraemia in the peri operative period

Table 1: Analysis of 48 patients operated for Single aneurysms.

	ICA	ACOM	MCA	A2	A1	VA
Patients	16	16	9	4	2	1
Male	4	12	5	3	1	-
Female	12	4	4	1	1	1
Mean Age (years)	45.5	47.8	50.7	54	57.3	70
Hunt and Hess grade on presentation						
1	2	2	-	-	1	-
2	7	6	5	1	-	1
3	6	6	2	3	-	-
4	1	2	2	-	1	-
5	-	-	-	-	-	-
Outcome based on mRS scale						
Good (mRS grade 0-1)	3	2	1	-	-	-
Fair (mRS grade 2-3)	11	9	4	3	1	-
Poor (mRS grade 4-5)	2	3	1	1	1	-
Death (mRS grade 6)	-	2	3	-	-	1

ICA Internal carotid artery , ACOM Anterior communicating artery, PCOM Posterior communicating artery, MCA middle cerebral artery, A1 first segment of anterior cerebral artery, VA vertebral artery, A2 second segment of anterior cerebral artery

In the paraclinoid subgroup almost all patients were in the 50 to 60 age group except one pt who presented at 25 years of age. The male female ratio was 3:4. One patient had a significant ventriculomegaly others all had SAH on plain CT. Two patients presented with HH grade 1 and both had a good outcome. Four patients came with HH grade 2, of which one patient had a good outcome & three had a fair outcome. One patient who presented in HH grade 3 and pneumonia had a poor outcome.

Table 2: Hunt and Hess scale (HH Grade).

Grade	Symptoms
Grade 1	Asymptomatic or mild headache
Grade 2	Cranial nerve palsy or moderate to severe
	headache/nuchal rigidity
Grade 3	Mild focal deficit, lethargy, or confusion
Grade 4	Stupor and/or hemiparesis
Grade 5	Deep coma, decerebrate posturing,
	moribund appearance

In the ACOM group the mean age was 47.8 years and a male female ratio was 3:1. Two patients came in HH grade 1, of which one patient who was a 47-year-old female had a good outcome despite having asthma as co morbidity. The other patient, who was a 44-year-old male, had a fair outcome. Six patients came in HH grade 2 of which one had a good outcome; three had a fair outcome while two patients had a poor outcome. Six patients presented with HH grade 3 of which four had a fair outcome while two patients expired in the post-operative period secondary to septicemia and electrolyte imbalance.

Both the patients were males with COPD and had severe vasospasm; one of them also had diabetes and hypertension. Two patients came with HH grade 4 of which one had a fair outcome and one did poorly.

Table 3: mRS modified Rankins Scale.

Grade	Description
0	No symptoms
1	No significant disability. able to carry out all
	usual activities despite some symptoms.
2	Slight disability. able to look after own affairs
	without assistance, but unable to carry out all
	previous activities.
3	Moderate disability. requires some help but
	able to walk unassisted.
4	Moderately severe disability. unable to attend
	to bodily need without assistance, unable to
	walk unassisted.
5	Severe disability. requires constant nursing
	care and attention, bedridden, incontinent.
6	Dead.

Nine patients belonged to the MCA group with the mean age being 50.7 years and a slight male dominance of 5:4. Five patients came in HH grade 2 of which three had a fair recovery and two expired. The youngest patient of our study, an 8-year-old female patient who presented in HH 3 with an MCA aneurysm with a right temporal hematoma and infarct in Rt MCA territory had an excellent recovery at 12 months follow-up with mRS grade 1 outcome. The other patient with HH grade 3 presentation had a poor outcome. Two patients came in HH grade 4 of which one had a fair recovery while the other expired on Post-operative day 10. This group had the most number of mortalities, with three deaths. There were four crossovers in this group. One patient presnetated in poor grade but didn't have a bad oucome while three patients presented in a good to moderate grade but faired poorly.

Four patients had an A2 segment aneurysm. The male female ratio was 3:1. The only female of this group came in HH grade 2 and had a fair outcome. All the males of this group came in HH grade 3 of which two had a fair recovery while one patient had a poor outcome.

Of the two patients with A1 segment aneurysm, the 35-year-old female patient who presented in HH grade 1 and had a fair outcome, while the 65-year-old male who came with HH grade 4 had a poor outcome.

Only one patient in our study had a posterior circulation in the V3-V4 segment of left vertebral artery. Patient was a 70-year-old female with HH2 on presentation, with hypertension and bronchial asthma. Though the patient had a good immediate post-operative outcome, she developed infective chest complication leading to a prolonged indoor stay and expired on 30th postoperative day.

#### **DISCUSSION**

Saccular aneurysms of ICA trunk and PCOM segment represents 30% to 50% of all intracranial aneurysms.<sup>2</sup> In our study 33.3% patients presented with ICA aneurysms, with a male to female ratio of 1:3 and an average age of presentation being 45.5 years, the youngest average age in our series.

Aneurysms of PCOM segment of ICA are the most common type of ICA aneurysm, representing about 50%, and are more common in females.<sup>2</sup> In our study too, of the 16 ICA aneurysms 9 were of the PCOM segment. Also there was a clear female preponderance with female to male ratio being 8:1.

The environmental conflict of this location has been suggested as a risk factor for rupture of these aneurysms with smaller size.<sup>2</sup> They usually cause symptoms when smaller than 10mm in patients with SAH.<sup>2</sup>

The reported outcome of PCOM segment aneurysm is favourable in 86% patients with a mortality rate of 6%.<sup>3</sup> In our study out of the 9 patients with clipped PCOM aneurysms eight had a fair outcome while one patient had a poor outcome. There were no mortalities in this subgroup.

During management of paraclinoid aneurysm the surgical compliation associated with permanent morbidity is known to be around 6% because of the complex anatomical relationship among neurovascular, dural, and bony structures, management of paraclinoid aneurysms is more challenging compared with intracranial aneurysms at other locations.<sup>3</sup>

In the present study of the 7 patients with paraclinoid aneurysm, three had a good outcome 3 had a fair outcome while one patient had a poor outcome. Surgical outcome of ICA aneurysm is generally good. Poor results are mainly related to poor aneurysm grade, atherosclerotic intracranial carotid artery, and severe persistent vasospasm.<sup>2</sup> The third nerve palsy usually resolves completely after 3 months in upto 90% patients and resolves partially in the remaining 10 % patients.

ACOM artery aneurysm is the most frequent site of Intracranial aneurysms constituting 30% to 37 % of all aneurysms. These aneurysms are seen in the middle aged with the peak in late forties. They are found to be more in more with a male to female ratio of 2.3:1. In our study ACOM aneurysm comprised 33.3% of all aneurysms. The mean age was 47.8 years (27-62 yrs), and a male to female ratio was 3:1.

Although ACOM aneurysms are very common & neurosurgeons most frequently encounter them in their surgical practice the outcome of patients with ACOM aneurysms remain not so good. Various eminent neurosurgeons have contributed immensely towards achieving the present standards of surgical techniques applied to ACOM aneurysms.

In 1936, Wilhiem Tonnis used a midline used a midline surgical approach to directly reach the ACOM aneurysm by splitting the corpus callosum. In 1938, Walter Dandy described the pterional craniotomy and his approach to the skull base has withstood the test of time. Kempe in 1968, and Vander Ark, in 1971 described the gyrus rectus approach to these aneurysms in the operative approach. In 1969, Yasargil et al, introduced the concept of microneurosurgery and popularized the microsurgical corridor using the pterional approach to ACOM artery along with Fox.<sup>4</sup>

The ACOM aneurysms have the worst surgical outcome among all anterior circulation aneurysms. The clinical grade of the patient as measured by the HH scale is still the primary factor that determines the final outcome in patients with an ACOM aneurysm after SAH. Andaluz et al, evaluated 75 patients with ACOM aneurysm and

found overall outcomes at discharge using the modified Rankins Scale to be good in 69.4% patient, fair in 17.3% and poor in 13.3%.

Worldwide MCA aneurysm constitute 20% of all aneurysms.<sup>5</sup> MCA aneurysms constituted 25.3% of more than 2500 intracranial aneurysms reported by Mathuriya et al PGIMER, Chandigarh. MCA aneurysms constituted 18.75% in our study.<sup>5</sup> Clinical presentation of ruptured MCA aneurysm though is indistinguishable from SAH due to other aneurysms, there are certain finding found to occur more frequently in MCA aneurysms, namely

- More than 50% patients present with loss of consciousness.
- 80% have focal neurological deficits in the form of hemiparesis, aphasia, visual field deficits and facial weakness, found in only 24% patients with aneurysms at other location.
- Seizure occurs in 10% patients of MCA aneurysms. It is far less common in other location.

In our study nine patients presented with a ruptured MCA aneurysm, with the mean age being 50.7 years and a slight male dominance of 5:4. Five patients had a favourable outcome while one had a poor outcome. Three patients expired in this group. Of these three patients, one had presented in a poor HH grade and had pneumonia with hyponatreamia, while the other two patients had presented more than a week after ictus with a good HH grade but had a poor outcome.

The overall morbidity and mortality of surgery for MCA aneurysms are 6% and 11% respectively. The outcome is significantly better if surgery is undertaken with in 0-3 days of ictus as compared to the group that had late surgery. Distal anterior cerebral artery (DACA) aneurysms, represent about 2.1 % to 9.2% of all intracranial aneurysms.<sup>6</sup>

Typically, these aneurysms are small and broad based, and many ruptured DACA aneurysms are found to be less than 5mm in diameter. This tendency to bleed at smaller sizes and their unique anantomic features add to the treatment challenges in the management of DACA Aneurysm.<sup>6</sup> In the present study four patients, three males and one female presented with a ruptured DACA aneurysm. The 38-year-old female presented in HH grade 2 and had a fair outcome. All the three male patients came in HH grade of which two had a fair recovery while one patient had a poor outcome.

A1 aneurysms comprise less than 1% of all intracranial aneurysms.<sup>7</sup> The unique characteristics of A1 aneurysms include small size, fragility, multiplicity of aneurysms, and vascular anomalies, such as hypoplasia, aplasia, fenestration, duplication, and azygous ACA.<sup>7-12</sup> Due to their small size, the risk of injury of perforating arteries, and the location of the aneurysm in the surgical field,

where they are frequently located behind the parent artery, treatment of these aneurysms is a challenge.<sup>7-12</sup>

In our series two patients had an A1 segment aneurysm. Of which one was a 35-year-old female with HH grade 1 and one was a 65-year-old male in HH grade.<sup>4</sup> The female patients had a superiorly pointing aneurysm and had a fair outcome while the male patient had a posteriorly pointing aneurysm and had a poor outcome.

#### CONCLUSION

Surgical outcome of ICA Aneurysm is generally good. Poor results are mainly related to poor aneurysm grade, atherosclerotic intracranial carotid artery, and severe vasospasm. ACOM aneurysm in spite of being very common the outcome of patients with ACOM aneurysms remains not so good. In patients with MCA aneurysm the post operative outcome is significantly better if surgery is undertaken earlier.

Funding: No funding sources Conflict of interest: None declared

Ethical approval: The study was approved by the

Institutional Ethics Committee

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**Cite this article as:** Sheikh ZA, Sodhiya P. A study of outcome of surgical management of ruptured intracranial aneurysms. Int Surg J 2018;5:1697-701.