

**Original Article**

**Outcome of Surgery of Ruptured Anterior Communicating Artery Aneurysms**

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**ABSTRACT**

**Background:** Anterior communicating artery complex is the most frequent site of intracranial aneurysms. Anterior communicating artery aneurysms are the most complex aneurysms of the anterior circulation due to the flow dynamics of the ACoA region, frequent anatomical variations, and danger of severing the perforators with ensuing neurological deficits. The surgical trajectory should provide optimal visualization of the ACoA complex without massive brain retraction. **Objective:** To study the influence of early surgery and intraoperative planning on the outcome of ruptured anterior communicating artery aneurysms surgery. **Patients and Methods:** In this study thirty patients with anterior communicating artery aneurysms underwent surgery in a 3-year period. In all patients early surgery through a pterional approach was performed. Evaluation of outcome of patients was done using Glasgow outcome scale. **Results:** The majority of patients (83.3%) were in grade I or II (Hunt and Hess scale). Outcome was excellent in fifteen patients (50%) and good in nine patients (30%). The mortality rate was 10%. **Conclusion:** Early surgery and selecting the suitable approach of surgery improve the surgical outcome of ruptured anterior communicating artery aneurysms.

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**INTRODUCTION**

Anterior communicating artery aneurysms (ACoAA) account for approximately 20% of all aneurysms and 30% of all ruptured aneurysms<sup>18</sup>. They are associated with the worst surgical outcomes among all anterior circulation aneurysms. These aneurysms usually become symptomatic and diagnosed as a result of subarachnoid hemorrhage (SAH). Anterior projection of an ACoA, presents of blebs and size more than 5 mm increase the risk of rupture<sup>8</sup>. The aim of microneurosurgical management of ACoAA is total occlusion of the aneurysm sac with preservation of flow in all branching and perforating arteries. This task necessitates perfect surgical strategy based on review of the 3D angioarchitecture and abnormalities of the patient's ACoA complex with its ACoAA and to orientate accordingly during the microsurgical dissection.

This study aimed to evaluate the effect of early surgery and intraoperative planning on the outcome of ruptured anterior communicating artery aneurysms surgery.

**PATIENTS AND METHODS**

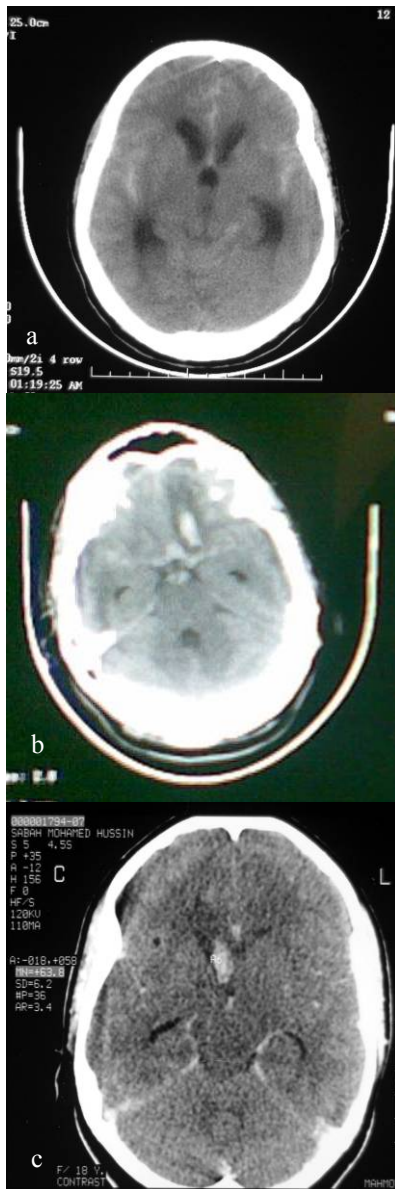
In this study, surgery was performed on thirty patients who were admitted to Neurosurgery and Neuroemergency Departments, Kasr Al-Aini Hospitals with the diagnosis of ruptured anterior communicating artery aneurysm during the years 2008 to 2011. Patients' ages were in the range of 18-75 years old. Seventeen patients were male and thirteen were female.

The majority of patients presented with the typical symptoms of SAH at the time of admission including headache, neck rigidity and decreased consciousness. Most of them were classified as grade I or II on Hunt and Hess Scale. Intracerebral hematoma and intraventricular hemorrhage were also detected (Fig. 1 a-c).

Computed tomography (CT) scan was the first choice imaging in these patients. Four-vessel angiography of brain or CT angiography was done at the earliest possible time within 48 hours. Specific views were requested with special stress on the dominance of A1 segment, the difference of the diameter of A1 right and left, the size of the anterior communicating artery, and the projection of the aneurysm.

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**Fig. 1a-c:** a. CT scans brain of different presentation of ruptured ACoAA, Subarachnoid hemorrhage; b. Intracerebral hemorrhage; c. Intraventricular hemorrhage

Our policy for the patients with anterior communicating artery aneurysm was early surgery. After stabilizing the general condition of the patients (cardiovascular and respiratory systems, fluids and electrolytes and coagulation state) and performing angiography, the surgery was done in the first 72 hours.

There are three standard techniques for patients with ruptured ACoAA which are the fronto-orbitozygomatic, interhemispheric, and pterional approaches<sup>5</sup>. Our patients were operated via the pterional trans-sylvian approach. In grades IV and V craniotomy was done in addition to ventriculostomy.

The patients were placed supine on the operating table. The head was held by three points fixator and rotated (45 to 60 degrees) to the opposite side of the surgical incision. The patient's head was tilted 10-15 degrees so that the zygoma becomes the highest point. The head of the table is elevated to bring the head higher than the heart<sup>1,18</sup>. During the craniotomy, the lateral sphenoid ridge was drilled up to the lateral end of superior orbital fissure and the cisterns of base were reached, in most cases, with no significant retraction of brain. With the dura retracted, the basal sylvian cistern was opened on the frontal side of the sylvian veins. Proper placement of the temporal lobe and frontal lobe retractors is vital in opening the sylvian fissure. The optic and carotid cisterns were opened in the depth of sphenoid wing.

The primary corridor depends on the location and angle of the aneurysm to the adjacent arteries. In the majority of anterior communicating artery aneurysms such as those with anterior and posterior direction and the aneurysms placed superior to the tuberculum sella, the primary exposure from the frontal corridor is much more secure. In aneurysms with anterior direction and adherence to the tuberculum sella or in aneurysms with inferior direction, it is safer to expose it primarily from temporal corridor. Placing the retraction on the frontal lobe must be done with precaution.

In the majority of patients (25 cases), cortisectomy in the gyrus rectus was performed. The cortisectomy was done to the extent of 5 mm parallel to olfactory tract and continued to the tip of the optic nerve. It was performed by suction and bipolar coagulation. Enough attention had to be paid to interhemispheric pia-arachnoid to remain intact; it played a major role in protecting the aneurysms and other important segments of the arteries. After marking A1 segment and the perforators, dissection was continued by opening the arachnoid. A2 and the aneurysm were then distinguished. A1 and A2 in the other side were also be exposed.

Temporary clipping was used routinely. Although most aneurysm necks could be dissected and cleared with only one temporary clip on the dominant A1 segment, difficult aneurysms required temporary clips on both A1 segments. Protection of brain during the temporary clipping was performed with the collaboration of anaesthesiologist. This included: mannitol 100 mg, thiopental, phenytoin 250 mg, keeping SBP: 120-170 mmHg. The duration of clipping was 5-7 minutes. If further time was needed, clipping was arranged intermittently.

**The direction of each aneurysm dictated different kind of procedure:**

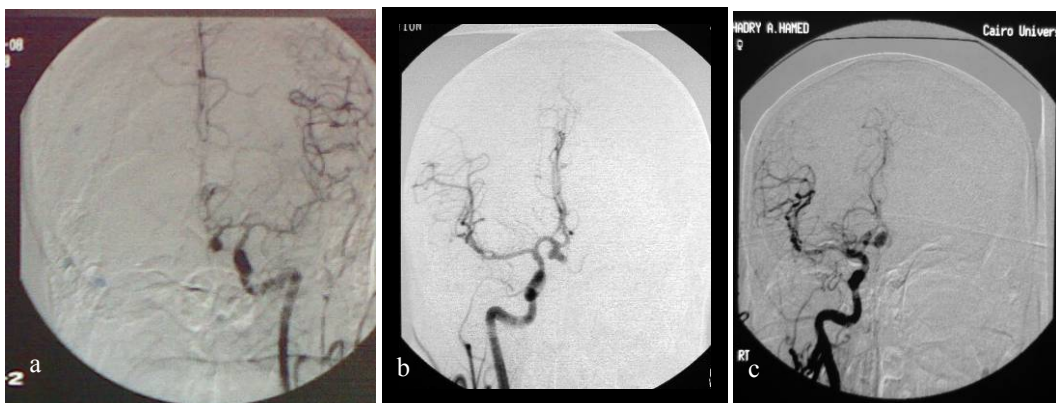
1. For aneurysms with anterior and inferior projection (nineteen cases) (Fig. 2. a&b); have more favourable relationship to the infundibular and hypothalamic perforators. Attention must be paid while retracting

the frontal lobe, because the dome of these aneurysms is attached to the tuberculum sellae and the probability of rupture was high.

2. For aneurysms with superior projection (nine cases) (Fig. 2 c); the A2 segment may be detected hardly or it is necessary to use fenestrated clipping. The posterior wall of their neck usually is associated intimately with the infundibular and hypothalamic perforators, which must be cleared and displaced below the path of the clip blade.
3. For aneurysms with posterior projection (two cases); were the most complicated type of

aneurysms. The majority of perforant vessels are placed adjacent to the neck or in the inferior surface of the dome of aneurysms, they have to be cleared and released before permanent clipping. An extended dissection of the perforators and more creative clip configurations were required for these aneurysms.

At the end of surgery, after removing the temporary clipping, the patients' blood pressure was stabilized to 150-170 mmHg to be sure of the hemostasis of the surrounding of aneurysm and the region of rectus gyrus cortisectomy.



**Fig. 2a-c:** Four vessel angiography of anterior communicating artery aneurysms AP view of different patients, in a and b the aneurysm is directed anterior and inferior while in c the aneurysm is directed superior

All patients were kept at the Neurosurgical Intensive Care Unit (ICU) postoperatively for at least 24 hours. In the ICU the blood pressure was maintained between 170 and 180 mmHg in order to treat the vasospasm.

Serum electrolytes, haematocrit and kidney functions were also checked. Nimodipine 8 mg/8 h was given for three weeks and phenytoin 100 mg/8h was prescribed for one year postoperatively. CT brain was done in all patients within the first 24 hours after surgery.

## RESULTS

Regarding the size of aneurysms as detected by angiography the minimum size in this study was 3 mm, the maximum was 12 mm with the mean aneurysm size  $5.4 \pm 2.932$  mm.

Among thirty patients who have been operated, twenty five cases (83.3%) were in grade I and II (Hunt and Hess scale). The majority of low grade patients recovered without neurological deficits. The outcome of patients was categorized based on Glasgow outcome scale. The outcome was excellent in fifteen patients (50%) while it was good in nine patients (30%). Surgical mortality was 10% in our study (**Table 1 and Fig. 3**).

**Table 1:** Outcome of surgery on the basis of Glasgow outcome scale

Grade	Number and percentages of cases	Excellent	Good	Fair	Poor	Dead
1	19 (63.3%)	11	8	-	-	-
2	6 (20%)	4	1	-	-	1
3	2 (6.7%)	-	-	1	1	-
4	2 (6.7%)	-	-	-	1	1
5	1 (3.3%)	-	-	-	-	1

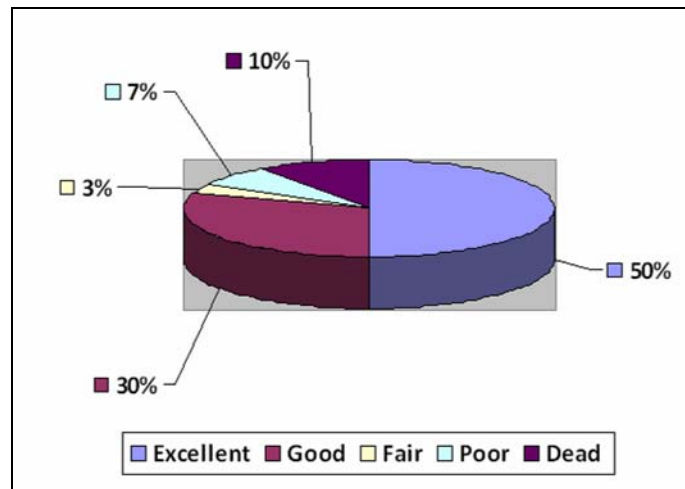


Fig. 3: Final outcome

Complications included vasospasm, hydrocephalus, hemiparesis, mental changes, seizures, aspiration, electrolyte disturbances, congestive heart failure, DVT, and meningitis (Table 2).

Vasospasm and cognitive deficits were the most common complications following surgery. Vasospasm worsened outcome in 6 patients (20%) while cognitive

deficits occurred in 9 patients (30%). Hydrocephalus occurred in 5 patients (16.67%) for which a ventriculo-peritoneal shunt was applied.

The duration of hospital stay in this study ranged from 5 days to 20 days with a mean duration  $11.25 \pm 3.697$  days.

Table 2: Post-operative complications

Complications		Number of patients	Percentage
Frontal manifestations	Amnesia	6	20
	Confusion	2	6.67
	Other manifestations*	1	3.33
Hydrocephalus		5	16.67
More deterioration of conscious level		3	10
Hemiparesis		3	10
Seizures		2	6.67

\*Other manifestations include lack of concentration and disinterest of the surroundings

## DISCUSSION

After stabilizing the general condition of the patients with ruptured anterior communicating artery aneurysms in this study, they were operated at the earliest possible time. Most of the authors have reported better management results with early than with delayed surgery as early surgery avoids rebleeding and helps treatment of ischemic events of vasospasm<sup>2,13</sup>. Early surgery in ruptured anterior communicating artery aneurysms has a good prognosis with a low morbidity<sup>11</sup>. Among the three standard approaches of anterior communicating artery aneurysm operations<sup>3,7,20</sup> we selected the pterional approach for these reasons: (1) the distance between skull and anterior communicating

region will be shortened (2) approach to the aneurysm is more vertical; (3) the proximal control is performed easily; and (4) the majority of surgeons are more familiar and experienced in this approach. Rectus gyrus cortisectomy was done in the majority of patients because of the better exposure, less retraction and the lack of retraction deficits.

Temporary clipping was used routinely in all patients as the rupture of aneurysm during surgery triples mortality and morbidity<sup>4</sup>. The duration of temporary clipping was 5-7 minutes in our study whereas in the cases which further time was needed, the clipping was done intermittently. In some of the reports the duration of clipping is permissible to extend to as much as 40 minutes<sup>9</sup>. In a study done in the patients

with temporary clipping during their surgery, especially those with the duration more than 9 minutes, cognitive deficits have been detected in long-term follow-up. The results showed the consequences of temporary vessel occlusion on cognitive changes occur before ischemic injuries<sup>14</sup>.

In our study, the outcome was excellent in 50% of patients and good in 30%. These results are comparable to other surveys<sup>2,7</sup>. The surgical mortality was 10% and the results of our study are similar to the majority of the surveys done<sup>2,4</sup>. French and colleagues reported a series of 25 patients with 4% mortality<sup>(6)</sup>, Hook and Norlen reported 67 patients with 7% mortality<sup>10</sup> and Pool reported 56 patients with 7% mortality<sup>16</sup>. In a cooperative study by Kassell and colleagues surgical mortality for ACA aneurysms was 16.8 %<sup>12</sup>.

The clinical grade of Hunt and Hess on admission was the most important factor influencing the surgical outcome in our study. Yassargil and colleagues reported a series of 371 cases of ruptured anterior communicating artery aneurysms (grades I-IV) operated during the years 1967 to 1979. All patients were operated on using Yassargil's microsurgical pterional approach. In their survey the rate of mortality was 5.9 %<sup>(19)</sup>. In our study 80% of patients were in grade I or II (Hunt and Hess scale) and this is the same as the Yassargil study, whereas in other studies the average of 54.4% of patients were in grade I or II<sup>(15)</sup>.

## CONCLUSION

Early intervention and superior surgical technique improve the surgical outcome in patients with ruptured anterior communicating artery aneurysms. The successful surgery of these aneurysms depends on extensive preoperative and intraoperative planning.

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