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## Original article

### Management of Anterior Cerebral Circulation Aneurysms by Endovascular Coiling

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#### ABSTRACT

**Background:** Endovascular management of cerebral aneurysms is relatively a new modality of management in Egypt. So, studies are needed to evaluate efficacy, safety, and outcome; especially with this rapid evolution in both materials and equipment.

**Aim of the work:** To assess safety, efficacy, and outcome of our case series with cerebral aneurysm managed by endovascular coiling.

**Patients and Methods:** Here we documented the clinical, treatment, and outcome variables of cerebral aneurysm case series treated by endovascular coiling between May 2018 and December 2019 in a single center in Egypt.

**Results:** In 30 patients, 34 aneurysms were found, 31 aneurysms [91.1%] were treated by coiling, and only 3 aneurysms [2 cases] [8.9%] failed to be treated by coiling. Total occlusion was achieved in 25 aneurysms [80.6%]. Neck remnants were present in 6 aneurysms [19.4%]. Regarding functional outcome, 26 patients had good outcome and 2 patients had poor outcome.

**Conclusion:** Endovascular coiling is safe and effective method for management of cerebral aneurysm and should be considered as the first choice in management.

**Keywords:** Subarachnoid; Hemorrhage; Cerebral; Aneurysm; Coiling.

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\* Main subject and any subcategories classified according to researchers' main field of study.

## INTRODUCTION

Evolution of endovascular treatment for intracranial aneurysms was basically attributed to pioneering effort of 3 scientists. First: introduction of cerebral angiography by Portuguese neurologist, *Egas Moniz* in 1927. Second: introduction of balloon occlusion of intracranial aneurysms by the Soviet neurosurgeon, *Fedor Sebinenko* in 1970. Third: introduction of detachable bare platinum coils by the Italian neurosurgeon, *Guido Guglielmi* in 1991<sup>[1]</sup>.

Initially, intracranial aneurysms [IAs] considered risky for microsurgical clipping, were treated with endovascular treatment [EVT]. Later, these narrow indications for EVT were broadened and therapeutic efficacy over microsurgical clipping was proven by International Subarachnoid Aneurysm Trial [ISAT], which up to date is the largest multicenter, double blind, randomized study that compares surgical clipping and EVT<sup>[2]</sup>. Results of the ISAT have shown that, there is a 7.4% absolute reduction in the risk of death or dependency at 1 year and a 24% relative risk reduction on modified Rankin scale in endovascular group when compared to surgical group. Thus, short-term safety and efficacy of the technique have been proven to a grade I evidence level<sup>[3]</sup>.

## AIM OF THE WORK

To assess safety, efficacy, and outcome of our case series with cerebral aneurysm managed by endovascular coiling.

## PATIENTS AND METHODS

A prospective study of patients who had treated by endovascular coiling for saccular intracerebral aneurysm between May 2018 and December 2019 in Tanta University hospital was performed.

Thirty-four aneurysms of 30 patients were included in our study.

All patients' aneurysms had the following inclusion criteria: ruptured aneurysms [presenting with acute subarachnoid hemorrhage] or unruptured aneurysms either presented with mass effect or accidentally discovered, presented in the anterior cerebral circulation.

Exclusion criteria include: patients with impaired renal and hepatic functions, pregnancy, patients with coagulation disorders, aneurysms with total parent artery incorporation with poor collaterals and

posterior circulation aneurysms.

Written consents were obtained from all patients before the treatment. The study protocol was approved by Damietta Faculty of Medicine, Al-Azhar University Ethical Committee.

All our patients underwent clinical examination and Hunt and Hess scale on admission, brain computed tomography [CT] scan, cerebral CT angiography [CTA], and digital subtraction cerebral angiography [DSCA] followed by endovascular management. Clinical and radiological follow-up was done six months after treatment.

## Technique of intervention and periprocedural management:

Our initial step in the evaluation of a patient with suspected subarachnoid hemorrhage [SAH] focuses on brief history and airway evaluation. This is followed by evaluation of vital signs and initial resuscitation. Early non contrast CT imaging is done. In cases the CT shows SAH, the patients do CTA immediately in the same study.

Conventional catheter angiography remains the gold standard for detection of intracranial aneurysms and it is performed either as part of therapeutic angiography or in case CTA is not conclusive. The standard transfemoral approach with double wall puncture was used in all patients. Using 5F diagnostic catheter initial cerebral angiography was performed to define the optimal projection for definition of the aneurysmal neck and its relationship to the parent artery and adjacent arterial branches. Exchange of 5-F diagnostic catheter [Bern] by 6-F guiding catheter and the guiding catheter placed in the appropriate position. The microcatheters used were [Excelsior SL-10; Boston Scientific]. The microcatheter was shaped by steam and placed coaxially through guiding catheter and navigated into the aneurysm with the aid of a 0.010- or 0.014-inch micro guide wire [Transend; Boston Scientific]. Different varieties of bare platinum, electrically detachable coils [GDCs; Boston scientific] and [Target, Stryker] were used.

The aneurysm was packed completely with platinum detachable coils. The immediate angiographic results were classified via Modified Raymond–Roy Classification into; class I [complete obliteration], class II [residual neck], class IIIa [residual aneurysm with contrast within coil

interstices], and class IIIb [residual aneurysm with contrast along aneurysm wall [4].

**RESULTS**

Patients were assigned to treatment between May 2018 and December 2019. Thirty patients, 11 [37%] males, and 19 [63%] females. The mean age was 44.43 [range, 26–60 years], and smoking was the most prevalent risk factor [10 patients 33.3%]. Patients characteristics and initial clinical evaluation were described in [Table 1].

Table [1]: Patients characteristics and initial clinical evaluation

Variables		Statistics
Sex	Male	11(48.4%)
	Female	19 (51.6%)
Age (years)		44.43±7.83; 26-60
Smoking		10(33.3%)
Hypertension		5(16.7%)
Diabetes mellitus		4(13.3%)

In the current work, 34 aneurysms were found among 30 patients. Their angiographic features were described in [Table 2]. Among 30 patients, Endovascular coiling was done successfully in 28 cases, it was aborted in two cases. One case of anterior communicating artery [AcomA] aneurysm; it was due to technical difficulty, as the patient had a very tortuous femoral artery, and internal carotid artery with double cervical loop which made the guiding catheter stability very difficult, and one case of AcomA aneurysm associated with a giant Cavernous carotid aneurysm; as the microcatheter reach the Cavernous aneurysm, we cannot pass it and cannot reach the anterior cerebral artery [ACA]. The patient then referred to neurovascular surgery unit for aneurysm clipping. Twenty-five patients in our series had single aneurysm and only 4 patients had 2 aneurysms, and one patient had AcomA aneurysm associated with arterio-venous malformation [AVM]. Endovascular treatment [EVT] was planned for all patients. For the patient with two aneurysms, a conventional angiography was done. The plan was to coil the first aneurysm which was the cause of the SAH, then after securing the main aneurysm, we decide to coil the other aneurysm in the same session or plan for another session to secure both aneurysms. This depend on the availability of the resources, financial condition, and the activity of the team. In our study all cases with wo aneurysms were coiled in the same session. In the

case of the AcomA which associated with AVM the patient was presented by SAH from the rupture of the aneurysm, so coiling was done to secure the aneurysm and to prevent the rebleeding. The patient cannot afford the financial demand for AVM embolization, and there was no bleeding from it. So, the patient was referred for Gamma knife unit, department of neurosurgery at Al-Azhar university for further management. All treated aneurysms were berry aneurysms.

According to the parent vessel, 22 aneurysms were from Acom/ACA complex, 4 aneurysms from middle cerebra artery [MCA], 2 aneurysms from posterior communicating artery [PcomA], one from pericallosal artery, and one aneurysm from Anterior Choroidal Artery [AchA].

Regarding size of the aneurysm, 3 aneurysms were small [2-6 mm], 4 aneurysms were large [12-24 mm], 22 aneurysms were medium [6-12mm] and 2 were giant aneurysms [more than 24mm].

Regarding size of the neck of the aneurysm; 25 aneurysms had narrow neck [Less than 4 mm] while 6 aneurysms had wide neck [more than 4 mm]. The aneurysm sac diameter to aneurysm neck was measured and this ratio was found equal or more than 2 in 21 aneurysms, from 1-2 in 10 aneurysms and no aneurysms had ratio less than 1.

Table [2]: Angiographic features

Character		n	%
Site	AcomA	22	73.7
	PcomA	2	6.6
	MCA	4	13.3
	AchA	1	3.3
	Pericallosal	1	3.3
	Carotid bifurcation	3	10
	Cavernous carotid	2	6.6
	Size	(2-6mm)	3
(6-12mm)		22	64.7
(12-24mm)		4	12.9
(>24 mm)		2	6.4
Neck type	Narrow	25	80.6
	Wide	6	19.4
D/N ratio	≥2	21	67.6
	1-2	10	32.4
Complications	Carotid dissection	1	3.5
	Femoral dissection	1	3.5
	Vasospasm	1	3.5
	Perforation	1	3.5
	<b>Total</b>	4	14.2

AcomA: Anterior communicating artery; PcomA: Posterior communicating artery; MCA: Middle cerebra artery; AchA: Anterior choroidal artery.

Successful EVT was achieved in 28 patients; 26

patients had good recovery [GOS 5], 2 patients had moderate disability, no patients severely disabled, and no patients were vegetative or died.

Clinical evaluation at hospital discharge was performed with Glasgow Outcome Scale [GOS].

In our series, we had 4 complicated cases, one case of Carotid dissection, one case of femoral dissection, one case of vasospasm, and one case of aneurysm perforation.

All patients were properly managed without any subsequent morbidity or mortality. Complete obliteration was achieved in 25 aneurysms [80.66%]. Residual neck was present in 6 aneurysms [19.4%]. Regarding Clinical outcome 26 patients were class 5 [86.6%], 2 patients were class 4 [6.6%].

## DISCUSSION

In our study we prefer endovascular coiling as the first choice in management of cerebral aneurysms. The ISAT showed that for bleeding aneurysms candidate for management by both techniques, endovascular coiling should be the first-choice treatment<sup>[2]</sup>.

### Demographic data:

Males represented [36.6%], and females [61.2%]. Age range [26-60] years, and the mean [44.43] years. Vanzin reported that 68.3% were women, and 31.7% were men. Age range was [16-90] years and the mean was [48] years<sup>[5]</sup>. Raymond reported the mean age was 54.2 years, and 74% of patients were females<sup>[6]</sup>. Elewa reported that Males were [48.4%], and age range [18-71], mean 45.7 %<sup>[7]</sup>.

### Risk factors:

In our study, 10 patients were smoker [33.3%], 5 patients were hypertensive [16.6%], and 4 patients were diabetic [13.3%]. Elewa reported that, smoking was [38.7%], hypertension [41.9%], diabetes type II [12.9%]<sup>[7]</sup>.

### Multiple aneurysms:

In our study [86.6%] patients have single aneurysm, and [13.3%] had two aneurysms. Raymond reported that, patients had multiple aneurysms in 35.6% of cases<sup>[6]</sup>. Vanzin reported that, patients had multiple aneurysms in 29.4% of cases<sup>[5]</sup>. Different distribution of risk factors and aneurysm characteristics among studies could be attributed to difference in inclusion criteria and

number of included subjects.

### Aneurysm location:

In our study, 22 aneurysms were AcomA [73.3%], 4 aneurysms were MCA [13.3%], 2 aneurysms were Pcom [Posterior communicating artery] [6.6%], 3 aneurysms were carotid bifurcation [10%], 2 aneurysms were cavernous carotid [6.6%], 1 aneurysm was at AchA [Anterior choroidal artery] [3.3%], and one aneurysm was at pericallosal artery 3.3%. Compared to other studies, Elewa reported that AcomA aneurysms were [34.4%], PcomA aneurysms were [20%], MCA were [11%], carotid bifurcation aneurysms were [5.7%], pericallosal artery aneurysm were [2.9%], cavernous carotid aneurysms were [2.9%]<sup>[7]</sup>.

### Size of the aneurysm:

In our study 22 [64.7%] aneurysms were medium size [6-12 mm], 4 [12.9%] aneurysms were large [12-24mm], 3 [8.8%] aneurysms were small [2-6mm], and 2 [6.4%] aneurysms were giant [ $\geq 24$ mm]. Compared to other studies, Elewa reported that [48.8%] were small aneurysms [ $\leq 5$ mm], [48.8%] were medium size aneurysms [5-10mm], and [2.9%] aneurysms were large [ $\geq 10$ mm]<sup>[7]</sup>. Raymond reported that [21.3%] aneurysms were small [3-9mm], [50.6%] aneurysms were  $\geq 10$ mm<sup>[6]</sup>.

### Neck of aneurysm:

In our study 25 [80.6%] aneurysms had narrow neck [ $\leq 4$ mm], 6 [19.3%] aneurysms had wide neck [ $\geq 4$ mm]. Compared to other studies, Elewa reported that [65.7%] of aneurysms had narrow neck [ $\leq 4$ mm], while [34.3%] of aneurysms had wide neck [ $\geq 4$ mm]<sup>[7]</sup>. Raymond reported that [23.7%] of aneurysms had narrow neck [ $\leq 4$ mm], while [52.2%] of aneurysms had wide neck [ $\geq 4$ mm]<sup>[6]</sup>.

### Immediate Angiographic Outcome:

According Raymond classification, total obliteration was achieved in 25 [80.6%] aneurysms [Figure 1], Subtotal obliteration was achieved in 6 [19.3%] aneurysms [Figure 2] and incomplete obliteration was achieved in zero aneurysms<sup>[6]</sup>. Compared to other series, Raymond reported complete obliteration in 35.9%, neck remnants in 46.3% and incomplete obliteration in 13.8%<sup>[6]</sup>. Roy reported complete obliteration in 47.2%, neck remnants in 42.2% and incomplete obliteration in 4.8%<sup>[8]</sup>. Gonzalez reported complete obliteration in

55.9%, neck remnants in 32.2% and incomplete obliteration in 1.2% [1]. Cognard reported complete obliteration in 57% neck remnants in 37% and incomplete obliteration in 6% [9]. Differences in outcome reflects the fact that, outcome is affected by many factors, related to both surgeon experience, resources and patient characteristics.

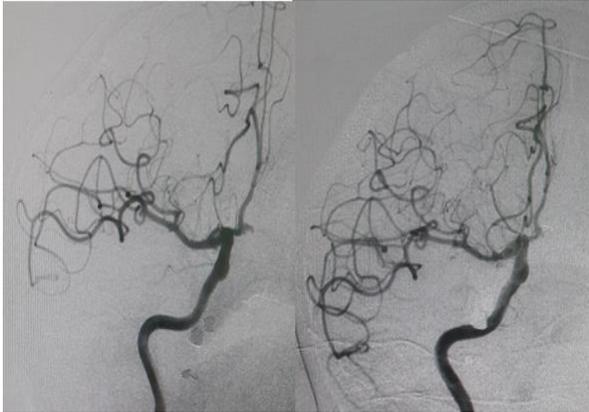


Figure [1] Acom aneurysm pre & after coiling

Renowden reported complete obliteration in 62%, neck remnants in 33% and incomplete obliteration in 5% [10]. Hasan et al reported complete obliteration in 63.4%, neck remnant in 30.8% and aneurysmal filling in 5.8% [11]. Elewa reported that complete obliteration in [82.9%], neck remnant in [11.4%], and aneurysmal filling in [2.9%] [7].



Figure [2] AchA Aneurysm pre & after coiling

## Conclusion

Endovascular coiling is considered safe and effective technique for management of cerebral aneurysms and should be considered as the first choice in management.

## Financial and Non-financial Relationships and Activities of Interest

Authors declare that there is none; the study completely funded by the researchers themselves.

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