Original Article

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Cardiology Section

Endovascular Management of Intracranial Giant Aneurysms: Experience on 25 Patients

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ABSTRACT

Background & Aim: Various endovascular modalities are available for the management of intracranial aneurysms. We present our experience with these modalities in the management of the giant aneurysms.

Methods: A retrospective analysis of the patients presenting with intracranial giant aneurysms, suspected clinically and confirmed on neuroimaging, in our institute between February 2003 and July 2008. Patients were treated by parent vessel occlusion, stent assisted coiling, balloon assisted coiling, stent grafts or onyx based upon clinical findings, cross compression and balloon occlusion test. Clinical and angiographic follow up done at intervals of 1, 3, 6, 12, 24 and 48 months.

Results: The records of 25 patients (7 males and 18 females; aged 9 to 76 years) from the study period were available for analysis. In 21 of the 25 patients, the giant aneurysms were localized in the anterior circulation (majority in caroticopthalmic segment) while in 4, they were found in the posterior circulation. Total occlusion was seen in 19 of the 25 cases. A worsening of the mass effect was seen in 3 cases, and ICH was seen in 2. Transient neurological deficits were observed in 6 patients, while permanent deficits affected 3 patients. Death occurred in one patient in our study. During the follow-up period, an improvement in mass effect was seen in 23 patients. Recanalisation was observed in 2 patients who underwent a conservative treatment. Four patients continued to have persistent symptoms and one patient expired during the follow up.

Conclusion: Various endovascular modalities appear to be an effective and safe alternative treatment for the management of intracranial giant aneurysms.

Key Words: Giant aneurysms, Endovascular coiling, Intracranial stent

INTRODUCTION

Giant intracranial aneurysms (> 2.5 cm in diameter) comprise of ~5% of total intracranial aneurysms and cause mortality in >60% of patients in 5 years of presentation [1]. The surgical intervention, though is considered as the standard mode of management, is often difficult and dangerous due to accompanying comorbidities and the state of arterial walls. Moreover, the longer temporary arterial occlusion times required during surgery may increase the risk of cerebral ischemia [2]. Due to these limitations, endovascular approaches have gained popularity as a treatment for giant cerebral aneurysms. The endovascular options available for such treatment are parent vessel occlusion, coil embolisation, balloon assisted coil embolisation, stent-assisted coil embolisation and onyx filling of the aneurismal sac [3]. We present our experience with the use of various endovascular modalities in the management of giant intracranial aneurysms during last 5 years.

MATERIALS AND METHODS

The presented data is a retrospective analysis of the patients managed for intracranial giant aneurysms in the departments of Neurosurgery and Intervention Radiology in a tertiary care referral centre between February 2003 and July 2008. The diagnosis of aneurysms was based upon clinical presentation and radiological findings (CT or MR angiography and DSA with 3-D rotation). The patients were managed with any of the endovascular modality based upon the clinical and radiological findings, as per unit protocol (discussed below). Flow diverters were not used in any of our cases due to their non-availability. The patients were followed up clinically after 3, 6, 12 and 24 months after the intervention. The information regarding persisting or upcoming symptoms and examination findings were recorded. Follow-up angiographies were performed at 6 months. The data was analyzed using descriptive statistics. A written informed consent was obtained from all the patients/guardians for the intervention. The study was approved by the institute ethics committee. Treatment strategy [4,5]. An endovascular procedure was performed in all patients under general anesthesia with proper pre- and post-procedure heparinisation. A balloon occlusion test was performed in thirteen patients; [8] had good cross circulation and passed the balloon occlusion test. All of the patients were administered dual anti-platelet agents (75 mg clopidogrel and 150 mg aspirin) for at least 3 months, followed by a regimen of a single anti-platelet agent (aspirin) for one year. Patients that had been treated with a stent were prescribed an anti-platelet regime for their lifetimes.

Parent vessel occlusion was performed in four patients [Table/Fig-1] whose aneurysms displayed large necks and very good cross-circulation, as confirmed by the balloon occlusion test, with a venous delay < 2 seconds. Simple coiling alone was conducted in 9 patients [Table/Fig-2] who had giant aneurysms with favorable geometry for direct coil delivery. Balloon-assisted coiling (Hyper-foam balloon) was performed in one patient [Table/Fig-3] in which the aneurysm was present in a distal location with an acute angle to the parent artery and with a normal parental artery.

Stent-assisted coiling was performed in 5 cases (Neuroform in four and LEO in one patient) [Table/Fig-4]. These patients had a diseased parental artery with an obtuse angle between the aneurysm and the parent artery. It should also be noted that affordability played a role in selecting a treatment. Stent graft was used in 4 patients (Jomed stent graft) [Table/Fig-5]. These patients had aneurysms that were situated in the proximal portion of the internal carotid artery, where a stent can be easily maneuvered. These patients also had good arterial anatomy with no tortuous course. Onyx was used in one patient that had a favorable neck to artery ratio and a positive seal test [Table/Fig-6].

RESULTS

The records of 25 patients (7 males and 18 females; aged 9 to 76 years) from the study period were available for analysis. The majority of our patients (20) presented with symptoms related to mass effect, such as headache and cranial nerve palsies. Eight of our patients presented with occulomotor nerve palsy, while six presented with subarachnoid haemorrhage. Only one patient suffered from intraparenchymal haemorrhage. 21 aneurysms were noted in the anterior circulation, while the remaining 4 occurred in the posterior circulation. 9 aneurysms were in the cavernous segment, 10 in the carotico-ophthalmic segment, 1 in the posterior communicating artery and 1 in the supraclinoid internal carotid artery. Of those 4 in posterior circulation, 3 were located in the basilar artery, and 1 was in the vertebral artery. All of the abovementioned aneurysms had a fundus diameter > 2.5 cm.

Total occlusion of the aneurysm was achieved in 19 cases (Raymond 1), and partial occlusion was feasible in 6 cases with contrast filling the neck of the aneurysm (Raymond 2). An improvement in mass effect was seen in 23 patients during the follow-up period. However, there was an initial worsening of the mass effect in 3 of the patients. These patients had increasing headaches, worsening visual symptoms and cranial nerve palsies. Transient neurological deficits were seen in 6 patients (these patients had improved by the time of the follow-up occurring one month after treatment), and permanent neurological deficits occurred in 3 patients (permanent cranial nerve palsy in 2 and dense motor deficit in 1 patient). Follow-up control angiographies were performed in 18 patients. The control angiography revealed recanalisation in 2 patients who underwent coiling and were being managed conservatively. Overall

[Table/Fig-1]: A&B: DSA depicting the giant cavernous segment (shown by the arrows) aneurysm C&D: Post Procedure angiogram showing complete exclusion after parent vessel occlusion.

[Table/Fig-2]: DSA depicting the giant basillar tip aneurysm (A).Post procedure angiogram shows complete occlusion of the aneurysm after endovascular coiling (B)

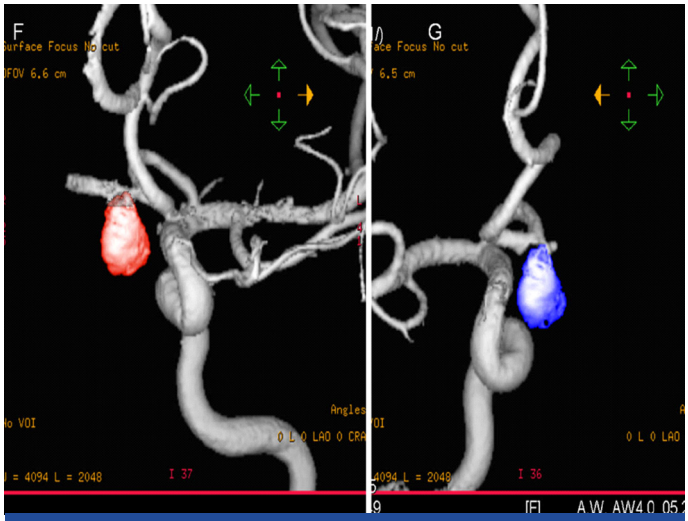
[Table/Fig-3a]: Preprocedure angiogram depicting the giant Anterior communicating aneurysm (A,B)

[Table/Fig-3b]: Balloon assisted coiling done; the position of the balloon is shown by the arrow.

4 patients continued to have persistent symptoms in follow up and death occurred in one patient in the present series.

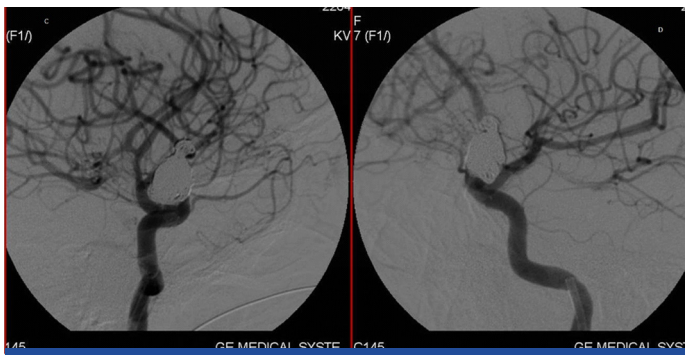
DISCUSSION

From our presented data, various endovascular modalities appear to be effective and safe alternative treatment for the management of intracranial giant aneurysms.

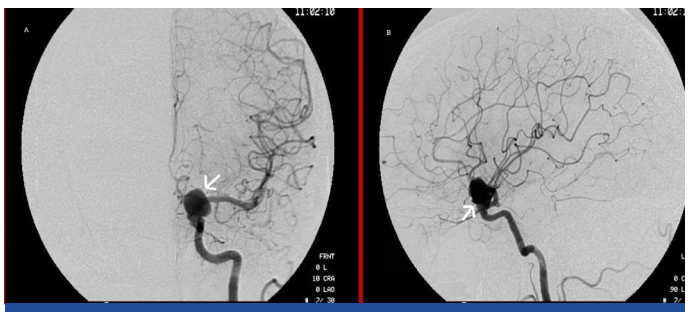


[Table/Fig-3c]: Post procedure angiogram showing complete exclusion of the aneurysm from the circulation.

[Table/Fig-4a]: Giant left carotico ophthalmic aneurysm as shown with arrows with a small daughter sac is noted.

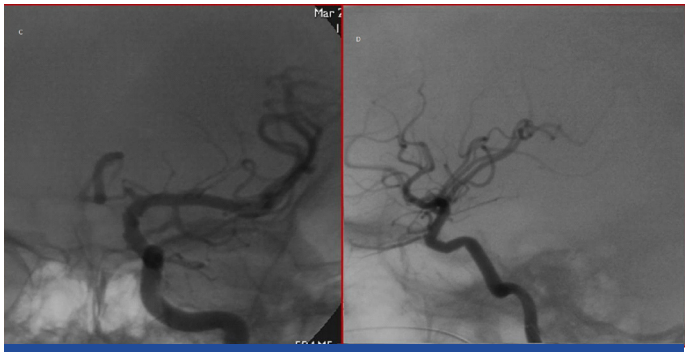


[Table/Fig-4b]: Angiogram reveals complete exclusion of the aneurysm following stent assisted coiling.



[Table/Fig-5a]: Giant aneurysm (arrows) of the left internal carotid artery is demonstrated

In 21 of the 25 patients, the giant aneurysms were localized in the anterior circulation (majority in caroticopthalmic segment) while in [4], they were found in the posterior circulation. Giant aneurysms are often seen at the sites of maximum hemodynamic stress, such as the cavernous, supraclinoid and vertebrobasillar regions. Giant aneurysms are formed from constant aberrant



[Table/Fig-5b]: Stent graft in the internal carotid artery isolates the giant aneurysm which is excluded from the circulation.

[Table/Fig-6a]: Pre procedure angiogram shows left carotico ophthalmic aneurysm.

[Table/Fig-6b]: Onyx is seen filling the aneurysm completely

vascular remodelling caused by abnormal hemodynamic flow and secondary healing processes in response to constant vessel injury by remodelling stresses. The majority of our patients (80%) presented with symptoms related to mass effect, such as headache and cranial nerve palsies. Giant aneurysms are dynamically active; continuous growth, despite near total thrombosis, results in the mass effect. The thrombus is the source of periodic distal emboli, and hemorrhage may occur at any point [1].

Currently, the indications for endovascular treatment of giant aneurysms with the aim of sparing the parent vessel are anticipated surgical difficulty, co-morbidities precluding craniotomy, poor grade subarachnoid hemorrhage, and unfavorable morphological features [6,7]. Total occlusion of the aneurysm was achieved in 19 cases (Raymond 1), and partial occlusion was feasible in 6 cases with contrast filling the neck of the aneurysm (Raymond 2). Raymond classified coiled aneurysms as complete occlusion of the aneurysm (class 1), minor recanalisation (class 2) which means persistence of the residual neck and major recanalisation (class 3) which include persistence of the residual aneurysm [8].

In this study, four of the patients presented with very wide aneurysm necks, excellent collateral circulation across the circle of Willis in the balloon occlusion test and venous delays < 2 s. These characteristics prompted us to occlude the parent vessel in these patients. Detachable coils were initially used by Cognard et al., (1997) in a group of 4 patients with giant aneurysms. Occlusion

was reported in 75% of the patients, and recanalisation occurred in 50% during the one-year follow-up period. In another study, Guglielmi Detachable Coils were solely used for the endovascular treatment of 40 patients, and recanalisation was seen in 52.9% of these patients after 11 years [4,9]. We used detachable coils alone in 9 of our patients, resulting in good angiographic outcomes, and 2 patients presented with recanalisation within one year. Aneurysm geometry is a very importantvfactor in endovascular treatment. The dome:neck ratio and the neck width determine the stability of coils placed in the aneurysm, as well as the likelihood of both primary neck occlusion and later recanalisation. The geometry also dictates the need for adjunctive strategies, such as stent assistance or balloon remodelling, to retain and stabilize the endovascular repair.

A combination of stent and onyx were employed in a group of 11 patients described by Mawad et al., (2002), with 81% complete occlusion, 9% morbidity and 18% mortality (10). Stent-assisted coiling was performed in five of our patients. Diseased parental arteries and the obtuse angles of the neck of the aneurysms in these patients rendered them suitable for stent-assisted coiling with near complete occlusion of the aneurysm from the circulation. Stent graft was used in four other patients in our study with successful outcomes. In these patients, aneurysms were present in the proximal portion of the ICA, less tortousity of the internal carotid artery which can easily be negotiated. However, the location of these aneurysms in the more proximal segment was quite favorable to negotiate stent grafts in these patients. Bare stent grafts were used to treat giant aneurysms and 100% occlusion was achieved [11]. A modified procedure, known as balloon-assisted coiling was performed in one patient by introducing a balloon remodelling technique. It was necessary to use a Hyperform balloon to assist coiling in this patient due to the acute angle of the aneurysm, which was located distally on a healthy parental artery. In another study, Molyneux et al., (2004) demonstrated a balloon remodeling technique performed in conjunction with Onyx delivery into the aneurismal sac; this study reported an effective occlusion in 64% of the 19 patients included in the CAMEO trial (Cerebral Aneurysm Multicenter European Onyx). The mortality and major morbidity were 9 and 12.5%, respectively, and there was no recanalisation up to one year after treatment [12].

Overall 4 patients continued to have persistent symptoms in follow up and death occurred in one patient in the present series and these results are on par with previous reports [13]. The patient became unstable 48 hours after the intervention, and a CT scan showed intraventricular haemorrhage. The mortality of untreated giant aneurysms is approximately 60 to 100 % within 2 to 5 years. The mortality and morbidity rates for anterior circulation aneurysms are 7.4 and 26.9% while, for posterior circulation aneurysms, these rates are 9.6 and 37.9%, respectively [14].

CONCLUSION

Endovascular treatment of giant aneurysms is a promising alternative treatment with promising results. The selection of appropriate techniques and materials is essential to obtain favourable results. Understanding the complex anatomy of the aneurysm is crucial to successful navigation and intervention.

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