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Outcome of endovascular treatment of giant aneurysm. A retrospective study

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ABSTRACT

Introduction: Very large and giant aneurysms are among the most challenging cerebrovascular pathologies in neurosurgery. The risk of aneurysmal rupture compounds with an increase in the size of the aneurysm thus warranting appropriate intervention.

Objective: To analyze the outcome of endovascular treatment of giant aneurysm.

Materials and Methods: A retrospective study was conducted at the Department of Neurosurgery. 35 cases were selected from the database with radiological diagnoses of giant aneurysm referred to our departments from 2016 to 2023.

Results: The patients mainly belonged to >60 years age group (37.14%) and had a mean age of 49 years, with a slight female preponderance (57.14%). Aneurysms were mainly located in patients who had left internal carotid artery (ICA) supraclinoid aneurysms (14.29%) and right middle carotid artery (MCA) bifurcation aneurysms (14.29%). The patients predominantly underwent simple coiling (45.7%) and stent-assisted coiling (42.8%). Of 35 patients, 2 (5.7%) died. The recurrence was higher in posterior circulation aneurysms with, 75% in basilar top aneurysms (3 out of 4 cases), 50% in posterior communicating artery aneurysms (one out of 2 cases), 37.9% in remaining cases (11 out of 29 patients).

Conclusion: Giant aneurysm is associated with reasonably high morbidity and mortality. The aneurysms are found most often in the anterior circulation, while the recurrence is mainly observed in the posterior circulation have more chances of recurrence. However, favourable outcome was frequently observed (94.3%).

Keywords
intracranial giant aneurysm,
clipping,
coiling,
bypass,
flow diverter

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INTRODUCTION

Giant intracranial aneurysms (GIAs), defined as greater than 25 mm, are rare intracranial lesions. Giant cerebral aneurysms account for ~5% of all intracranial aneurysms. [1-3] They occur more commonly in the 5th-7th decades and are more common in females. [2] Patients can present with symptoms and signs of mass effect or subarachnoid hemorrhage. [1,2] GIAs are typically saccular in shape, though they can also be fusiform or serpentine in morphology. [1] They are thought to develop via two pathways: internal elastic lamina *de novo* defect and enlargement from a smaller aneurysm. [2]

Compared to non-giant cerebral aneurysms, GIAs are more commonly located in the posterior circulation, with an incidence of around 35%. [3]

The appearance can vary depending on whether the aneurysm is non-thrombosed, partially thrombosed, or completely thrombosed. Radiographically, non-thrombosed GIAs appear as well-defined, slightly hyperdense, round extra-axial masses, and may demonstrate a peripheral calcified rim. [2]

The treatment of GIAs includes both endovascular and open surgical techniques, with endovascular options generally associated with lower morbidity. [3] Available therapeutic approaches include reconstructive techniques (such as clipping, coiling, stent-assisted coiling, and flow diversion) and deconstructive techniques (including parent artery occlusion, sometimes combined with bypass surgery, and flow modification strategies). [4] Given the poor natural course of GIAs, aggressive treatment is often recommended to achieve both aneurysm occlusion and relief of mass effect. [5,6] However, the risks of treatment must be carefully weighed against the potential benefits.

Reconstructive techniques are usually the preferred treatment strategy for intracranial aneurysms, as these procedures preserve the patency of the parent vasculature and maintain cerebral blood flow distal to the aneurysm. [7-9] Direct surgical clip ligation of the neck with preservation of the parent vasculature remains the ideal reconstructive treatment strategy in the majority of very large and giant vascular aneurysms. On the other hand, coil embolization has proven ineffective in the treatment of very large and giant aneurysms. Intravascular coil embolization has significant limitations in wide-necked aneurysms due to comparably lower packing densities and subsequently higher rates of recanalization. [10]

Deconstructive treatments are considered only when reconstructive methods are not feasible or would result in unacceptable morbidity. The present study aims to describe the characteristics of patients with giant intracranial aneurysms and to assess treatment outcomes.

Material and methods

This retrospective study reviewed electronic medical records of patients diagnosed with GIAs (≥25 mm) from 2016 to 2023 at the Trauma Centre, Department of Neurosurgery, in a tertiary care hospital. The study included patients with radiological diagnoses confirmed by digital subtraction angiography (DSA) or computed tomography angiography (CTA) and underwent endovascular treatment. Only patients with available pre- and post-operative DSA and computed tomography (CT) scan (from either our institution or external sources) and those undergoing their first surgical intervention were included. Exclusion criteria included a history of trauma or iatrogenic injury, poor prognosis conditions (e.g., severe heart disease, cancer), connective tissue disorders, and patients lost to follow-up. Patients with incomplete or erroneous clinical, radiological, or surgical data were also excluded. Necessary permission was obtained from the Institutional Ethics Committee and patient consent was waived due to the retrospective nature of the study.

Participants and assessment

This study involved the review of 35 cases of GIA with data collected on patient demographics, clinical presentation, aneurysm rupture, and aneurysm configuration, as well as treatment modalities and outcomes. Diagnostic imaging, including DSA, magnetic resonance imaging (MRI), CT scan, and CTA was independently analyzed by a neuroradiologist and a neurosurgeon. Treatment decisions were based on the location and morphology of the aneurysms, and procedures such as DSA, coiling, stent-assisted coiling, balloon-assisted coiling, and flow diversion were performed as appropriate. All patients completed regular follow-up assessments. Outcomes were evaluated using the Glasgow Outcome Scale (GOS), with a good outcome defined as a final GOS of 4 or 5, and a poor outcome as a final GOS of less than 4.

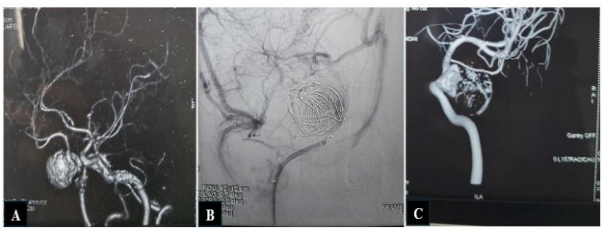

Figure 1. Digital subtraction angiography of giant basilar top aneurysm. Pre-operative (A), post-operative stent assisted coiling of a patient showing occlusion of aneurysm (B), and at 1 year illustrating residual filling of the aneurysm.

Statistical analyses

Descriptive statistics were used.

Results

The mean age of the study population was 49 years (range, 22–66 years). The patients were mainly in the >60 years age group (37.14%), with slight female preponderance (57.14%).

The majority of patients had left internal carotid artery (ICA) supraclinoid aneurysms (14.29%) and right middle carotid artery (MCA) bifurcation aneurysms (14.29%). While the least common locations were right ICA cavernous giant segment aneurysms (5.71%), and others (2.86%) (Table 2).

The patients predominantly underwent simple coiling (45.7%) and stent-assisted coiling (42.8%) (Table 3).

Of 35 patients, 2 (5.7%) died. One had a right middle cerebral artery bifurcation giant aneurysm and underwent simple coiling. The other had a ruptured left supraclinoid giant aneurysm and underwent balloon-assisted coiling. Additionally, two patients (5.7%) experienced weakness in the left upper limb, and one patient (2.8%) had weakness in both the left upper and left lower limbs. Additionally, one patient (2.8%) developed left eye ptosis, while another patient (2.8%) experienced right eye enophthalmos. The recurrence rate was higher in posterior circulation aneurysm with, 75% in basilar top aneurysm (3 out of 4 cases), 50% in posterior communicating artery aneurysm (one out of 2 cases), 37.9% in remaining cases (11 out of 29 patients) (Table 4).

Table 1. Demographic characteristics

Characteristics	Number
Sex, n (%)	
Male	15 (42.85%)
Female	20 (57.14%)
Mean age, years	49
Age, n (%)	
<30 years	7 (20.00%)
31- 50 years	8 (22.86%)
51-60 years	7 (20.00%)
>60 years	13 (37.14%)

Table 2. Diagnosis of patients with aneurysm

Diagnosis, n (%)	n (=35)
Left ICA aneurysm	4 (11.43%)
Right ICA aneurysm	3 (8.57%)
RICA Cavernous Giant Segment Aneurysm	2 (5.71%)
Right ICA Supraclenoid giant aneurysm	4 (11.43%)
Right MCA Bifurcation aneurysm	5 (14.29%)
Left ICA Supraclenoid giant aneurysm	5 (14.29%)
Left ICA Cavernous Giant Aneurysm	1 (2.86%)
Right ophthalmic Artery Giant aneurysm	1 (2.86%)
Right PCOM artery aneurysm	1 (2.86%)
Left ophthalmic Artery giant aneurysm	1 (2.86%)
Left PCOM artery aneurysm	1 (2.86%)
Giant ACOM aneurysm	4 (11.43%)
Baislar Top Giant Aneurysm	3 (8.57%)

ACOM: Anterior communicating artery, ICA: Internal carotid artery, PCOM: Posterior communicating artery

Table 3. Treatment of patients with aneurysm

Treatment, n (%)	n (=35)
Simple coiling	16 (45.7%)
Stent assisted Coiling	15 (42.8%)
Flow diverter	3 (8.5%)
Balloon Assisted Coiling	1 (2.8%)

Table 4. Outcome of patients with aneurysm

Outcome	Number
Dead	2 (5.7%)
Left Upper limb weakness	2 (5.7%)
Left Upper limb + Left lower limb weakness	1 (2.8%)
Left eye ptosis	1 (2.8%)
Right eye enophthalmos	1 (2.8%)

Discussion

Giant cerebral aneurysms have a poor natural history, with high risk of subarachnoid hemorrhage or progressive symptoms of mass effect. Several endovascular techniques may be applied for treatment, depending on location, size, anatomy and presence of collateral circulation. The authors reviewed clinical experience of 35 very large and giant aneurysms and presented their perspective on the present state of the outcome in endovascular therapy for these aneurysms.

In our study, patients who were treated for Giant aneurysm had a mean age of 49 years (range, 22–66 years). Majority of patients belonged to 51- 60 year age group with female preponderance (57.14%). This data was supported by study of Chalouhi et al., [11] and Dutta et al. [12] where 64.3% were female with a mean age of 47.8 years. A meta-analysis of nearly 4000 patients found that aneurysm growth was associated with both increasing age and female sex. [13] The risk of developing a brain aneurysm increases with age, particularly after 40 years, likely due to the progressive weakening of blood vessel walls over time as they endure the constant pressure

of blood flow. Although aneurysms generally affect males more than females, with a male-to-female ratio of approximately 4:1, females tend to experience worse outcomes. Available literature suggests that ruptured aneurysms occur in females more frequently and also at smaller diameters compared to males. [1]

In our study, the majority of patients had left ICA supraclinoid aneurysms and right MCA bifurcation aneurysms. Similarly, Serbinenko et al. found giant aneurysm in internal carotid artery. [14] Similar study states that these lesions are found most often in the anterior circulation, affecting the ICA, MCA, and ACA, [1,2] while in the posterior circulation, they most commonly occur at the basilar artery, vertebrobasilar junction, PCA, and PICA. [2]

Large and giant aneurysms can be managed with various treatment options like open surgery, endovascular therapy, or a combined approach. Although endovascular modalities like stenting, coiling, and flow diverters have favorable clinical and angiographic outcomes, surgical clipping continues to be the first management option in experienced hands. In our study, maximum patients i.e. 45.7% underwent simple coiling, followed by 42.8% cases who underwent stent assisted coiling. Others had balloon assisted occlusion and FD.

Treatment strategy is planned by assessing factors such as age, comorbidities, size, location, morphology, projection of the aneurysm, neck-to-dome ratio, aneurysmal characteristics such as thrombosis and calcification, collateral circulation, and the presence of critical perforating vessels arising from the aneurysm wall. [1,12]

Among all patients, two died, in which 1 had right MCA bifurcation giant aneurysm who underwent simple coiling. Other one had ruptured left supraclenoid giant aneurysm who underwent Balloon assisted coiling. Sughrue et al., in their study of 140 patients with 141 giant aneurysms treated surgically, reported a mortality rate of 13%, morbidity of 9%, and a favorable outcome in 81% of cases. [15] Similarly, Sharma et al. reported a mortality rate of 9%, and a morbidity rate of 12% for giant aneurysms treated surgically, with favorable outcomes in 86% of patients. [16] Our study also had comparable results with a favorable outcome in 91% with 9% mortality.

Recurrence rate was higher in posterior circulation aneurysm with, 75% in basilar top aneurysm (3 out of 4 cases), 50% in posterior communicating artery aneurysm (one out of 2 cases), 37.9% in remaining cases (11 out of 29 patients)

Conclusion

Giant aneurysms are associated with reasonably low morbidity and mortality. Cases reported in our institution occurred in the 5th-7th decades and are more common in females. These lesions are found most often in the anterior circulation, affecting the ICA and MCA. Recurrence rate is higher in posterior circulating aneurysm, maximum with basilar top aneurysm (75%), DSA remains a "gold standard" in the diagnosis and treatment planning of giant aneurysms. Endovascular coiling was frequently used as treatment technique for large and giant aneurysms, especially in the setting of subarachnoid hemorrhage. Our study had a favorable outcome in 94.3%. Moving forward, there is a critical need for further research into newer treatment modalities, such as flow diverters, which may offer improved outcomes for managing giant aneurysms.

Abbreviations

DSA	Digital subtraction angiography
ICA	Internal Carotid Artery
MCA	Middle Carotid Artery
GIA	Giant intracranial aneurysm

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