

# Functional Outcome in Clipping Versus Coiling of Anterior Communicating Artery Aneurysms

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## ABSTRACT

**Objective:** To evaluate early functional outcome in clipping versus endovascular coiling of anterior communicating artery aneurysm, in terms of Glasgow Outcome Scale (GCS) at 3 and 6 months.

**Methodology:** This comparative study was conducted from July 2022 to June 2023 at Department of Neurosurgery, Punjab Institute of Neurosciences, Lahore. A total of 56 patients were selected by non-probability sampling and randomized into two equal groups. In patients of one group, clipping was done while other group's patients were treated with endovascular coiling of anterior communicating artery aneurysm. After the surgical procedures, patients were followed up at three and six months and GCS was measured. Data was collected on the proforma and analyzed by using SPSS version 25.

**Results:** The mean value of Glasgow Outcome Scale Extended (GOSE) at three months follow-up in group A & B were 6.25±1.83 & 6.00±1.98 respectively. The mean value of GOSE at the follow-up of six months in Group A & B were 6.61±1.85 & 5.96±2.46 respectively.

**Conclusion:** No prominent variations were found in both groups at the follow-up of 3 & 6 months.

**Key Words:** Cerebral aneurysm, Circle of Willis, Endovascular coiling, Glasgow Coma Scale Extended.

### Authors' Contribution:

<sup>1,2</sup>Conception; *Literature research; manuscript design and drafting;* <sup>3,6</sup>Data analysis; <sup>4</sup>Manuscript Editing. <sup>5</sup>Critical analysis and manuscript review

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## Introduction

A complex condition known as intracranial aneurysm (IA) is typified by pathologic protrusions of the cerebral vascular wall. An IA is thought to be present in 3-5% of the general population. The majority of cases are asymptomatic, hence the precise prevalence is unclear. The most frequent cause of non-traumatic subarachnoid hemorrhage (SAH), a catastrophic event with high rates of death, morbidity, and disability along with expensive medical expenses, is the rupture of an IA. It represents 5% of all strokes<sup>1</sup>. Despite being

a serious public health concern, little is known about the pathophysiology and natural history of IAs<sup>2</sup>. An IA has three possible outcomes after it forms: it can expand, rupture, or stay stable. IAs are caused by the expansion and distortion of the artery lumen. They typically have a saccular shape and are most frequently seen at the cerebral artery bifurcations in the Circle of Willis or in the vessels that are either directly proximal or distal to it<sup>4</sup>. People in their 30s to 60s are prone to it. Eighty percent of aneurysms are located in the posterior Willis ring<sup>5</sup>. The usual configuration was only 29.4%<sup>6</sup>.



Neurosurgeons currently agree on a large number of crucial risk factors for cerebral aneurysm rupture, including older age, female sex, smoking, hypertension, numerous aneurysms, size, and location. The incidence of SAH increases with age, reaching its peak in the 60s. Compared to younger patients, senior individuals typically have worse outcomes after SAH<sup>7</sup>. One of the main risk factors for the emergence, growth, and rupture of cerebral aneurysms is known to be hypertension. A brain aneurysm may form and burst as a result of artery wall damage and dilatation brought on by the hemodynamic stress and inflammation that high blood pressure causes. Thus, it is thought that careful blood pressure regulation is crucial for the treatment of cerebral aneurysm<sup>8</sup>. One independent risk factor for cerebral aneurysmal rupture is cigarette smoking, and the rupture risk increases to three times higher than non-smokers<sup>9</sup>.

A significant factor in the pathophysiology of IA is genetics. Compared to the general population, patients with specific genetic disorders (such as Ehlers-Danlos syndrome, Marfan syndrome, and Neurofibromatosis-1) are known to have greater incidence of IAs (10–20%) and aneurysm rupture (8–25%)<sup>10</sup>. Researchers led by Irina M. found a correlation between extrarenal anomalies, such as cerebral aneurysms, and autosomal dominant polycystic kidney disease (ADPKD)<sup>11</sup>. Furthermore, connective tissue illnesses are linked to extracranial carotid artery (ECA) tortuosity, when the ECA deviates from its typical shape<sup>12</sup>. Because postmenopausal women have a higher prevalence of aneurysmal SAH, it is possible that estrogen protects against the formation or rupture of aneurysms<sup>13, 14</sup>.

Achieving total IA blockage while maintaining blood flow in the parent, branching, and perforating arteries is the fundamental therapy tenet. In 1933, Norman Dott was the first to surgically treat an IA, wrapping a ruptured IA; in 1938, Walter Dandy was the first to obliterate

an IA. The traditional microscopic assisted open techniques for IA clipping were reported by Yasargil and Fox in 1975. One such approach was the pterional craniotomy (PTC), which allowed for the safe and efficient exposure of the circle of Willis through the Sylvian fissure with the least amount of retraction on the frontal and temporal lobes<sup>15</sup>.

The Guglielmi, a detachable bare platinum coil device, was first used in clinical settings in 1990. Since then, endovascular therapy using coils has been widely accepted as an effective treatment for IAs. As a result, new coil variations have entered the market, such as coils coated with polymer, which stimulates tissue response throughout the IA neck, and coils coated with hydrophilic gel, which expands when exposed to blood, minimizing dead space.

The purpose of coiling is to limit blood flow to the IA lumen<sup>16</sup> by achieving dense packing through the administration of detachable platinum wires, which causes thrombus and granulation tissue formation. The development of secure and efficient endovascular methods for the management of IAs, particularly those affecting the posterior circulation, has, nevertheless, been a more recent development in IA treatment. The International Subarachnoid Aneurysm Trial<sup>17</sup> results in 2002 led to a rise in the acceptance and use of endovascular methods.

It is crucial to choose between endovascular therapy and surgical clipping for an intracranial aneurysm. Age, Hunt and Hess grade, neurological or medical comorbidity, and the characteristics of the aneurysm itself are among the clinical factors that determine how an intracranial aneurysm should be treated. Technological developments in imaging have enhanced our understanding of the three-dimensional geometry of cerebral aneurysms, which has further impacted treatment protocols and assisted neurosurgeons in diagnosing, organizing, and evaluating therapeutic methods. It

has been said that digital subtraction angiography (DSA) is the "gold standard" for diagnosing cerebral aneurysms and determining treatment decisions<sup>18</sup>.

After aneurysmal subarachnoid hemorrhage, the 30-day death rate might reach 45%. Whether or not to treat interrupted IAs is still up for debate. In certain regions of the world, patients with unruptured aneurysms are offered surgical clipping or endovascular coiling. These invasive procedures have seen significant technical developments and improvements<sup>19</sup>. This study's purpose or rationale is to compare the early functional results of endovascular coiling versus clipping IAs.

## Methodology

The comparative study was conducted at Department of Neurosurgery, Punjab Institute of Neurosciences, Lahore, from 1<sup>st</sup> July 2022 till 30<sup>th</sup> June 2023 after taking written permission from ethical review board. A total of 56 patients were included in the study after taking consent from patients. Non-probability consecutive sampling approach was employed to select patients. The sample size for this study was determined using the OpenEpi calculator, with a 90% confidence interval considered. In accordance with this calculation, a total of 56 patients (divided into two groups of 28 each) were included in the study. Patients of both sex between 25-65 years, diagnosed with subarachnoid hemorrhage having single aneurysms suitable for both coiling/clipping, WFNS Grade 1 and 2 were included in the study. Patients with multiple aneurysms, redo surgery, aneurysm secondary to connective tissue disorders (Autosomal dominant polycystic kidney disease, Ehlers-Danlos syndrome, fibromuscular dysplasia, and Marfan syndrome,) were excluded from this study. Patients were randomized into two groups by lottery method. In Group A (n=28), clipping was done while group B patients were treated with endovascular coiling (n=28). All the patients were

shifted to an intensive care unit, post-procedure for monitoring. The patients were evaluated during OPD follow up visits at 3 and 6 months for the clinical condition, and data was tabulated according to the Glasgow outcome scale extended (GOSE). All the results were collected and recorded on Pro-forma. Data analyzed using SPSS 25. Quantitative data like gender and age was enumerated by the standard and mean deviation & qualitative data like complications by percentages and frequency. Stratification was done based on age, gender, type of management, and results to see its consequences on the outcome variable. Comparison of the two groups were made. Chi-Square and odds ratio p-value  $\leq 0.05$  was taken as significant.

## Results

The overall mean age of the participants was  $49.51 \pm 8.8$  years ranging from 27 to 65 years. There were 23(41.1%) females and 33(58.9%) males with a higher male-to-female ratio. Preoperative clinical condition of patients was assessed with Glasgow Coma Scale (GCS) for the conscious level. Focal impairments, acuteness of damage and to predict patient outcomes, World Federation of Neurological Surgeons (WFNS) Grading System was used. Both first and second grades were represented in the research. Out of 56 patients, 25 (44.6%) have WFNS Grade 1, and 31(55.4%) had WFNS grade 2. (Table 1)

**Table 1. Comparison of WFNS Pre-Op clinical status of patients in both groups.**

Study Groups	Pre-Op Clinical Status		Total
	Group A- Clipping	Group B- Endovascular Coiling	
Pre-Op Clinical Status Grade 1	13	12	25
Pre-Op Clinical Status Grade 2	15	16	31
<b>Total</b>	28	28	56

Glasgow Coma Scale was recorded both pre & post-operatively. The mean pre-operative GCS for Group A came out to be  $14.14 \pm 0.841$  and for Group B it came out to be  $14.17 \pm 0.81$ . The mean

post-operative GCS for Group A came out to be  $13.57 \pm 1.93$  and for Group B it was calculated as  $13.14 \pm 2.67$ . (Table 2) The mean duration of stay at the hospital after the surgery was  $4.7 \pm 2.1$  days. Group A was  $5.6 \pm 2.0$  ranging from 3 days to 12 days. For group B, it was  $3.6 \pm 1.5$  days ranging from 2 to 7 days.

**Table 2. Comparison of Glasgow Coma Scale before and after surgery in both the groups.**

Study Groups	GCS Before Surgery	GCS After Surgery
	Mean± SD	Mean± SD
Group A-Clipping	$14.14 \pm 0.841$	$13.57 \pm 1.93$
Group B-Endo-vascular Coiling	$14.17 \pm 0.81$	$13.14 \pm 2.67$
P- Value	0.77	0.16

Out of 28 participants in Group A, 7(25%) patients had experienced intra-operative rupture. None of the participants from the endovascular coiling have faced such complications. The mean duration of temporary clipping was  $14.09 \pm 8.00$  minutes ranging from 5 to 30 minutes.

After the surgical procedures in both groups, patients were followed up the three months and six months. The neurological level of the affected persons was assessed based on Glasgow Outcome Scale Extended (GOSE). (Table 3)

**Table 3. Comparison of GOSE at 3- and 6-months follow-Up.**

Study Groups	GOSE at Three Months Follow Up	GOSE at Six Months Follow Up
	Mean± SD	Mean± SD
Group A-Clipping	$6.25 \pm 1.83$	$6.61 \pm 1.85$
Group B-Endo-vascular Coiling	$6.00 \pm 1.98$	$5.96 \pm 2.46$
p value	0.82	0.09

At the follow-up of three months, one patient from Group A had a GOSE 1 and he expired due to intra-operative complications (intra-operative rupture). 2 patients expired in Group B. At the follow-up of three months, 1 patient died due to cardiac events. Second patient had a GOSE score of 2 and was in a vegetative state, later on expired at 6 months follow-up. 3.6% mortality rate was

seen in Group A. 7.1% mortality was found in group 2

Based on the results and p-values provided, the study found that there were no significant variations in the GCS scores between Group A and Group B before surgery (p-value: 0.77). Additionally, there were no significant differences in the GCS scores between the two groups after the surgery (p-value: 0.16). This suggests that, based on the GCS scores, the early functional outcome in terms of the Glasgow Outcome Scale did not significantly differ between the two methods of treatment (neurosurgical clipping and endovascular coiling) at the 3 and 6 months follow up.

## Discussion

The overall mean age of the participants was 49.51 ranging from 27 to 65 years. A. M. Buunk et. Al. stated that mean age of presentation of ACoA aneurysm is slightly higher & is around 57 years as compare to other aneurysm<sup>20</sup>. In our study, 59 % of the total participants were males. Though Ramit Chandra Singh at one of the centers in India proved that number of females (60%) is higher<sup>21</sup>.

In this study, preoperative clinical condition of patients with GCS for the conscious level was assessed using World Federation of Neurological Surgeons (WFNS) Grading System. Out of 56 patients, 25 (44.6%) have WFNS Grade 1, and 31(55.4%) had WFNS grade 2. Ramit Chandra states that the GCS ranged from 3 to 15 at the time of presentation, with a mean of  $12.5 \pm 2.4$ . There were 24%, 40%, and 24% of patients with Hunt and Hess Grades 1, 2, and 3, respectively; 8% of patients had Grade 4 and 4% had Grade 5. Headache (76%), altered sensorium (52%), and seizures (16%)<sup>21</sup> were the presenting complaints.

The mean value of GOSE at the follow-up of three months in Group A and in B were  $6.25 \pm 1.83$  &  $6.00 \pm 1.98$  respectively. This is similar with other studies. For example, no significant differences in the proportion of patients with impaired

performance on any of the tests were found between patients who were treated with clipping or endovascular occlusion in the total SAH patient group<sup>20</sup>. Rabih Aboukais & her colleagues stated that selective clipping of a giant AcomA aneurysm is a reliable therapeutic option after a careful evaluation of local vascular anatomy<sup>22,23</sup>.

In our study, 3 to 7% mortality was observed, though, mortality was slightly less in other parts of the world. Recently, a study published (2023) conducted in Warsaw, Poland by Katarzyna Wójtowicz & her colleagues. Mortality for all patients with available follow-up was 2.4% (3/124) and permanent morbidity was 1.6% (2/124) over a mean follow-up of 64.2 months<sup>24</sup>. However a study conducted by Misha Khalid Khan & her associates in Agha Khan University Hospital, Karachi, Pakistan published in 2021 showed very similar results of 4% mortality rate which are similar to our study<sup>25</sup>.

## Conclusion

There were no significant differences among both surgical procedures (surgical clipping and endovascular coiling) in regards to the post-operative GOSE recorded at 3 and 6 months follow up.

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