ORIGINAL ARTICLE

Aneurysmal Subarachnoid Hemorrhage: Outcome of Aneurysm Clipping Versus Coiling in Anterior Circulation Aneurysm

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Abstract

Objective: To compare the neurological outcome of microsurgical clipping versus coiling in patients with anterior circulation aneurysm.

Study Design: Comparative study.

Place and Duration of Study: Department of Neurosurgery, Lahore General Hospital, Lahore, from January 2010 to December 2013.

Methodology: Patients aged 14 - 60 years, with ruptured cerebral aneurysm of anterior circulation and World Federation of Neurosurgical Society (WFNS) grades 1, 2 and 3 were included. Patients more than 60 years, medically unfit patient and posterior circulation aneurysms and WFNS grades 4 and 5 were excluded. Aneurysm sac obliteration was done in randomized manner with microsurgical clipping or coiling. Postoperatively, the patients were assessed and followed-up upto one year for outcome parameters on the bases of WFNS grade and Modified Ranking Scale (mRS) as favourable (mRS ≤ 2) and unfavourable (mRS > 2).

Results: Among 140 subjects selected for study, 70 were included in group A, i.e. coiling and other 70 were in group B, i.e. clipping. The median age of patients in group A was 52.5 ±10 years and in group B was 51.00 ±10 years. Overall, 56 (40%) males, 28 (60%) males in each group; and 84 (60%) females, 42 (60%) in each group were included. The male to female ratio in this study was 1:1.5. In group A, i.e. coiling, 27 (38.6%) patients had no disability (grades 1 and 2), 25 (35.7%) were slightly disabled (grade 3) and 18 (25.7%) had moderate disability (grade 4); whereas in group B, i.e. clipping group 23 (32.9%) patients had no disability (grades 1 and 2), 23 (32.9%) were slightly disabled (grade 3) and 24 (34.3%) had moderate disability (grade 4). At one year follow-up, in group A, favourable outcome was achieved in 56 (80%) of patients compared to 48 (68.6%) in group B; whilst, 14 (20%) patients in group A and 22 (33.1%) in group B showed unfavourable outcome. Although mortality rate was higher in clipping (n=3, 4.3%) as compared to coiling (n=1, 1.4%), but was not statistically significant (p = 0.310).

Conclusion: Endovascular coiling of anterior circulation aneurysms is safe and as effective and successful as aneurysm clipping and is less invasive also.

Key Words: *Anterior circulation. Cerebral aneurysm. Microsurgical clipping. Endovascular coiling. Subarachnoid haemorrhage. WFNS grades. Modified ranking scale (mRS).*

INTRODUCTION

Intracranial aneurysms are potentially life threatening or disabling vascular lesions, which can pose formidable treatment challenges. The majority of aneurysms are located at branching points along the proximal arterial tree, suggesting that haemodynamic factors play a significant role in aneurysm formation. The incidence and prevalence in general population is very difficult to estimate owing to clustering in various high risk groups, large number of deaths without autopsy or neuro-imaging, and presence of asymptomatic lesions. The most common location of intracranial aneurysm is the anterior circulation (85%) and within this region the most common aneurysm is of anterior communicating artery (35%) followed by Posterior communicating (P com) and then middle cerebral artery aneurysms. The most common presentation of intracranial aneurysms is Subarachnoid Haemorrhage (SAH) that can cause significant morbidity and mortality.[1] Those patients who experience SAH after aneurysm rupture, approximately one-third return to a functional life, one-third live a dependent life, and one-third do not survive. The incidence of SAH is around 10 per 100,000 of the population *per annum* with a median age at presentation of 61 years and a female preponderance (64%) with women to men ratio of 3:2.[2,3] Five to 10 percent of aneurysms present prior to rupture with cranial nerve palsy and other symptoms of mass effect. Sometimes patients can present with sentinel events due to enlargement in size of aneurysm. Delayed Ischaemic Deficits (DIDs), arising within the first 2 weeks of haemorrhage, contribute significantly to the high morbidity and mortality associated with SAH.[4] Vasospasm is the major cause of deteriorating neurologic status during this time.[5]

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The goal of treatment is to exclude the aneurysms from the circulation with minimum morbidity. Two definitive treatment modalities are in use, i.e. microsurgical clipping and endovascular obliteration of aneurysm. As the peak incidence of re-bleed for ruptured aneurysm occurs within first 48 hours, the most effective strategy to minimize this risk is to secure the aneurysm as soon as possible. Surgical clipping has a lower rate of aneurysm recurrence after treatment. A higher rate of recurrence is associated with a higher rebleeding rate, given that the re-bleed rate of coiled aneurysms appears to be eight times higher than that of surgically treated aneurysms in the ISAT study.[6]

The overall risks associated with surgical clipping and endovascular coiling, in terms of stroke or death from the procedure, are the same.[7] Patients aged older than 60 years and WFNS grade 4 and 5 SAH have poor outcomes with either technique.[8] Survivors of aneurysmal SAH commonly experience deficits in memory and executive function. These cognitive impairments interact to affect patients' day-to-day functioning, including activities of daily living, return to work, and quality of life.[9]

The aim of this study was to assess post-procedural (aneurysm clipping versus endovascular coiling) neurological outcome in patients of anterior circulation aneurysms.

METHODOLOGY

This study was carried out at Lahore General Hospital, Lahore, from January 2010 to December 2013. All the consecutive patients between 14 - 60 years of age with aneurysmal subarachnoid haemorrhage of anterior circulation and WFNS grades of 1, 2 and 3 were included. Informed consent was obtained. Patients more than 60 years of age, medically unfit patients, those with posterior circulation or giant (> 2.5 cm) aneurysms, broad neck (> 5 mm) aneurysm on DSA (Digital Subtraction Angiography) and aneurysm of cavernous segment of internal carotid artery were excluded. Those patients who had deteriorated to WFNS grade 4, 5 during hospital stay were also excluded from the study. The clinical condition of each patient was graded according to the WFNS grading. On the basis of CT scan, the Fisher's grading was also done.

DSA was done on the 10th post-admission day to determine location, size and dome-to-neck ratio of the aneurysm.

The patients who fulfilled the inclusion criteria were randomised for microsurgical clipping and endovascular coiling. Endovascular coiling was done on the same day of DSA and clipping of the aneurysm sac was carried out after 11 days of the aneurysmal rupture. DSA and coiling was done on the same day to lessen financial burden on the patients and resource burden on neuroradiology department. The neurovascular interdisciplinary team, consisting of neuro-surgeon, neuro-physician, neuro-radiologist and neuro-anaesthetist jointly discussed the time for treatment of ruptured aneurysm with micro-vascular clipping or coiling in randomized manner. All patients underwent routine medical treatment for SAH in neuro-intensive care unit.

CT scans (brain) were obtained in all patients after 24 hours of treatment. If the clinical condition of the patients deteriorated, additional CT scans were requested to determine the cause: hydrocephalus, ischaemia or re-bleed. If no cause of deterioration on CT scan then metabolic was profile also requested to determine whether there is any metabolic cause or if vasospasm responsible for deterioration of patient. The neurological deterioration of the patients were determined by the worsening of the WFNS grade after treatment.

Evan's ratio > 0.3 was labelled as hydrocephalus. At the end of one year, outcome was considered to be favourable (mRS 0, 1, 2) or unfavourable (mRS > 2).

Data was entered and analyzed using SPSS Version 20. Quantitative data (age) was presented in the form of median ± IQR (as data was not normal). Qualitative data (gender, WFN and final outcome) was presented in the form of frequency and percentages. Chi-square test was applied to compare qualitative data in both study groups (coiling vs. clipping). Mann-Whitney U test was used to compare age of patients in both study groups. P-value ≤ was taken as significant.

RESULTS

Among 140 subjects selected for study, 70 were included in group A, i.e. coiling and other 70 were in group B, i.e. clipping. The median age of patients in group A was 52.5 ±10 years and in group B was 51.00 ±10 years. Overall, 56 (40%) males, 28 (60%) males in each group and 84 (60%) females, 42 (60%) females in each group were included. The male to female ratio in this study was 1:1.5. Both age and gender were statistically insignificant among study groups (p=0.928 and 1.00 respectively). In group A, i.e. coiling, the WFNS

Table I: Comparison of age, gender, WFNS and final outcome in both study groups.

	Study groups		p-value
	Coiling (n=70)	Clipping (n=70)	
Median ± I.Q.R of age (years)	52.5 ± 10	51.00 ± 10	0.928
Gender			
Male (n =56)	28 (40%)	28 (40%)	1.00
Female (n =84)	42 (60%)	42 (60%)	
WFNS			
No significant disability (n = 50)	27 (38.6%)	23 (32.9%)	0.532
Slight disability (n = 48)	25 (35.7%)	23 (32.9%)	
Moderate disability (n = 42)	18 (25.7%)	24 (34.3%)	
Final outcome			
Favourable outcome (n = 104)	56 (80%)	48 (68.6%)	0.122
Unfavourable outcome (n = 36)	14 (20%)	22 (31.4%)	

grading showed that 27 (38.6%) patients had no disability (grades 1 and 2), 25 (35.7%) were slightly disabled (grade 3) and 18 (25.7%) had moderate disability (grade 4); whereas, in group B, i.e. clipping 23 (32.9%) patients had no disability (grades 1 and 2), 23 (32.9%) were slightly disabled (grade 3) and 24 (34.3%) had moderate disability (grade 4). The WFNS grading was not different statistically among the two study groups (p = 0.532).

At one year follow-up, in group A, favourable outcome was achieved in 56 (80%) of patients compared to 48 (68.6%) in group B; whilst, 14 (20%) patients in group A and 22 (33.1%) in group B showed unfavourable outcome. There was no statistical difference in final outcome among the two study groups (p = 0.122). Although mortality rate was higher in clipping (3, 4.3%) as compared to coiling (n=1, 1.4%) but was not statistically significant (p = 0.310).

DISCUSSION

In this prospective study of SAH in patients age 14 - 60 years, all patients were randomized for microsurgical clipping or coiling of aneurysms. The analysis of this study shows that poor outcome are higher with surgical treatment than after endovascular treatment, despite relatively higher risk of re-bleeding in endovascular treatment. Furthermore, the risks of seizure, delayed cerebral ischemia, and ischemic lesion on MRI and in-hospital complications are lower after endovascular treatment.[10-13] Early neurological deterioration is frequent observation in SAH of elderly patients. This is due to the SAH and secondary to the procedure.[14,15] The procedure related complications were not uncommon which were in 7 patients (5%) due to infection, epilepsy, and metabolic disturbances. Hydrocephalus is more common in elderly with SAH.[16,17] Shunt implantation was requiring in 3 out of 140 patients which was lower as compared to 20% for global population reported in the literature.[18] This may be due to the younger age group and good grade SAH. Secondly, no pre-operative EVD was done in our group of patients.

A sub-group of patients, enrolled in the ISAT, also showed improved cognitive outcome after coiling compared with surgery.[19]

Kuopio study conducted in Finland also showed that clinical outcome at one year was not significantly different between two groups with 23% versus 33% poor outcome of coiling versus clipping.[20]

ISAT study also shows proportion of poor outcome at one year was 23.5% among patients assigned to coil embolization versus 30.9% to clip ligation (p=0.001).[21]

The investigators at the Barrow Neurological Institute in Phoenix launched BRAT in 2002[22] and proved that outcome at one year was better after coiling versus clipping. Proportion of poor outcome was 23.3% versus 33.7%. Endovascular coil embolization of ruptured intracranial aneurysm is associated with better outcome; but the risk of aneurysm recurrence, the need for treatment, and the risk of rebleeding was higher.[21,22]

The literature shows that 70% of aneurysms can be coiled safely. Posterior circulation aneurysm (15%) and cavernous segment aneurysms of internal carotid artery are mostly coiled and these were excluded in this study. Only the aneurysms of anterior circulation aneurysm were randomized into two groups with consideration of DSA findings in mind. The limitations of this study were that those patients who deteriorated to WFNS grade 4 and 5 and in which ischaemic insult was suspected no angiographic evidence was available and no angiographic intervention was done to counteract the vasospasm. Another limitation was that there were no patients in the early surgery group, although literature shows that early surgery has good results after CT angiogram. It is not possible to decide on CT angiogram for suitability of coiling and DSA is the gold standard investigation for this. To avoid burden on hospital resources, we use DSA only. Although most prognostic factors for outcome after SAH are present on admission and are not modifiable, a substantial contribution to outcome is made by factors developing post-admission and which may be more easily influenced by treatment.

CONCLUSION

In this study, endovascular coiling is as equally effective treatment as aneurysm clipping but it is less invasive too. In patients with SAH careful pre-operative assessment, interdisciplinary approach and proper decision whether to coil or clip and meticulous tissue handling during aneurysm clipping may decrease the unfavourable outcome.

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