Long-Term Outcome in Surviving Patients After Clipping of Intracranial Aneurysms

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■ OBJECTIVE: **The quality of life and functional outcome may be significantly impaired in patients of aneurysmal subarachnoid hemorrhage. The purpose of the present study was to assess the status of patients undergoing surgical clipping of intracranial aneurysms in a long-term follow-up and to identify factors affecting outcome.**

■ METHODS: **494 patients who underwent clipping of their intracranial aneurysms with a minimum follow-up of 1 year after their discharge were studied. Preoperative factors such as age, Hunt and Hess grade, Fisher grade, time interval between ictus and surgery, and site of aneurysm were recorded. The long-term status was assessed using Glasgow Outcome Scale (GOS), Modified Rankin Scale (MRS), Barthel index (BI), and Mini-Mental State Examination (MMSE).**

■ RESULTS: **Site of aneurysm and ictus—surgery interval did not have any effect on any parameter at long-term follow-up. Majority of patients who were discharged continued to improve as measured by GOS, Modified Rankin Scale, and Barthel index. However a significant proportion of patients had impaired MMSE at long-term follow-up. Multivariate analysis showed a significant effect of age on MMSE and also a positive correlation between number of aneurysms and GOS.**

■ CONCLUSIONS: **Most patients who survived and were discharged continued to improve in the postoperative period even though the immediate postoperative outcome was not favorable in many. However, a substantial subset had impaired cognitive function.**

INTRODUCTION

Aneurysmal subarachnoid hemorrhage (SAH) is a devastating disease associated with high mortality and morbidity. In recent years, improved outcome following surgical clipping has been routinely reported. However, patients undergoing clipping of intracranial aneurysms may have a significant impairment in cognitive functioning and health-related quality of life although their neurologic outcome is rated as good according to their Glasgow Outcome Scale (GOS) scores. A large number of patients with ruptured intracranial aneurysms are being operated every year in different centers in India. Most of the available reports describe their results at the time of discharge from the hospital, and no data are available on long-term outcome, especially in the Indian setup. It is important to determine the factors influencing the long-term outcome and proportion of patients who really achieve a good functional outcome or remain severely disabled. In the present study, patients with clipped intracranial aneurysms were followed for a period of time after their discharge. The purpose of the study was to assess their neurologic status as well as functional status and to identify parameters affecting the outcome measures.

MATERIAL AND METHODS

Data were collected from patients who had clipping of their aneurysms and were discharged from the hospital. The study analyzed results among survivors. It was carried out over a period of about 3 years from March 2007 to January 2010. This was a prospective study. Patients who were discharged after the clipping of ruptured intracranial aneurysms were enrolled into the study. Because the purpose of the study was to have data about long-term results, all patients who were operated at the institute and for whom we had all the required information available in our records were included. At our Institute, we have a standard protocol for data recording for all patients undergoing surgery for intracranial aneurysms. Patients who underwent coiling or were not operated were not included in the study. In the final analysis, only those patients who had a minimum of 1 year of follow-up were included. After discharge from the hospital, the post-hospital care is not standardized. Most patients were taken home and cared for by the relatives of the patients. A significant proportion of patients were lost to follow-up and we

cannot comment on what was the final outcome in these. Therefore, in the present study the status at the last follow-up of the patients who were available was compared with the status at the time of discharge from the hospital.

At admission, all patients were assessed for neurologic status and were categorized per their Hunt and Hess (H&H) grades. A computed tomography (CT) was done in all and the SAH was graded by Fisher grade. Patients were further investigated by either a CT angiogram or a digital subtraction angiogram and the location of the aneurysm(s) recorded. The patients were managed as per a standard protocol. The patients were operated as early as possible after stabilization of their hemodynamic and metabolic parameters. The time interval between the last ictus and surgery was noted. The central venous pressure was monitored in all patients. In the postoperative period, the mean arterial pressure was kept about 20–30 mmHg above the baseline blood pressure. A postoperative CT scan was done in the immediate postoperative period and later as indicated by the neurologic status. Daily monitoring of the serum sodium levels was done. Adequate hydration was maintained in the postoperative period. Transcranial Doppler was used as a bedside procedure to detect cerebral vasospasm. The status at the time of discharge was classified according to GOS scores.

All patients were followed up and the status at the time of last assessment was used for final analysis of the results. At each follow-up, patients were assessed by the following parameters:

1. Glasgow Outcome Scale (GOS): Glasgow Outcome Scale is not intended to provide detailed information about the specific difficulties faced by individual patients, but to give a general index of overall outcome. The scale reflects disability and handicap rather than impairment; that is, it focuses on how the injury has affected functioning in major areas of life rather than on the particular deficits and symptoms caused by injury. GOS scores of 5 and 4 were considered as good outcome whereas GOS scores 3 and 2 were classified as poor outcome.

2. Barthel index (BI): The advantage of the BI is its simplicity. It is useful in evaluating a patient's state of independence. It uses 10 variables describing activities of daily living (ADLs) and mobility. A higher number is associated with a greater likelihood of being able to live at home with a degree of independence following discharge from hospital. BI above 70 was taken as good outcome.

3. Modified Rankin scale (MRS): The MRS is the most prevalent outcome measure in stroke trials, and is fast and easy to apply. MRS scores of 0–2 were considered as good outcome.

4. Mini-Mental State Examination (MMSE) or Folstein test: The MMSE involves a brief 30-point questionnaire that is used to screen for cognitive impairment. It is the most widely used standardized cognitive screening test in both clinical practice and research.

Statistical Analyses

The statistical analysis was carried out using the Statistical Package for Social Sciences (SPSS Inc., Chicago, IL, version 15.0 for Windows). Proportions were compared by using χ^2 tests. Two-sided significance tests were used throughout, and the significance level was kept at $P < 0.05$. Multivariate analyses were conducted using nominal logistic regression, with a probability value less than 0.05 required to enter the model. BI, MRS, and GOS were individually analyzed, adjusting for well-known prognostic factors such as age, sex, timing of surgery, H&H grade, and number of aneurysms.

RESULTS

During the study period of 3 years, 875 patients underwent clipping of their intracranial aneurysms. When all grades and all ages were included, that is, considering results of grade 4 as well as grade 5 along with good grade, the overall mortality was 30.1%. Because of economic constraints, very few patients at our Institute underwent coiling. The operated patients included those with posterior circulation as well as multiple aneurysms. Out of these 875 patients, 630 survived and were available for follow-up. A minimum follow-up of 1 year was available for 494 patients, and further results are discussed for these 494 patients. Thus the focus of this study is to assess the long-term outcome of the surviving patients and comparing it with the status at discharge.

There were 264 female and 230 male patients, with a mean age of 45.01 ± 11.7 years. The neurologic status at the time of surgery was taken for analysis. Out of the 494 patients who underwent clipping, 29 were in H&H grade 1, 215 were in grade 2, 183 had grade 3, whereas 61 were in grade 4 and 5. We did not have accurate details of the preoperative grade in 6 patients.

Table 1. Long-Term Outcome at 1 Year

GOS		MRS			BI			MMSE		
5+4	3+2	0+1+2	3	4+5	>70	50—70	<50	28—30	24—27	<24
437	57	420	27	47	440	18	36	197	78	219

GOS, Glasgow Outcome Scale; MRS, Modified Rankin Scale; BI, Barthel Index; MMSE, Mini-Mental State Examination.

Table 2. Effect of Age on Long-Term Outcome Measures

Age (years)	n = 494	GOS		MRS			BI			MMSE		
		5+4	3+2	0+1+2	3	4+5	>70	50—70	<50	28—30	24—27	<24
<45	207	184	23	176	15	16	186	9	12	107	28	72
≥45	287	253	34	244	12	31	254	9	24	90	50	147
P value		0.801		0.196			0.450			0.001		

GOS, Glasgow Outcome Scale; MRS, Modified Rankin Scale; BI, Barthel Index; MMSE, Mini-Mental State Examination.