ORIGINAL ARTICLE

Aneurysmal Subarachnoid Haemorrhage: Outcome of Aneurysm Clipping in Elderly Patients and Predictors of Unfavourable Outcome

Liaqat Mahmood Awan[1], Abdullah Haroon[1], Mukhtar Ahmed[3], Abdul Majid[1], Muhammad Asif Shabir[1], Azam Niaz[1], Abdul Jaleel[2], Muhammad Naeem Kasuri[4] and Anjum Habib Vohra[1]

ABSTRACT

Objective: To determine the outcome of treatment of microsurgical clipping in elderly (60 – 70 years) patients with aneurysmal subarachnoid hemorrhage and determine the predictors of poor outcome.

Study Design: Longitudinal analytical study.

Place and Duration of Study: Nishtar Hospital, Multan, Mayo Hospital, Lahore, Department of Neurosurgery, Lahore General Hospital, Lahore, from January 2000 to January 2010.

Methodology: Elderly patients (60 – 70 years) with ruptured cerebral aneurysm were enrolled and graded on the basis of World Federation of Neurosurgeons Scale (WFNS). Aneurysm sac obliteration was done in all the patients with microsurgical clipping. Postoperatively, the patients were assessed upto 3 months for outcome parameters i.e., neurological deterioration (based on WFNS grade and modified Rankin scale as favourable (mRS score $\leq$ 2) and unfavourable (mRS score > 2). The factors associated with unfavourable outcome were also noted which included age > 65 years, poor initial WFNS grade, and the occurrence of ischaemia.

Results: The mean age of the 48 patients was 65 $\pm$ 5.45 years. There were 31 (64.6%) male and 17 (35.4%) female patients. Postprocedural neurological deterioration occurred in 23 patients (47.9%) related to ischaemia in 14 (29.16%), rebleeding in 1 (2%), and hydrocephalus in 8 (16.66%). At 03 months, the outcome was favourable in 25 patients (52.08%) and unfavourable in 23 (47.91%).

Conclusion: In old patients, careful pre-operative assessment, interdisciplinary approach and meticulous tissue handling during aneurysm clipping may decrease the unfavourable outcome.

Key words: *Elderly. Subarachnoid hemorrhage. Cerebral aneurysm. Microsurgical clipping outcome.*

INTRODUCTION

Subarachnoid haemorrhage (SAH) is a most common presentation of intracranial aneurysms and often has devastating outcome, if not treated in time. Aneurysmal subarachnoid haemorrhage (SAH) is a type of haemorrhagic stroke that can cause significant morbidity and mortality.[1] Population based studies indicate that 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: men of 3:2.[2,3] They are more common in women than in men, by a ratio of 3 – 2.[3] Most intracranial aneurysms remain asymptomatic until rupture, with only 10% presenting prior to rupture, usually with symptoms of mass effect. Delayed ischaemic deficits (DIDs) arising within the first two weeks of haemorrhage contribute significantly to the high morbidity and mortality associated with SAH.[4] After aneurysmal rupture, SAH causes diffuse neurotoxic damage to the exposed cerebrum. Vasospasm and subsequent cerebral ischaemia have been identified as major causes of deteriorating neurologic status during this time.[5] Two definitive treatment modalities are in use i.e. microsurgical clipping and endovascular obliteration of aneurysm. Surgical clipping has a lower rate of aneurysm recurrence after treatment. The higher rate of recurrence is associated with a higher rebleeding rate, given that the rebleed rate of coiled aneurysms appears to be 8 times higher than that of surgically treated aneurysms in the ISAT study.[6] At this point it appears that the 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 Hunt and Hess grade V SAH had poor outcomes with either technique.[8] Survivors of aneurysmal SAH commonly experience deficits in memory, executive function, and language. These cognitive impairments interact to affect patients' day-to-

[1] *Department of Neurosurgery / Anaesthesia[2], PGMI / Lahore General Hospital, Lahore.*

[3] *Department of Neurosurgery, HHSKBZ Hospital, CMH, Muzaffarabad, Azad Kashmir.*

[4] *Department of Neurology, KEMU / Mayo Hospital, Lahore.*

Correspondence: Dr. Liaqat Mahmood Awan, Department of Neurosurgery, Ward No.15, Lahore General Hospital Lahore. E-mail: drliaqatawan@hotmail.com

Received August 18, 2011; accepted February 11, 2013.

day functioning, including activities of daily living, instrumental activities of daily living, return to work, and quality of life.[9] Factors that contributed most to variation in outcome, in descending order of importance, were cerebral infarction, neurological grade, and age, body temperature on day 8, intraventricular haemorrhage, vasospasm, intracerebral haematoma, and history of hypertension.[10]

Currently, some of elderly individuals live independently in good mental health at their homes, and despite the risk related to the aneurysm obliteration in this patient group with higher incidence of co-morbidities, age does not constitute a sufficient argument to refuse treatment. The aim of the study was to assess postprocedural (aneurysm clipping) neurological deterioration, functional outcome and predictive factors of unfavourable outcome in patients between 60 – 70 years of age.

METHODOLOGY

This longitudinal multi-centre study was carried out at Nisthtar Hospital, Multan, Mayo Hospital, Lahore and Lahore General Hospital, Lahore over a period of ten years from January 2000 to January 2010. All the consecutive patients between ages 60-70 years of age with aneurysmal subarachnoid haemorrhage of anterior circulation with WFNS grade I – IV were included. Informed consent was obtained. Patients with posterior circulation aneurysmal subarachnoid haemorrhage and with multiple haemorrhages were excluded. Different key baseline characteristics were recorded which included age and gender. The clinical condition of each patient was graded according to the WFNS classification. On CT scans, the bleeding severity was classified according to the Fisher's classification. The aneurysm features were determined using CT angiography and/or digital subtraction angiography as follows: (1) the location was subdivided into AcomA (anterior communicating artery), ICA (internal carotid artery), MCA (middle cerebral artery), and VBA (vertebrobasilar artery); and 2) size was categorized as < 5 mm, 5 – 10 mm, > 10 mm, and giant (> 2.5 cm).

Only those patients were selected for microsurgical clipping which were not suitable for coiling on angiographic studies. Treatment of the aneurysm sac was carried out early-within 24 hours or after 11 days of the aneurysmal rupture (Figure 1). The neurovascular interdisciplinary team, consisting of vascular neurosurgeon, neurophysician and neuroanaesthetist jointly discussed the time for microvascular clipping based on clinical conditions, aneurysm characteristics, and co-morbid conditions. The primary intention of microsurgical clipping was an MCA (middle cerebral artery) location; Acom and ICA aneurysms. All patients underwent routine medical treatment for SAH and depending on the neurological state of the patient, they were managed

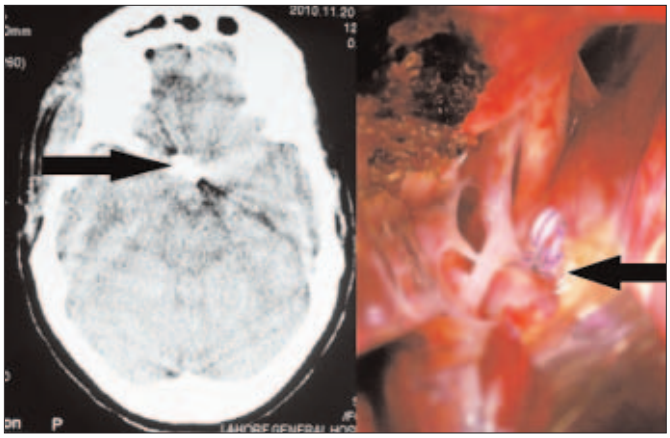

Figure 1: Microsurgical clipping of middle cerebral artery aneurysm.

either in high dependency unit, or intubated and ventilated in intensive care. General neuro-protective strategies were employed in ICU, particularly; adequate sedation, control of oxygenation and ventilation (CO_2 levels), avoidance of hypotension, prevention of hyperthermia, and normo-glycaemia.

For standardized documentation of early postprocedural outcome, routine cranial CT scans were obtained in each patient on third postprocedural day. Additional CT scanning was performed early or late depending upon the neurological deterioration to exclude hydrocephalus, ischaemia or rebleed. Neurological deterioration, upto 3 months postprocedurally, was defined by a lower (worse) WFNS grade after treatment, by the development of a new neurological deficit, or by a significant worsening of an existing neurological deficit. The causes of this neurological deterioration were analyzed using CT scanning and metabolic profile. These causes were classified into cerebral ischaemia, rebleeding and hydrocephalus and metabolic.

Cerebral ischaemia was defined as a new CT-documented hypodense lesion compatible with the clinical features. Temporary was distinguished from definitive ischaemia as favourable and unfavourable outcome respectively. The ischaemic cause was classified, according to timing and location as following: (1) Procedural complications, whether after microsurgical clipping (occlusion of perforating arteries, or major cerebral arteries and their cortical branches); (2) intraoperative systemic events (junctional territory) and (3) DID (junctional territory, perforating, or major arteries).

Abrupt deterioration in neurological status following the initial SAH was confirmed by an increase in the spontaneous hyperdensity (rebleeding) on CT scans. Hydrocephalus was suspected on progressive deterioration of consciousness and confirmed on CT scans. Hydrocephalus was defined as a bithecal/bicaudate ratio (the width of the lateral ventricles in

millimeters at the level of the foramen of Monro as a fraction of the transverse inner diameter of the skull at the same level). Ratio of 6 was considered normal, 5 a moderate dilation and 4 represented a marked dilation. The necessity of a shunt for permanent CSF diversion was recorded at 3 months after surgery; outcome was assessed in consultation according to the mRS by an independent observer.

A binary outcome was considered to be favourable (mRS scores of 0, 1, and 2, independent survival) or unfavourable (mRS score > 2, morbidity or death). The unfavourable outcome was classified as related either to SAH (initial haemorrhage, hydrocephalus, or DID) or to procedural complications (cerebral ischaemia related to procedural maneuvers, intraoperative systemic events, or rebleeding) and deranged metabolic profile.

Data was analyzed using Statistical Package for Social Sciences (SPSS) version 13. The quantitative data like age is presented in the form of mean ± S.D. and qualitative data (like, gender, WFNS grades, Fisher grade, location of aneurysm, etc.) is presented in the form of frequency (%).

RESULTS

Baseline characteristics obtained in 48 patients comprising our population. The mean age of the patients was 65 ± 5.45 years. There were 31 (64.6%) male and 17 (35.4%) female patients. The female to male ratio was 1:1.83. According to WFNS grading 14 (29.16%) patients were in grade-I, 16 (33.33%) in grade-II, 12 (25%) in grade-III and 06 (12.5%) in grade-IV. Bleeding severity on CT scan was grade-I in 4 (8.3%), II in 18 (37.5%), III in 16 (33.33%) and IV in 10 (20.83%) patients. Aneurysm location was Acom in 28, pericollosal in 2, ICA in 7, MCA in 11, VBA in 4 and multiple aneurysms in 2 patients. Aneurysm size was < 5 mm in 19 (39.58%), 5 – 10 mm in 21 (43.75%), > 10 mm in 6 (12.5%) and 2 (4.16%) were giant aneurysms.

Postprocedural neurological deterioration occurred in 21 (43.75%) patients. The causes were ischaemia in 07 (14.58%), hydrocephalus in 11 (22.91%) and electrolyte disturbances in 03 (6.25%). Ischaemia was temporary in 3 (6.25%) and definite in 4 (8.3%) [2 immediate and 2 delayed]. It was more in older patient with co-morbid factors. This was not observed to be related with Fisher grade on CT scan, WFNS grade or character of the aneurysm. Hydrocephalus occurred in 11 (22.91%) patients. Repeated lumbar puncture helped temporary in 4 (8.3%) patients and 7 (14.58%) required VP shunt. No patient required pre-operative EVD or ventriculoperitoneal shunt. Hydrocephalus was mainly in patients with poor WFNS grade, severe Fisher grade but not related to age, co-morbid factors, and aneurysm location, electrolyte disturbances, infection or epilepsy.

The outcome was favourable in 25 patients (52.08%) and unfavourable in 23 (47.91%). Out of these 23 patients, 07 (14.58%) had unfavourable outcome due to initial damage and delayed ischaemia due to SAH. In 09 (18.75%) patients unfavourable outcome was secondary to procedure, systemic events and 07 (14.58%) had uncontrolled infections, metabolic disturbances etc. At three months, 8 (16.66%) patients died. Out of these, 4 (8.3%) died due to systemic event, 2 (4.1%) due to procedure related ischaemia and 2 (4.1%) due to delayed ischaemic deficit.

DISCUSSION

In this prospective study of SAH in patient age 60 – 70 years all patients had microsurgical clipping of aneurysms. Early neurological deterioration occurred in 07 (14.58%) patients. Unfavourable outcome at 3 months occurred in 23 (47.91%) patients. Independent factors were age > 65 years, initial WFNS grade, extent of bleeding on CT scan and the occurrence of immediate or delayed ischaemia. Early neurological deterioration is frequent observation in aSAH of elderly patients. This is due to the SAH and secondary to the procedure.[11,12] The procedure related complications were not uncommon which were in 7 patients (15%) due to infection, epilepsy and metabolic disturbances. In this age group ischaemic risk is high for the management of subarachnoid haemorrhage secondary to the ruptured aneurysm. Irrespective of the site of aneurysm the occurrence of ischaemia is the main determining factor for the outcome inspite of less vasospasm as compared to younger patients. The ischaemic insult in older age group is due to low cardiac output, decreased cerebral blood flow and less compensatory reserves in addition to tortuous vessels and atheroma in the vessels in the operative field.[13-15]

Hydrocephalus is more common in elderly with SAH.[16-18] Eleven patients (23%) had hydrocephalus as compared to 55% reported in literature is probably due to lower age groups.[18,19] Higher incidence in elderly may be due to large volume of SAH which results in more fibrosis of arachnoid granulations, prolong CSF circulation time and larger ventricular size due to atrophic brain makes patient more susceptible to hydrocephalus. Shunt implantation was requiring in 7 (14.6%) out of 48 patients which was lower as compared to 20% for global population reported in the literature.[17] This may be due to the younger age group (60 – 70 years) as compared to older age group (70 – 80 years). Secondly, no pre-operative EVD was done in our group of patients. Thirdly, patients were assessed only for 3 months which may have missed outpatients who developed hydrocephalus afterwards.

Other limitations of the study were that patients in which ischaemic insult was suspected no angiographic evidence was available and no angiographic inter-

vention was done to counteract the vasospasm. There were no patients in the early surgery group. In this group favourable outcome was in 25 patients and unfavourable in 23 patients (52.08% vs. 47.91%) as compared to the reported 50.7 – 63.3% favourable outcome in the last 15 years.[20-25] Most prominent factor for the poor outcome was the poor grade to begin with.

To improve the outcome of aneurysmal clipping, efforts should be made to reduce the ischaemic insult. Although most prognostic factors for outcome after aSAH are present on admission and are not modifiable, a substantial contribution to outcome is made by factors developing after admission and which may be more easily influenced by treatment.

CONCLUSION

In this series, the proportion of patients older than 60 years with favourable outcome after clipping for ruptured cerebral aneurysm was in 52.08% at 3 months despite postprocedural occurrence of neurological deterioration in 43.75%. In old patients careful pre-operative assessment, interdisciplinary approach and meticulous tissue handling during aneurysm clipping may decrease the unfavourable outcome.

REFERENCES

1. Denise H. Rhoney, Karen McAllen, Xi Liu-DeRyke. Current and future treatment considerations in the management of aneurysmal subarachnoid haemorrhage. *J Pharm Pract* 2010; **23**:408-24.
2. Pobereskin L. Incidence and outcome of subarachnoid haemorrhage: retrospective population based study. *J Neurol Neurosurg Psychiatry* 2001; **70**:340-3.
3. Brisman JL, Song JK, Newell DW. Cerebral aneurysms. *N Engl J Med* 2006; **355**:928-39.
4. Grasso G. An overview of new pharmacological treatments for cerebrovascular dysfunction after experimental subarachnoid haemorrhage. *Brain Res Brain Res Rev* 2004; **44**:49-63.
5. Dorsch NW. Therapeutic approaches to vasospasm in subarachnoid haemorrhage. *Curr Opin Crit Care* 2002; **8**:128-33.
6. Mitchell P, Kerr R, Mendelow AD, Molyneux A. Could late rebleeding overturn the superiority of cranial aneurysm coil embolization over clip ligation seen in ISAT? *J Neurosurg* 2008; **108**: 437-42.
7. Raja PV, Huang J, Germanwala AV, Gailloud P, Murphy KP, Tamargo RJ. Microsurgical clipping and endovascular coiling of intracranial aneurysms: a critical review of the literature. *Neurosurgery* 2008; **62**:1187-202.
8. Natarajan SK, Sekhar LN, Ghodke B, Britz GW, Bhagawati D, Temkin N. Outcomes of ruptured intracranial aneurysms treated by microsurgical clipping and endovascular coiling in a high-volume center. *AJNR Am J Neuroradiol* 2008; **29**:753-9. Epub 2008 Jan 9.
9. Timour Al-Khindi, Macdonald RL, Schweizer TA. Cognitive and functional outcome after aneurysmal subarachnoid haemorrhage. *Stroke* 2010; **41**:e519.
10. Rosengart AJ, Schultheiss KE, Tolentino J, Macdonald RL. Prognostic factors for outcome in patients with aneurysmal subarachnoid haemorrhage. *Stroke* 2007; **38**:2315-21. Epub 2007 Jun 14.
11. Nieuwkamp DJ, Rinkel GJ, Silva R, Greebe P, Schokking DA, Ferro JM. Subarachnoid haemorrhage in patients > or = 75 years: clinical course, treatment and outcome. *J Neurol Neurosurg Psychiatry* 2006; **77**:933-7.
12. Ryttlefors M, Enblad P, Kerr RS, Molyneux AJ. International subarachnoid aneurysm trial of neurosurgical clipping versus endovascular coiling: subgroup analysis of 278 elderly patients. *Stroke* 2008; **39**:2720-6.
13. Melamed E, Lavy S, Bentin S, Cooper G, Rinot Y. Reduction in regional cerebral blood flow during normal aging in man. *Stroke* 1980; **11**:31-5.
14. Meyer CH, Lowe D, Meyer M, Richardson PL, Neil-Dwyer G. Subarachnoid haemorrhage: older patients have low cerebral blood flow. *Br Med J (Clin Res Ed)* 1982; **285**:1149-53.
15. Torbey MT, Hauser TK, Bhardwaj A, Williams MA, Ulatowski JA, Mirski MA, *et al*. Effect of age on cerebral blood flow velocity and incidence of vasospasm after aneurysmal Subarachnoid haemorrhage. *Stroke* 2001; **32**:2005-11.
16. Dehdashti AR, Rilliet B, Rufenacht DA, de Tribolet N. Shunt dependent hydrocephalus after rupture of intracranial aneurysms: a prospective study of the influence of treatment modality. *J Neurosurg* 2004; **101**:402-7.
17. Dorai Z, Hynan LS, Kopitnik TA, Samson D. Factors related to hydrocephalus after aneurysmal subarachnoid haemorrhage. *Neurosurgery* 2003; **52**:763-71.
18. Ferch R, Pasqualin A, Barone G, Pinna G, Bricolo A. Surgical management of ruptured aneurysms in the eighth and ninth decades. *Acta Neurochir (Wien)* 2003; **145**:439-45.
19. Yoshioka H, Inagawa T, Tokuda Y, Inokuchi F. Chronic hydrocephalus in elderly patients following subarachnoid haemorrhage. *Surg Neurol* 2000; **53**:119-24.
20. Chung RY, Carter BS, Norbash A, Budzik R, Putnam C, Ogilvy CS. Management outcomes for ruptured and unruptured aneurysms in the elderly. *Neurosurgery* 2000; **47**:827-32.
21. Fridriksson SM, Hillman J, Säveland H, Brandt L. Intracranial aneurysm surgery in the 8th and 9th decades of life: impact on population-based management outcome. *Neurosurgery* 1995; **37**:627-32.
22. Horiuchi T, Tanaka Y, Hongo K. Surgical treatment for aneurysmal subarachnoid haemorrhage in the 8th and 9th decades of life. *Neurosurgery* 2005; **56**:469-75.
23. Laidlaw JD, Siu KH. Ultra-early surgery for aneurysmal Subarachnoid haemorrhage: outcomes for a consecutive series of 391 patients not selected by grade or age. *J Neurosurg* 2002; **97**:250-8.
24. Yamashita K, Kashiwagi S, Kato S, Takasago T, Ito H. Cerebral aneurysms in the elderly in Yamaguchi, Japan. Analysis of the Yamaguchi data bank of cerebral aneurysm from 1985 to 1995. *Stroke* 1997; **28**:1926-31.
25. Ogden JA, Mee EW, Henning M. A prospective study of impairment of cognition and memory and recovery after subarachnoid haemorrhage. *J Neurosurg* 1993; **33**:572-87.