ORIGINAL REPORT

Timing of Surgery for Aneurysmal Subarachnoid Hemorrhage

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Received: 9 Jun. 2010 ; Received in revised form: 26 Jun. 2010; Accepted: 31 Jul. 2010

Abstract- Despite the many studies about timing for surgery in subarachnoid hemorrhage (SAH), the optimum time is still unclear. The aim of this study was to determine the results of early and late surgery for aneurysmal subarachnoid hemorrhage. In this cross-sectional study we evaluated the results of 70 consecutive surgery for aneurysmal subarachnoid hemorrhage in in Firuzgar hospital from 2005 to 2008. Surgery was performed in 50 cases (71.4%) in early period after SAH (first 4 days) and in 20 cases (28.6%) in at least 7 days after SAH. Statitical analysis was done by SPSS software, using Chi-square and t-test. Mean age of patients was 48.54 ± 13.4 years. 41.4% of patients were male and 58.6% were female. Most (77.2%) of patients had clinical grade I or II. 92.9% of aneurysms were single. Hypertension was the most common associated disease (34.3%). The most common site of aneurysms was anterior communicating artery (41.4%), followed by middle cerebral artery (35.7%). The outcome of surgery was favorable in 70% and unfavorable in 30%. Mortality rate was 24.3%. Outcome was favorable in 66% of early surgeries and 80% of late surgeries. There was no statistically significant difference between early and late surgery in terms of complications and outcome. Mean hospital stay of patients in the early surgery group was significantly lower than late group (16.46 ± 9.36 vs. 22.5 ± 7.97 days; *P*=0.01). The results of early and late surgery for aneurysmal subarachnoid hemorrhage is similar and decision making for timing of surgery should be based on each patient individual clinical conditions, age, size and site of aneurysm.

Acta Medica Iranica, 2011; 49 (7): 420-424.

Keywords: Subarachnoid hemorrhage; Time of surgery

Introduction

Despite the attempts to determine the optimum time for surgery of aneurysmal subarachnoid hemorrhage (SAH), some contraversies exist over the optimum timing for this surgery (1-5). The proponents of early surgery focused on reduction of the devastating effects of aneurysmal re-bleeding within the first 2 weeks and its high mortality. On the other hand, some authors believe that delayed surgery may be better choice, because operating on the acutely injured brain may be associated with high risk for surgical morbidity and mortality (1). Some studies advocates surgery neither early nor late, and indicate that the intermediate period in 4 to 10 days after the SAH is a risky time for surgery, because during this period the risk for cerebral vasospasm and ischemia may be very high (6).

Kassell *et al.* compared 24 late surgery patients (planned at least 7 days after SAH) with 27 early surgery patients (within 4 days of the SAH). The overall management results for the late group showed 42% favorable outcome, 17% unfavorable outcome, and 42% mortality. The early group had 81% favorable outcome, 7% unfavorable outcome, and 11% mortality. Patients in both good and poor conditions fared better in the early group. Seven late group patients re-bled, compared to none in the early group. The number of medical complications, the length of hospitalization, and the occurrence of symptomatic vasospasm were all greater in the late group (7). In another study the results of early and late surgery were similar in patients with good condition, but early surgery in patients with poor condition had better outcome (8). However, the optimum time for surgery could not be determined (8). Some other studies indicated that early surgery is more effective than late surgery and has fewer complications, especially lower re-bleeding rate (9-16).

The aim of this study was to compare the results of early and late surgery in aneurysmal SAH and determine the optimum time for this surgery.

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Patients and Methods

All patients (n=70) with aneurysmal SAH who underwent surgery in Firuzgar hospital from 2005 to 2008 were enrolled in the study. The patients were categorized in two groups: early surgery (during first 4 days after SAH), and late surgery (7 days or later after SAH). The exclusion criteria were patients who needed emergent surgery, patients whom their surgery was performed in the 5th and 6th day after SAH diagnosis, patients whom their surgery was performed 3 weeks or later after SAH diagnosis and patients with re-bleeding before surgery.

In this study demographic data, history, physical exam, brain computed tomography (CT), angiography, the outcome of surgery and follow-up were assessed. All patients underwent a standard surgery for aneurysmal SAH. The outcome of patients was determined according to the Glasgow outcome score (GOS) (17): good recovery (5); moderate disability (4); severe disability (3); vegetative state (2); and death (1). Scores 5 and 4 were considered as favorable and scores 1-3 were considered as unfavorable outcome. Statistical analysis was done by SPSS vs.15. Comparison of outcome between early and late surgery groups was made using the Chi-square test. Comparison of hospital stay and some other variables was performed by independent t-test or Mann-Whitney test.

Results

Mean age of patients was 48.54 ± 13.4 (19-78) years. 45.8% were above 50 years old. 41.4% of patients were male and 58.6% were female. SAH grading showed that most of patients had mild to moderate severity (58.6% grade I, and 18.6% grade II). Fifteen (21.4%) were smoker and ten (14.3%) were drug abuser. Hypertension existed in 34.3% and diabetes mellitus in 4.3% of patients. Mean hospital stay was 18.2 ± 9.34 (2-60) days.

The aneurysms were single in 92.9% and multiple in 7.1% of patients. The most common location of aneurysm was anterior communicating artery (41.4%), which was associated with other aneurysms in 5.7% of cases. Middle cerebral artery (MCA) was the second common location (35.7%).

The outcomes of patients were as following: good recovery 55.7%; moderate disability 14.3%; severe disability 4.3%; vegetative state1.4%; and death 24.3%). The outcome was favorable in 70% and unfavorable in 30%.

Early surgery was performed in 50 (71.4%) and late surgery group consisted of 20 (28.6%) cases. The comparison between these two groups revealed that there was no statistically significant difference in results of surgery, surgical complications, and final outcome. Favorable outcomes were seen in 66% of early surgery group and 80% of late surgery group (P>0.05). Complication of surgery occurred in 52% of early surgery group and 50% of late surgery group (P>0.05); among the important complications, vasospasm (based on clinical findings and evidence of infarct in brain CT that was consonant with site of vasospasm) occurred in 7.14 % of early surgeries and 2.8% of late surgeries (P>0.05). Other complications included seizure, hemodynamic instability, plegia or paresis, hydrocephaly, etc.

Table1. Comparison of early and late surgery groups

	Early surgery	Late surgery	*P* value
Age (Mean ± SD)	47.80 ± 13.29	50.40 ± 13.95	> 0.05
Male	40	45	
Female	60	55	
Anterior cerebral artery	2	15	
Ant communicating artery	34	40	
Middle cerebral artery	42	20	
Internal carotid artery	12	5	
Other	10	15	
Vasospasm	7.14	2.8	
Re-bleeding	8	5	
Other	36.86	42.2	
Favorable	66	80	
unfavorable	34	20	
Hospital stay (day)	16.46 ± 9.36	22.5 ± 7.97	0.01

There were no statistically significant differences between early and late surgery groups in terms of clinical grading, age, sex, associated disease, smoking and addiction. However, hospital stay in the early surgery group was significantly lower than late surgery group (16.46 ± 9.36 vs. 22.5 ± 7.97 days; P=0.01).

Discussion

There is no consensus about optimum timing for operation on aneurysmal SAH. Some studies advocate early surgery and some authors believe that late surgery may be a better choice due to stabilizing the patient's condition and reduced risk of cerebral vasospasm and ischemia (1). Intermediate period in 4 to 10 days after occurrence of SAH also has been reported as a risky time for surgery (6).

In this study there was no significant difference between results of early and late surgeries. Nieuwkamp *et al.* demonstrated that the results of early and late surgery were similar in patients with good condition, but unlike our study, early surgery in patients with poor condition had better results. However, the optimum time for surgery could not be determined (8). Miyaoka *et al.* reported that in the low grade aneurysmal SAH (grade 1 and 2) the time of surgery is not a significant issue, but in more serious conditions early surgery may be helpful (9). However, le Roux and Wallace reported that early aggressive treatment of good grade patients seems to provide the best outcome for SAH (18). In another study on 1168 aneurysmal SAH, the results of early (first 3 days), intermediate (4-10th days) and late (11-21th days) surgeries were similar (1). Lee *et al.* demonstrated that the low Hunt-Hess grade was the main predictor of favorable clinical outcomes in aneurysmal SAH. The timing of embolization did not significantly affect clinical outcome but early embolization reduced inpatient stay (19). Taylor *et al*. in their study on 47 patients with poor grade [World Federation of Neurosurgeons (WFNS) Grades 4 and 5] reported that more than half of these patients who are treated early and aggressively with coil embolization in association with supportive neurocritical care can achieve a good quality neurological outcome (20). However, it should be anticipated that these patients will spend a significant period of time in the neurocritical care (20).

Samson *et al.* reported that the outcome and complications of early surgery on first 8 days after SAH were not different from late surgery in 9 to 31days after SAH, but ischemic events after early surgery were significantly higher (11).

Kassell *et al.* study totally advocates early surgery in all conditions; in their study results for the late surgery group showed a 42% favorable outcome, a 17% unfavorable outcome, and 42% mortality. The early group had an 81% favorable outcome, 7% unfavorable outcome, and 11% mortality. Patients in both good and poor conditions fared better in the early group. The number of complications, the length of hospitalization, and the occurrence of symptomatic vasospasm were all greater in the late group (7). Some other studies indicate that early surgery is more effective than late surgery and has fewer complications, especially lower re-bleeding rate (9-16,21,22). Yang et *al*. in their study on 127 cases of early microsurgery combined with anti-vasospasm agents for treatment of SAH demonstrated that early operation could prevent second-time rupture effectively, lower the death rate, and at the same time lower the occurrence of cerebral vasospasm and the succeeding damage caused. Anti-vasospasm agents used postoperative could help preventing cerebral vasospasm and maintaining function (23). Pan *et al*. suggest ultra-early surgery under general anesthesia within 24 hours from SAH, and demonstrated that ultra-early surgery can avoid early re-bleeding of intracranial aneurysm, therefore, should be considered in the treatment of Hunt-Hess grade IV-V intracranial aneurysms (24).

However, Shabepour *et al.* study in Iran had some results different from most previous studies (25); they evaluated 110 aneurysmal SAH and reported that the complications of late surgeries were significantly lower than early surgeries; the complication rate in surgeries performed during first 3 days after SAH was 66.7%. This rate was was 54.57% for surgeries in 3 to 14 days after SAH, and 22.9% for surgeries after 14th days (25).

In our study the hospital stay in early surgery group was significantly lower than late group. This finding is concordant with Ross *et al.* (1) and Bolander *et al.* (14) and Lee *et al.* (19) studies.

Some studies have shown that the presence of associated disease such as hypertension or history of smoking makes the outcome worse (26-28). However, in our study there was no significant relationship between outcome of surgery and associated disease, smoking, age, or severity of conditions. In Ross *et al.* study age and clinical grade in presentation significantly affected the outcome (1). However, in Adams *et al.* study only neurologic condition (clinical grade) was correlated with surgery results (10). In a large study on 2,128 patients with aneurysmal SAH clinical grade was the most important predictor of case-fatality, followed by age, lumen size of the aneurysm and Fisher grade (29).

Shirao *et al*. in their study on 283 patients with SAH in Japan concluded that advanced age, WFNS grade V, improvement in WFNS grade, and low-density area associated with vasospasm on CT were found to be independent predictors of clinical outcome, whereas re-bleeding, early aneurysm surgery and treatment modality were not independently associated with outcome in patients with poor-grade aneurysm (30).

Based on above discussion, the optimum time for surgery of aneurysmal SAH cannot be determined definitely. Thus, decision making about timing of SAH surgery may depends on clinical condition of each individual patient based on their age, size of aneurysm, progression pattern of signs and symptoms and etc. Finally, it seems logical to conduct further multicenter prospective studies with greater sample size to compare the results of surgery based on site and size of aneurysm as well as its clinical grading. In conclusion, this study revealed that the results of early and late surgeries for aneurysmal SAH are almost similar. Timing of surgery should be individualized for each patient based on clinical situation, age, size and site of aneurysm, and other factors.

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