

The Timing of Anterior Communicating Artery Aneurysm Surgery: Comparison of Outcome in Early Versus Intermediate Surgery†

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= Abstract = The authors analyzed 47 cases of ruptured anterior communicating artery aneurysms during the past three years that were clipped within 14 days after initial hemorrhage, to study the influence of the timing of surgery on the development of vasospasm-related complications. Twelve patients were operated within three days after the onset of subarachnoid hemorrhage (SAH) (early group), and 35 patients were operated 4-14 days after SAH (intermediate group). For the statistical analysis the chi-square test with Yates' correction and Fisher's exact test were used. There were no statistically significant differences between the early and the intermediate groups in (1) the Hunt-Hess grade on admission and preoperatively, (2) the final outcome, (3) the presence of associated diseases, or (4) the occurrence of angiographic vasospasm. There was no difference in the preoperative medical management. The occurrence of symptomatic vasospasm or infarct was not different in the early and intermediate groups ($p > 0.10$), nor was the occurrence of infarct in the anterior cerebral artery (ACA) or non-ACA territory ($p > 0.10$). Laterality of infarct was not related to laterality of surgical approach in either the early or intermediate groups, nor in the whole group ($p > 0.10$). Hydrocephalus, rebleeding, and other complications were also not different in the early and intermediate groups. The authors did not find any evidence that in patients with ruptured anterior communicating artery aneurysms, the timing of surgery affects the development of vasospasm-related complications.

Key Words: *Anterior communicating artery aneurysms, Early surgery, Intermediate surgery, Vasospasm, Timing of surgery, Outcome*

INTRODUCTION

It has been stated that early surgery may

Received September 1992, and in final form November 1992

† This paper was presented at the 60th Annual Meeting of the American Association of Neurological Surgeons in San Francisco, CA, April 11-16, 1992

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reduce vasospasm, and that intermediate surgery brings a higher rate of vasospasm and surgical complications in patients with subarachnoid hemorrhage (SAH) which follows the aneurysmal rupture (Kassell *et al.* 1990b; Torner *et al.* 1990). The authors assumed that if surgery exerts more harm in the intermediate period than in the early period, the culprit is the aggravation of vasospasm. Consequently, (1) the frequency of vasospasm and/or infarct should be different between the early and inter-

mediate surgery groups, (2) the occurrence of infarct should be more frequent in the operated arterial territory, and (3) laterality of infarct should be related to the laterality of surgical approach. So the authors performed a retrospective study in which the three consequences of the above hypothesis were examined in 47 cases of the ruptured anterior communicating artery aneurysms during the past three years that were clipped within 14 days after initial hemorrhage, to study the influence of timing of surgery on the development of vasospasm-related complications.

MATERIALS AND METHODS

Material

The authors chose the anterior communicating artery aneurysms as the material, and analyzed 47 patients with ruptured anterior communicating artery aneurysms that were clipped within 14 days of bleeding by one surgeon (DH Han) during the past 3 years (1989 to 1991). Patients were not purposely allocated into groups for their Hunt-Hess grade on admission, nor for any other medical reason. The authors operated as soon as possible after patients' referral to Seoul National University Hospital. Patients received the calcium channel blocker, nimodipine, intravenously after their admission. The author operated through the pterional approach with the gyrus rectus resection if necessary. The aneurysms were approached mainly through the right side. The left approach was used in cases of (1) dominant left A1, (2) the dome of aneurysm directing to the right side, and (3) the other aneurysms in the left anterior circulation. Computerized tomographic scans (CT scan) were obtained immediately after surgery, 7 days after surgery, and at discharge. During the intervening period, the CT scan was used generously if the neurological condition of the patient deteriorated.

Method of Analysis

This study was a retrospective study.

Charts and radiologic studies including angiography, CT scans, and magnetic resonance imaging (MRI) were reviewed by one (CK Chung), who had no previous clinical knowledge about these patients. Hunt-Hess grade was used for the classification (Hunt and Hess 1968), and there was no downgrading for serious medical problems. Outcome at discharge was assessed to the Glasgow outcome scale (Jennet and Bond 1975). The severity of SAH was graded to the Fisher's SAH grade (Fisher *et al.* 1980), and angiographic vasospasm to Fisher's angiographic vasospasm grade (Fisher *et al.* 1977). The presence of symptomatic vasospasm was defined in cases of any focal neurological deficit or mental deterioration without relevant findings on CT scans and on serum electrolyte. Infarction was thought to be present if any low density lesion in the brain parenchyma was seen on CT scan or if any high signal intensity lesion on T2-weighted image of MRI during the management. Patients were grouped into the early surgery group (surgery within third day after the SAH) and the intermediate group (fourth to fourteenth day). The occurrence of the symptomatic vasospasm and/or infarct was compared between the two groups. The territory of infarct was divided into anterior cerebral artery (ACA) and non-ACA territory. This distribution of infarct territory was compared between the two groups. Laterality of infarct was compared with the laterality of the surgical approach.

Before the statistical analysis, the factors that might influence the development of the vasospasm-related complications were analyzed between the two groups.

Statistical Analysis

Statistical significance was determined by chi-square test. If the effective frequency was less than 5, Yates' correction was employed. In the two by two table with sample size less than 20, Fisher's exact test was also used. Results were considered significant at $p < 0.05$.

RESULTS

Patients were aged from 19 to 72 years (mean 48.6 years). Male to female ratio was 27:20. This aneurysm was most commonly found in the fifth (male) and sixth (female) decades. The sizes of aneurysms were distributed as 34 small (<12 mm in diameter) or 13 large (12 to 24 mm in diameter). Multiple aneurysms were found in two patients. All 47 patients were admitted in condition of Hunt-Hess grade I to III (19 in grade I, 15 in grade II and 13 in grade III). However, two patients in the intermediate surgery group deteriorated to the condition of Hunt-Hess grade IV just before surgery (Table 1). Outcome at discharge was 28 in a good recovery state, 11 in a moderately disabled state, 7 in a severely disabled state, and 1 death.

Hunt-Hess grade on admission was I-II in 34 (early surgery 8, and intermediate 26), and III-IV in 13 (early surgery 4, and intermediate 9). Hunt-Hess grade preoperatively was I-II in 32 (early surgery 8, and intermediate 24), and III-IV (early 4, and intermediate 11). The distribution of Hunt-Hess grade on admission and preoperatively had no statistically significant difference ($p=0.89$ and $p=1.00$ respectively). The difference of the proportion of the severely disabled, moderately disabled and dead did not attain any significance ($p=0.68$ and $p=0.57$ respectively) (Table 2). The presence of associated disease (hypertension, diabetes mel-

Table 1. Hunt & Hess grade preoperatively

	early	intermediate	total
I	3	15	18
II	5	9	14
III	4	9	13
IV		(2)	(2)
V			
total	12	35	47

(): No. of patients whose grade increased after admission

Table 2. Final outcome #

1) morbidity		
	early	intermediate
good recovery and moderately disabled	9	30
severely disabled, vegetative, and dead	3	5
# according to Glasgow outcome scale	P = 0.6839	
2) mortality		
	early	intermediate
alive	11	35
dead	1	0
	P = 0.5706	

litus, chronic hepatitis, or others) was 40.4% of 47 patients. The early group had the associated disease in 5, and the intermediate group in 14. These were also evenly distributed between the two groups ($p=1.00$). The distribution of Fisher's SAH grade was not insignificant ($p=0.133$ in one tail test, and $p=0.06$ in two tail test), because the day after the initial bleeding at which the CT scan was taken was different between the two groups (1.58 ± 0.90 days after bleeding in the early surgery group and 3.34 ± 2.67 days in the intermediate group). The angiographic vasospasm was present in 4 (early group) and 6 (intermediate group). The detection rate of the angiographic vasospasm was also statistically insignificant ($p=1.00$). The two groups were comparable in respect to the distribution of factors which might influence the development of the vasospasm related complications. And there was also no difference in the preoperative medical managements.

The symptomatic vasospasm was found in 3 patients of the early group, and 5 intermediate group. The presence of the symptomatic vasospasm was not statistically different between the two groups ($p=0.68$). The infarct was detected in 6 patients in the early group, and 10 intermediate. The presence of infarct did not show any statistically significant differ-

Table 3. Other complications

	early	intermediate
postoperative		
intracerebral hematoma	1	1
postoperative		
epidural hematoma	1	1
subdural fluid collection		2
postoperative meningitis	1	

ence in the two groups ($p=0.32$). Even the combined rate of symptomatic vasospasm and/or infarct (7 in the early group, and 13 intermediate) did not attain any statistical significance ($p=0.35$). About the territory of infarct, anterior cerebral artery territory was 4/6 in the early group and 7/10 in the intermediate group. The occurrence of infarct had no preference to ACA territory ($p=0.65$). The result of the analysis in that the choice of the surgical side affected the laterality of infarct showed no statistically relevant data. In the early group, the right sided approach resulted in the occurrence of infarct in the right side (3) and the left (1), and the left approach in the occurrence of infarct in the right side only ($p=0.8$ in the early surgery group). In the case of the intermediate group, the right sided approach resulted in the occurrence of infarct in the right side only (2), and the left sided approach resulted in the even occurrence of infarct (3 respectively) ($p=0.36$ in the intermediate group). Even the combined early and intermediate group, this analysis did not attain statistical significance ($p=0.34$).

Rebleeding was found only in 2 patients in the intermediate group, the distribution of which was not significant ($p=1.0000$). Hydrocephalus was found in 12 patients (3 in the early group, and 9 intermediate), the distribution of which was also insignificant ($p=1.0000$). Other complications were tabulated in table 3.

DISCUSSION

The timing of aneurysm surgery had been the subject of a major neurosurgical contro-

versy (Kassell *et al.* 1990b). Initial attempts were made to prevent rebleeding by operating as soon as possible after the initial aneurysmal rupture. This early surgery was said to be associated with difficult operative conditions and intra- or postoperative disasters (Ljunggren *et al.* 1983). In the 1950's and 1960's, surgeons generally delayed operating at least 1 week following SAH so that the brain could recover from the acute effects of the hemorrhage and the patients' condition could become stabilized. This approach resulted in excellent operative results. Mishima *et al.* (1990) evaluated the effect of early surgical removal of clots on the prevention of delayed ischemic neurological deficits following SAH. Their results suggest that surgical manipulations might aggravate vasospasm and cause a reduction of regional cerebral blood flow leading to delayed ischemic neurological deficits in the hemisphere on the operated side. Tomita *et al.* (1990) also reported that symptomatic vasospasm occurred more frequently on the side of the operation approach in the early surgery group.

The International Cooperative Study on the Timing of Aneurysm Surgery (ICSTAS) reported that there was no difference in early (0 to 3 days after the bleed) or late surgery (11 to 14 days) (Kassell *et al.* 1990b). Surgical results were better for patients operated on after 10 days. Patients alert on admission fared best; however, alert patients had a mortality rate of 10% to 12% when undergoing surgery prior to day 11 compared with 3% to 5% when surgery was performed after day 10. Patients who were drowsy on admission had a 21% to 25% mortality rate when operated on up to day 11 and 7% to 10% with surgery thereafter. Overall, early surgery was neither more hazardous nor beneficial than delayed surgery. The postoperative risk following early surgery is equivalent in terms of rebleeding and vasospasm in patients waiting for delayed surgery (Kassell *et al.* 1990b).

Early surgery would improve outcome by preventing rebleeding and by decreasing the incidence and severity of vasospasm or

facilitating the management of its ischemic consequences (Adams *et al.* 1981; Kassell *et al.* 1990a; Kassell *et al.* 1990b). The incidence of focal ischemic deficit was higher in planned intervals of 7 to 10, 11 to 14, and 15 to 32 days, and surgery planned for days 7 to 10 had both high preoperative and postoperative rates, resulting in an overall higher mortality level (Kassell *et al.* 1990b). Öhman and Heiskanen (1989) reported that in both the overall group and the subgroup without nimodipine, significantly more patients in the intermediate-surgery group were dependent at the 3-month follow-up review. Intermediate surgery brings a higher rate of vasospasm and surgical complications in the subarachnoid hemorrhage which followed the aneurysmal rupture. Surgical complications were highest in the 4- to 6- and 7- to 10-day intervals (Kassell *et al.* 1990b). However, Yasargil (1984) maintained that angiographically demonstrated vasospasm is only one of many neurological and medical factors that must be considered in the preoperative assessment of a patient. When vasospasm (grade I or II) is present and the patient is in good clinical and medical condition (grade I or II), it does not seem necessary to delay operation. In a retrospective study, Weir and Aronyk (1981) reported no differences in overall management results between patients undergoing surgery on Days 0 to 3, 4 to 9, or 10 to 32, although there seemed to be an increased mortality rate in grade 3 and 4 patients planned for delayed surgery.

All these contradictory results might stem from the concept that the incidence of permanent morbidity or mortality from vasospasm declined and that from rebleeding increased progressively with increasing intervals from SAH. Whether the intermediate surgery had actually both high preoperative rebleeding and postoperative vasospasm rates might be the core of these disputes.

Because the anterior communicating artery aneurysms are located in the midline, they might be surgically approached through either side and the results could be compared be-

tween the operative site to the non-operative site. In addition, clots following SAH might be more equally distributed to both sides of the basal cisterns than in other aneurysms. The authors presumed that vasospasm related complications must include the development of symptomatic vasospasm and infarct, because the diagnosis of symptomatic vasospasm is multifactorial and in some sense subjective. This study showed that the occurrence of symptomatic vasospasm or infarct was not different in the early and intermediate groups, nor was the occurrence of infarct in the ACA or non-ACA territory. Laterality of infarct was not related to laterality of surgical approach in either the early or intermediate groups, nor in the whole group. Hydrocephalus, rebleeding, and other complications were also not different in the early and intermediate groups.

Our results revealed that symptomatic vasospasm or infarct, only and combined, were evenly distributed between the early and intermediate surgery groups. It suggested that in the intermediate period, surgery did not aggravate the vasospasm. However, the intermediate period was from the fourth to fourteenth day, and could be heterogeneous in the point of the influence on the vasospasm.

The analysis of the site preference of infarct to the territory of anterior cerebral artery showed that there was no difference between the early and intermediate surgery groups. Also this data suggested more strongly that surgery was not more deleterious to the vasospasm.

Finally the aspect that laterality of infarct was related to the laterality of surgical approach was analyzed. This analysis also revealed that no statistically relevant relation existed between them. These results suggested that vasospasm had its own fate from the onset of SAH and no other intervention in the present day could influence its course.

This study was a retrospective one of a small sample size, so it had the limitation that to extrapolate from these data must be very cautious. But this study again cast the ever-revolving question about surgical timing.

In conclusion, the authors did not find any evidence that in patients with ruptured anterior communicating artery aneurysms, the timing of surgery affected the development of vasospasm-related complications.

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