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Operative Factors Influencing Surgical Outcome in Middle Cerebral Artery Aneurysm Surgery

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=국문초록=

중대뇌동맥류 파열로 인한 뇌지주막하 출혈 환자에서 수술성적과 수술시기에 영향을 미치는 요인

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목 적 : 본 연구의 목적은 중대뇌동맥(MCA) 파열에 의한 뇌지주막하 출혈(SAH)의 수술적 결과와 수술시기 결정에 영향을 미치는 요인을 규명하기 위하여 본 연구를 수행하였다.

실험재료 및 방법 : 1995년 10월부터 1998년 4월까지 30개월간 22세부터 76세까지 수술을 받은 MCA 파열로 인한 SAH로 이화의료원에 입원한 총 67증례를 연구대상으로 하여 수술전 신경학적 상태, 뇌 전산화상(CT scan) 출혈량 및 혈압, 연령, 뇌동맥류의 낭의 크기, 위치 그리고 혈종 등의 예후 요인들이 수술성적과 수술시기에 미치는 영향을 분석하였다. 환자의 신경학적 상태는 Hunt와 Hess(HH) 분류를 변형한 HH등급 1~2를 grade 1 그리고 HH 4-5를 grade 2로 분류하였다. CT상 Fisher 1, 2등급을 grade I 그리고 3, 4등급을 II로 분류하였다. 고혈압 판정은 입원당시 2회이상 이완기 혈압이 90mmHg 이상이며 수축기 혈압이 연속적으로 축적시 140mmHg 이상을 고혈압 환자군으로 분류하였다. 수술시기는 SAH발생 후 0~3일내에 수술을 시행한 군을 조기수술군(group I), 3~9일에 시행한군을 중간군(group II) 그리고 10일 이후에 시행한 군을 지연군(group III)로 분류하였다. 수술 결과의 판정은 퇴원 6개월 후 신경학적 손상없이 정신활동으로 직업을 수행하고 있거나 경도의 신경학적 손상은 있으나 정상 정신활동 직업을 정상적으로 수행하는 군은 Exellent-Good군으로, 그리고 국소적 신경손상과 정신장애가 잔존되어 있거나 사망시 Poor-Dead군으로 분류하였다.

결 과 : 수술전 신경학적 상태 grade I군의 86%는 수술전 상태로 호전되었고 14%는 식물인간 또는 사망하였다. 즉 수술전 의식 상태가 좋을수록 수술 성적도 의의 있게 양호하였다($p<0.01$). 신경학적 상태가 양호할수록 조기수술시 더 양호한 수술성적을 관찰하였다($p<0.01$). CT상 출혈량이 적을수록 조기수술을 할수록 양호한 결과가 의의있게 관찰되었고 수술 성적도 의의 있게 양호하였다($p<0.05$). 고혈압군 환자는 정상적인 환자에 비하여 수술 성적이 의의 있게 불량하였다($p<0.05$). 수술전 신경학적 상태, 입원시 CT상이 출혈량과 고혈압간의 최대 가능성 추정치(maximum lifehood estimates) 분석상, 입원시 CT상 출혈량과 고혈압을 통제하면 수술전 의식 상태가 혼미 또는 혼수인 환자가 수술전 의식이 명료한 환자보다 4.3배 식물인간 또는 사망하게 되었다.

결 론 : 이상의 결과를 미루어 수술전 신경학적 상태, CT상 적은 출혈량 그리고 정상혈압군 소위 위험도가 양호한 MCA aneurysm 파열 환자에서는 조기 수술이 권고되며 수술성적에 영향을 미치는 중대 요인으로 사료되었다.

KEY WORDS : MCA · Neurologic status · CT scan · Hypertension.

Introduction

Since Walter Dandy[1] performed the first direct clipping intracranial aneurysm in 1938, the overall management results[2-6] for aneurysmal SAH have improved significantly. Selected reports in the literature indicate operative mortality rates in intracranial aneurysm surgery are impressibly low in good risk patients. Despite this reports less than half of the patients curving to hospital admission have a favorable out come[7]. The main causes are the direct effect of initial hemorrhage, vasospasm, rebleeding and surgical complications. Therefore, the management focused interest on early intracranial operative repair of ruptured saccular aneurysms. Surgeons[8-24] who advocate early surgery cite lower incidence of rebleeding, reduced vasospasm and this approach was more effective management of delayed ischemia. Since middle cerebral artery(MCA) aneurysms are located peripherally and therefore deep retraction is not necessary, they can be exposed by opening the fissure peripherally or by suctioning some of the superior temporal gyros without much retraction at all. Most experienced aneurysm surgeons are currently operating early on most patients who are in good condition. However, the optimal timing of surgery for ruptured aneurysms has been the subject of considerable neurosurgical controversy. Early surgery during Days 0 to 3 following aneurysmal SAH prevents recurrent bleeding but associated with brain swelling and more frequent intra or postoperative complications. Delayed surgery, usually over 10 days post SAH has been considered less risky and better results. Drake[4], commenting on Hunt and Hess's[5] report of 1.4% mortality rate in good risk patients, suggests the frequently quoted mortality figures of 30% to 33% are misleading and the conservatives should be quoting these much low figures. Certainly the above figures indicate that acceptable low mortality can be achieved in selected patients. However, it is obvious that signigicant number of factors influenced the management outcome. Factors prognostic for death were the level of consciousness on admission, age, the CT finding, the admission blood pressure, preexisting medical conditions, and the aneurysm site. The purpose of this study was to define operative factors influencing of tiral timing of surgical intervention and outcome in patients with MCA aneurysm SAH.

Clinical Material and Methods

We have analyzed 67 patients who underwent surgery on day 0 to 3, day 4 to 9 and subsequent to day 10 post MCA aneurysmal rupture SAH and were admitted to Ewha Womans Medical Center between October, 1993 and April, 1998 to identify the important factors influencing on the surgical result and the timing planned surgery groups.

1. Timing of surgery

The timings of surgery were divided into the groups as follows group 1 received MCA aneurysm repair within 3days of the last preadmission SAH ; Group 2 underwent MCA aneurysm repair 4 to 9 days after last preadmission SAH ; and group 3 had MCA aneurysm repair 10 or more days after the last preadmission SAH

2. Neurologic status

Preoperatively neurotic function on based on a modification of Hunt-Herss[5] grading system as follows :

Grade 1 : moderated headache(mild severe), nuchal rigidity and mild alteration in sensorium or mi-

nor focal deficits

Grade 2 : stupor-deep coma, major focal deficits or decerebrate rigidity

3. The amount of blood on CT

Based on a modification grading system of Fisher[25].

Grade I : no and diffuse or vertical layer less than 1mm thick

Grade II : localized clot, vertical layer more than 1mm and intracereard or intraventriander lot with diffuse SAH

4. Hypertension

Blood pressure on admission was determined by the average of three measurements 1 hour apart. The hypertension is defined when the average of three systolic blood pressure in consistently greater than 140mmHg and the average of three diastolic blood is 90mmHg or higher.

5. Size of aneurysm sac

The classification who followings

A group : 3-5mm, B group : 5-10mm, C group : 10-24mm, D group : >25mm

6. Location of aneurysm

It is classified into 3 groups based on the course of M1, segment and the direction of the aneurysm funclus[26].

1) Median type

The M1 segment runs in a straight, diagonal course along the proximal fissure. It is usually associated with aneurysms that point posteriorly along the direction of the Sylvan fissure.

2) Inferior type

The inferior type M1 segment of the middle cerebral artery has a convex course toward the linen insult. It is usually associated with aneurysms that point inferiorly toward the insular substance.

3) Anterior type

The anterior type M1 segment has a concave course away from the linen insult toward the spheroid wing. It is usually associated with an aneurysm pointing anteriorly.

7. Patient with hematomas

1) Outcome

The outcome is evaluated at the time of death or at the 6-month post-SAH evaluation.

Two main methods of measurely outcome were utilized is the study :

(1) Good recovery : a full and undependent life with or without mmimal neurological deficits.

(2) Poor and dead : totally dependent on others to get activities of the day and dead.

2) Statistical method

Significant between the above factors influencing outcome and timing of surgery was determined by Chi-Square tests and analysis of maximum likelihood estimates were determined by the logistic procedure.

Results

1. Overall surgical results

The overall management results are summarized according to timing operation of admission in Table 1. 48(72%) patients had an excellent or good results and 16 patients(28%) were not survived. But the outcome between timings of surgery was not statically signigicant.

2. Surgical factors influencing the outcome

1) Preoperative neurologic status

38(86%) patients among 44 patients who were grade 1 of neurologic status preoperatively had good result and 6(14%) patients poor and death.

23 patients were preoperative grade 2 neurological status. 10(43%) of this group had good results and 13(57%) poor and death result. Patients who were grade 1 preoperatively had the better results than

Table 1. Overall surgical results

Timing surgery	Outcome		Total
	Good	Poor and	
Group 1	24(67%)	12(23%)	36(100%)
Group 2	7(58%)	5(42%)	12(100%)
Group 3	17(89%)	2(11%)	19(100%)
Total	48(72%)	16(24%)	67(100%)

grade 2(Table 2).

2) Outcome according to amounts of blood in the CT scan

34 patients who were grade I and in this group 30(88%) patients had a good result and 4(12%) a poor and death result.

18(55%) patients who were group II had a good result and 15(45%) patient of the same group a poor and death result.

Patients who are grade I had the lower mortality and morbidity than grade II(Table 3).

3) Outcome according to Hypertension

23 patients had hypertension and 13(56%) patient had a good result. 35(80%) patients had a good result in the normotensive patients.

Patients who were normotensive had better results than hypertensive patients(Table 4).

4) Size of aneurysm sac

The incidence of the size of aneurysm sac were the following.

Table 2. Surgical Results according to neurologic states

Neurologic states	Outcome		Total
	Good	Poor and	
Group 1	38(86%)	6(14%)	44(100%)
Group 2	10(43%)	13(57%)	23(100%)
Total	48(72%)	19(28%)	76(100%)

*p<0.01(Chi-square test)

Table 3. Surgical results according blood amounts in the CT scan

Grade of amount blood	Outcome		Total
	Good	Poor and	
Group I	30(88%)	4(12%)	34(100%)
Group II	18(55%)	15(45%)	33(100%)
Total	48(72%)	19(28%)	67(100%)

*p<0.05(Chi-Square test)

Table 4. Surgical results according to blood perdure

	Outcome		Total
	Good	Poor and death	
Normal blood precure	35(80%)	9(20%)	44(100%)
hypertension	13(56%)	10(44%)	23(100%)
Total	48(72%)	19(28%)	67(100%)

*p<0.05(Chi-Square test)

B(5-10mm) : 48% A(3-5mm) 34%, C(10-24MM) : 11% and D(>25mm) 2%, in order of frequency.

5) Location of aneurysm

Inferior type : 40%, interior type : 36%, and median type 24%.

6) Hematoma

The incidence of ICH was 17%, in 67 patients. The incidence according to timing of surgery, early(35%), intermediate(0%) and late(11%). Two(33%) patient underwent early surgery died.

3. Surgical factors influencing outcome according to timing of surgery

1) Preoperative neurologic status

The surgical results by timing surgery and preoperative neurologic grade are summarized in Table 5.

Patients who were grade 1 status preoperatively had the most favorable outcome when surgery was performed within 3 days post SAH.

Early surgical intervention is recommended base on evaluation in Table 5($p<0.01$).

2) The amounts of blood on CT scan

Must favorable outcome was noted in those patients who were CT grade 2 with surgery after day 10 however, motality rates of patients who had small amounts of blood on CT with early surgery were lower in comparison to the 3 planned intervals of surgery and demonstrated statistically signifiant(Table 6).

3) Hypertension

The surgical outcome by timing of surgery and hy-

Table 5. Surgical results by timing of surgery and preoperative neurologic stats

Timing of surgery	Neurologic grade	Outcome		Total
		Good	Poor and death	
Group 1	grade 1	16(94%)	1(6%)	17(100%)
	grade 2	8(42%)	11(58%)	19(100%)
Group 2	grade 1	5(62%)	3(38%)	8(100%)
	grade 2	2(50%)	2(50%)	4(100%)
Group 3	grade 1	17(90%)	2(10%)	19(100%)
	grade 2	17(90%)	2(10%)	19(100%)
Total		17(90%)	2(10%)	19(100%)

*p<0.01(Chi-Square tests)

pertension at the time admission are summarized in Table 7.

Comparison of 3 planned internals to surgery did not demonstrated statically significant the differences outcome between hypertension and normal blood pressure patients with(Table 7).

Other prognostic factors age(size, location and multiplicity and aneurysm, hematoma, and multiplicity of aneurysms) between planned surgical timings and overall surgical outcome did not demonstrate statistical significant difference.

The age, aneurysm type, locates, and size of aneurysm, and multiplicity of aneurysm were not signigicant relationship to surgical timing and rebleedings. Analysing of surgical result with rebleed and temporary occlusion fail to demonstrate in this study.

Table 6. Surgical results by timing of surgery and the blood amounts on the CT preopecatively

Timing of surgery	CT grade	Outcome		Total
		Good	Poor and death	
Group 1	I	13(93%)	1(7%)	14(100%)
	II	11(50%)	11(50%)	22(100%)
Group 2	I	4(80%)	1(20%)	5(100%)
	II	3(43%)	4(57%)	7(100%)
Group 3	I	13(87%)	2(13%)	15(100%)
	II	4(100%)		4(100%)
Total		17(90%)	2(10%)	19(100%)

*p<0.05(Chi-Square Tests)

Table 7. Surgical results by time of surgery and blood pressures on admission

Blood pressure	Outcome		Total
	Good recory(%)	Poor and death(%)	
Group 1	17(74%)	6(26%)	23(100%)
	7(54%)	6(46%)	13(100%)
Group 2	6(67%)	3(33%)	9(100%)
	1(33%)	2(67%)	3(100%)
Group 3	12(100%)		12(100%)
	5(71%)	2(29%)	7(100%)
Total	17(90%)	2(10%)	19(100%)

Discussion

MCA aneurysms account for approximately 20% percent[27-29] of all intracranial aneurysms rupture of an MCA aneurysm usually result in a syndrome indistinguishable from that associated with the SAH from rupture of an aneurysm in any other location. However, certain clinical characteristics favor the diagnasion of a ruptured MCA aneurysmal SAH. Hook and Norlen[30] discribed at first the clinical characteristics. About 60% of patients lose consciousness at the oncet of rupture, diffuse headache or unilateral headache in one-third of patients, focal neurologic signs and symptoms. The incidence of ICH is between and 50% which are frequently of the diagnostic value. Recently magnetic resonance imaging(MRI) show the true size of the lumen and anatomic relations optimally is great value in giant MCA aneurysm. Still in the acute stage CT scan is available because the SAH are better seen in this scan.

The surgical timing early versus late intervention still remains controversial. In 1965 Norlen[31] reported operating on aneurysms during the 1st or 2nd day after the SAH. In 1975 presented a series of 45 patients subject to surgery within a week after the SAH ; this series had a 4% operative mortality rate and 70% of the survivors returned to full working capacity. Many recent studies have shown that early aneurysm surgery in good risk patients is not associated with high-

Analysis of Maximum Likelihood Estimates

Variable	*DF*	*Parameter Estimate*	*Standard Error*	*Wald Chi-Square*	*Pr> Chi-Square*	*Standardized Estimate*	*Odds Ratio*
INTERCPT	*1*	*-2.5891*	*0.6468*	*16.0214*	*0.0001*	.	.
HHG	*1*	*1.4593*	*0.6976*	*4.3768*	*0.0364*	*0.384901*	*4.303*
FISHERG	*1*	*1.1181*	*0.7490*	*2.2284*	*0.1355*	*0.310518*	*3.059*
HYPER	*1*	*0.9106*	*0.6386*	*2.0332*	*0.1539*	*0.240178*	*2.486*

**Controlling the hemorrhage in the CT scan and hypertension the possibility of death vegetative survival in the preoperative comatose, size strpororous patients is 4.3 times than that of alert or good patients

er mortality or morbidity rates. as suggested by proponents of late surgery. There is however no prospective randomized study on the optimum timing of aneurysm surgery. The International Cooperative Study on the Timing of Aneurysm Surgery[32] evaluated the results of surgical and medical management in 3521 patients between December, 1980, and July, 1983[33].

At admission, 75% of patients were in good neurological condition and surgery was performed in 83%. At the 6-month evaluation, 26% of the patients had died and 58% exhibited a complete recovery. Vasospasm and rebleeding were the leading causes of mot morbidity and mortality in addition to the initial bleed. Predictors for mortality included the patients decreased level of consciousness, and increased age, thickness of the SAH clot on CT scan, elevated blood pressure, preexisting medical illnesses and basilar aneurysms. Analysis by a prespecitied "planned" surgery interval demonstrated that there was no difference in early(0 to 3 days after the bleed) or late surgery(11 to 14 days). Outcome was worse if surgery was performed in the 7 to 10-day post-bleed interval. Surgery 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 thereafter. Overall early surgery was neither more hazardous nor beneficial than delayed surgery[33].

The experienced aneurysm surgeons are operating early on most patients who are in good condition in recent years. However, the optimal timing of surgery for ruptured cerebral aneurysms remains controversial [5][8][34-40]. The majority opinion among neurosurgeons that the better management results were obtained when the operation could be delayed until the clinical condition of the patient was stable and brain edema or reactive brain swelling following SAH had subside[40-49]. This opinion was based mostly on the concern that early surgery was technical difficulties of management of the aneurysms. But delayed surgery is associated with increased risk of rebleeding and ischemic complications[50-56]. Neurosurgeons who advocated the early surgery cite a lower incidence of rebleeding, reduced vasospasm removing potentially vasospasmogenic agents from contact with vessels [11-12].

The more active early surgical policy in the 1980s resulted in significantly better functional outcome : after the 4-year follow up, 82% of the survivors were independent in daily living compared with 62% of those treated in the 1970s[57]. In a retrospective series, Weir and Aronyk 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. Kassell, et, al[58], described result in 61 consecutively reffered patients. A change in policy from delaying surgery to performing early surgery occurred during the study period, thus rendering roughly equal the numbers of patients available for analysis in each group. Improved overall outcome from early surgery was attributed to the ability to aggressively manage ischemia due to cerebral vasospassm using hypertensive/hypervolemic therapy once the aneurysm was secured. Chyatte, et al.[11] reported ; of patients who were categorized neurological into Hunt and Hess Grades I to III on admission, 87% had ans excellent or good increase in the incidence of postoperative ischemic symptoms, which was balanced by similar complications preoperatively in the 10-day post-SAH surgical group. Most rebleeds occurred before admission but delaying surgery did increase the risk of rebleeding in the hospital. Management morbidity and mortality occurred primarily as a direct result of a severe initial hemorrhage ; thus the measured benefits of early surgery were less than might have been predicted. Despite substantial investigation[11][17][21-22][49][56][58], the overall outcome of earlysurgery for aneurysmal SAH remains controversial. Also, the surgical timing did not significantly affect the incidence or severity of operative complication[11].

The prognostic factors influencing surgical outcome are age, sex, preexing medical conditions, aneurysm location and size, time to admission, admission neurological and blood pressure status, and CT find-

ings[59]. In our 67 patients series underwent surgery, neurologic grade 1(Hunt-Hess I-III) were 44. Among them 86% returned to their premorbid statue within 6 months and 14% died or vegetative survival. In grade 2(Hunt-Hess III-IV)only 43% wereg good survival. Thirt-six patients underwent surgery on 0 to 3 days(early group). In neurologic grade 1 in this group the mortality and morbidity is 6%. Neurologic grade 1 patients in the intermediate(on 4-9days) and late(after day 10) surgical group the mortality and morbidity rate 38% and 11% respectively. Management results for grade 1 patients were uniformly good regardless of timing of surgical intervention, and grade 2 patients did poorly regardless of timing of surgical intervention. The relationship between neurologic status and selection of planned surgery groups is statistically significant. There was a strong relationship between the neurologic status preoperatively and outcome, stage of operation($p<0.01$, Chi-Square test).

The CT grade(Fisher group I-II) were 34 patients. Among them 12% died or vegetative state. The motality and morbidity in Group II 45%. On the base Table 6 the patients whose CT group 1 had statically significant favorable surgical outcome, significant relationship between outcome and surgical timing($p<0.05$, Chi-Square test). The mortality and morbidity was 43% in the hypertensive patient on admission, statistically significant favorable result in normotensive group($p<0.05$). But the surgical outcome is no relationship statistically between surgical timing and hypertension. The patient's age was inversely related to favorable outcome[59]. Patient with smaller aneurysm (12mm) had more favorable result than those with large aneurysms(12 to 24mm). Only 39% of cases with giant aneurysm(24mm) had a good outcome[59].

The type of MCA aneurysms classified into 3 type related to the course M1 segment and the direction of the fundus(8). In our 67 patient the anterior type was 36%, median type was 24% and inferior type 40%. The size of aneurysm sacs were classified into 4 ; A(3-5mm), B(5-10mm), C(10-24mm), and D(giant). The B was 48%, A34%, C11% and D 2% in order of frequency. The incidence of intracerebral hematoma (ICH) Iin patients with ruptured MCA aneurysms is between 30 and 59%. In our study the incidence of ICH was 17% in total patient, and null and 11% in intermediate and late surgical group respectively. 2 patient underwent early surgery died. The bleeding has been primary into the brain parenchyma rather than into subarachnoid space in many of these patients, and therefore vasospasm is not a significant problem in early surgery. In the presence of ICH (usually in the located on the temporal lobe), a preliminary partial or subtotal evacuation of hematoma is recommended first and on the side distal to aneurysm. The dissection is then performed with more relaxed brain[26]. The multiplicity of aneurysm was 8(12%). Unfortunately age, sex, aneurysm location and size did not influenced statically significantly the surgical result in our study. The temporary arterial occlusion underwent in complexing aneurysm patient. Since 1998 the authors used as an adjunct to aneurysm surgery during the periods of temporary occlusion.

The protocols, modified Samson[60] and Ogilvy[61] methods are followings : the current dose of etomidate to maintain a burstsuppresive coma is 1mg/kg for an intravenous push, followed by 10g/kg/min. Mannitol (1g/kg) was administered at the time skin incision with mild hypothermia(35℃) and induced hypertension. Analyzes of that the rebleeding and temporally clip affected the result of surgery fail to demonstrate in this investigation. We used trans-syluian approach in 57 patients including 2 patients with small ICH, and the others with large ICH by superior temporal gyrus approach. Introspectively MCA aiyurcation was torn and occluded in one case with good risk patients who had early surgery and died.

Conclusions

We have analyzed 67 patients who underwent surgery on day 0 to 3, day 4 to 9 and subsequent to day 10 post MCA aneurysmal rupture SAH and were admitted to Ewha Womans Medical Center between October, 1993 and April, 1998 to identify the im-

portant factors influencing on the surgical result and the timing planned surgery groups.

1) Forty-four pteint were in good neurologic condition(Hunt and Hess grade 1－3) and twenty-three patients in stuporous or comatose state(Hunt-Hess grade 4－5). In good neurologic condition 86% returned to their premorbid status within 1 months and 14% died or vegetative state. In stuporous or comatous state only 43% returned to their premorbid status. There was strong relationship between the neurologic condition of consciousness on admission and surgical outcome($p<0.01$).

2) In good neurologic patients who underwent surgery in early stage the 94% returned to premorbid work, 63% in intermediate group and 90% in delayed group. Early surgical intervention had very significant favorable outcome($p<0.01$).

3) The relationship between the selection of planning surgery and neurologic condition was statically very significant($p<0.01$).

4) In the CT grade I(Fisher's grade 1－2) 88% returned to their premorbid status and only 12% died. In the grade II (Fisher's grade 3－4) 55% favorable outcome and 45% died. There was significant relationship between the blood amounts on CT and surgical outcome($p<0.05$).

5) The relationship between the selection of planning surgery and CT grade was statistically significant. In the small amount blood on CT(CT grade I) the early surgery was statically significant favorable outcome($p<0.05$)

6) 80% of normotensive patients who underwent early surgery was significant favorable outcome, but in hypertensive group only 57% favorable outcome($p<0.05$). But there was no significant relationship between hypertension and the stages of operation.

In this studies, hematoma size of aneurysms and multiplicity of a aneurysms were type, size and location of aneurysms were not significant relationship to surgical timing and outcome. Analysis of surgical result with rebleeding and temporary occlusion fail to demonstrate in this study. MCA aneurysms are located peripherally and deep retraction is not necessary. Based on these observations, early surgical intervention is recommended in MCA aneurysm patients whos good grade(good consciousness level and small amounts blood in CT scan).

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