

## A Study of the Treatment of Multiple Aneurysms

Katsuaki SAKODA, Tohru UOZUMI, Shuuichi OKI, Masami YAMANAKA,  
Takashi HATAYAMA and Toshinori NAKAHARA

*Department of Neurosurgery, Hiroshima University School of Medicine, Hiroshima 734, Japan*

### ABSTRACT

During the period from January 1975 to December 1988, a total of 28 among 215 cases or 13.0% with multiple aneurysms were seen in the Department of Neurosurgery, Hiroshima University. Classifying by sex, there were 17 males and 11 females with a mean age of 52 years. The number of aneurysms was four in 2 cases, three in 6 cases, and two in 20 cases. By location, there were 13 aneurysms in the anterior communicating artery, 20 in the internal carotid artery, 28 in the middle cerebral artery, 4 in the anterior cerebral artery, and 1 in the posterior inferior cerebellar artery. The incidence of rupture of anterior communicating aneurysm was extremely high being 10 out of 11 cases (90%) followed by that of 3 out of 4 cases (75%) for the anterior cerebral aneurysm. Although the number of cases undergoing surgery during the acute stage has been increasing, there was an unexpectedly long waiting period from onset of the initial symptom to surgery averaging 23.6 days. As a rule, clipping was undertaken for the treatment of ruptured aneurysm. For non-ruptured minor aneurysm, coating and wrapping were sometimes performed to reinforce the aneurysmal wall. All the aneurysms were treated through a single craniotomy simultaneously in 13 cases, by two craniotomies in one day in 10 cases, and by two craniotomies on separate days in 5 cases. The results of surgical treatments were satisfactory in all the cases except for a female who expired following surgery due to vasospasm and GI bleeding.

**Key words:** *Multiple aneurysm, Subarachnoid hemorrhage, Craniotomy, Clipping*

Subarachnoid hemorrhage due to ruptured aneurysm, being a disease which suddenly develops in the prime of life, also attracts a good deal of social interest. The most dreaded point in this disease is the risk of re-bleeding soon after the initial hemorrhage which is contributive to a high mortality rate. The current practice among neurosurgeons confirms the ruptured aneurysm as soon as possible and takes measures to prevent re-bleeding if the level of consciousness of the patient is favorable. Operative procedure for aneurysm is a radical procedure for the prevention of re-bleeding and not a management for improving the level of consciousness. About 15% of the aneurysms are multiple with some patients having two to several aneurysms in the cerebral arteries. It still remains controversial in dealing with ruptured aneurysm at the acute state whether treatment should also be made on the unruptured aneurysms at the same time. A review was made on cases of multiple aneurysms to date and on our treatment methods. The findings of this review are presented here.

### CASES

During the period from January 1975 to Decem-

ber 1988 a total of 215 cases of aneurysm were seen in the Department of Neurosurgery, Hiroshima University School of Medicine, of whom 28 cases or 13.0% had multiple aneurysms. In classifying by sex the 28 cases having a mean age of 52 years (range 32 to 67 years), there were 17 males and 11 females.

The number of aneurysms observed in these cases was four in two cases, three in six cases, and two in 20 cases. By location, there were 13 in the anterior communicating artery (A Com A), 20 in the internal carotid artery (ICA), 28 in the middle cerebral artery (MCA), 4 in the anterior cerebral artery (ACA), and 1 in the posterior inferior cerebellar artery (PICA).

As for the initial symptoms of these cases, the symptoms in the remaining cases were headache, nausea and/or loss of consciousness due to subarachnoid hemorrhage. Exceptions included one case with headache due to intramural hemorrhage of giant aneurysm and one case of arteriovenous malformation associated with multiple aneurysm with convulsion as the initial symptom accompanied by loss of consciousness.

The operative findings of ruptured aneurysm rev-

ealed that, of the 13 cases of A Com A aneurysm with other multiple aneurysms, the A Com A aneurysm was ruptured in 10 cases. Furthermore, of the three cases of unruptured A Com A aneurysm, there were two cases whose initial symptom was not subarachnoid hemorrhage. Thus the incidence of rupture of A Com A aneurysm is extremely high being 90%, following by the high rate of 75% for ACA aneurysm.

In addition, there were so-called mirror image cases in whom multiple aneurysms were located in the left and right middle cerebral arteries. The direction of the dome of these aneurysms, however, was not necessarily the same. In the three cases out of five cases with bilateral MCA aneurysms, one of the aneurysms faced upward and the other faced downward. A study was made whether any relationship could be found between the direction of the dome of the aneurysm and risk of rupture. There were two cases in whom the aneurysm facing downward ruptured and one case in whom the aneurysm facing upward ruptured. No apparent relationship could thus be demonstrated between the direction of the aneurysm and risk of rupture.

The waiting period from onset of 26 cases with subarachnoid hemorrhage as the initial symptom to surgery was unexpectedly long averaging 23.6 days. This is because in the early period there were many cases with a long waiting period. Recently, the number of cases undergoing surgery during acute stage has been increasing however.

When a patient with subarachnoid hemorrhage is admitted, it is the basic policy of our department to conduct angiography centering on the site demonstrated by CT to have the greatest hemorrhage. A study is made of the location and morphology of the aneurysm, its relation to artery of origin, and the presence or absence of vasospasm and arteriosclerosis. As a rule, four vessel study is made and examination is made of all vessels within

the cranial cavity for the presence or absence of multiple aneurysms. If as the result of examination, the level of consciousness of the patient is relatively good, being Grade 3 or less according to the classification of Hunt and Kosnik, and the ruptured aneurysm is other than the basilar aneurysm, emergency operation is, as a rule, performed for prevention of re-bleeding.

Table 1 shows the cases classified by distribution of the multiple aneurysms in relation to craniotomy performed for treatment of the aneurysm. All the aneurysms were treated by a single craniotomy in one day in 13 cases, by two craniotomies in one day in 10 cases, and by two craniotomies on separate days in 5 cases. Two surgical procedures were necessary in 15 out of 28 cases or 53.5%.

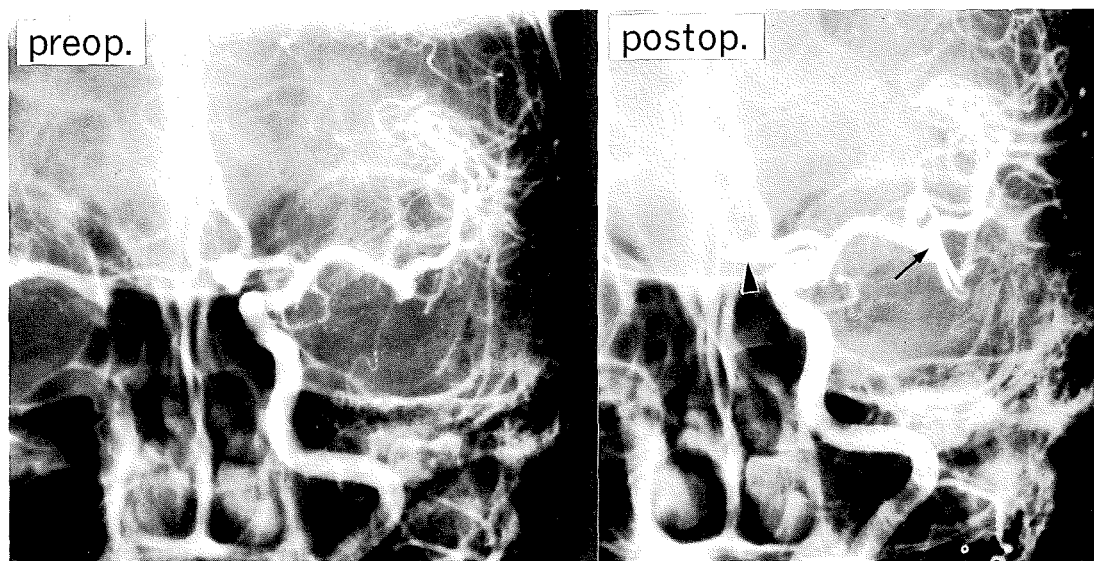
As a rule, clipping is undertaken for the treatment of aneurysm, but for minor aneurysm, coating and wrapping are sometimes performed to reinforce the vascular wall. In the present series, coating was made on four internal carotid-posterior communicating (ICPC) aneurysms and on three MCA aneurysms and wrapping was performed on one ICPC aneurysm, A Com A aneurysm, and MCA aneurysm each. However, for ruptured aneurysm, clipping was made on all cases except for wrapping on one ICPC aneurysm.

Of these cases, there were two cases in which due to severe brain swelling developing during the procedure the bone flap in craniotomy was temporarily removed and thereafter plastic surgery using removed bone flap was performed. There were five cases requiring VP shunt due to hydrocephalus.

The results of surgical procedures were satisfactory in all the cases except for a 63-year-old female who with aneurysms in the anterior cerebral artery and left middle cerebral artery expired following surgery due to vasospasm and GI bleeding, three cases with hemiplegia (one case subsequently improved), one case with dysphasia, and one case with

**Table 1.** Distribution of aneurysms in multiple aneurysm case

Groups	Combination of multiple aneurysms	No. of cases	Total
1. Multiple aneurysms including A Com A aneurysm	+ Unilateral MCA aneurysm	7	13
	+ Unilateral ICA aneurysm	3	
	+ Bilateral MCA aneurysms	1	
	+ ICA aneurysm + MCA aneurysm	1	
	+ ICA aneurysm + MCA aneurysms	1	
2. Unilateral multiple aneurysms	Multiple ICA aneurysms	2	3
	ICA aneurysm + ACA aneurysm	1	
3. Bilateral multiple aneurysms	MCA aneurysm + MCA aneurysm	2	11
	MCA aneurysm + MCA aneurysm + ICA aneurysm	2	
	MCA aneurysm + ICA aneurysm	2	
	ICA aneurysm + ICA aneurysm	2	
	MCA aneurysm + ACA aneurysm	3	
4. Multiple aneurysm including PICA aneurysm	PICA aneurysm + ICA aneurysm	1	1



**Fig. 1.** Clipping of the A Com A aneurysm (Arrow head) was made following left frontotemporal craniotomy and wrapping of the left MCA aneurysm was made with arterial substitute with both ends fixed with a clip through the same operative field (Arrow).

oculomotor paresis.

Three cases for whom different typical surgical procedures were performed are described below.

Case 1: This 67-year-old female had two aneurysms, one in the anterior communicating artery and one in the left middle cerebral artery. The A Com A aneurysm had ruptured and on the date of onset clipping was made of the A Com A aneurysm following left frontotemporal craniotomy and wrapping of the MCA aneurysm was made with arterial substitute with both ends fixed with a clip (Fig. 1). Hydrocephalus developed postoperatively, but she has been able to resume a normal life following VP shunt.

Case 2: This 42-year-old male had aneurysms in the left middle cerebral artery and left internal carotid artery as well as in the right middle cerebral artery. The left MCA aneurysm had ruptured, but on the day of onset following left and right frontotemporal craniotomies, clipping was made of both MCA aneurysms and small left ICPC aneurysm was coated. The postoperative course has been uneventful (Fig. 2A, 2B).

Case 3: This, 58-year-old female had aneurysms in the left VA-PICA and right internal carotid artery. Aneurysm in the VA-PICA had ruptured, but on the 14th day after rupture, following suboccipital craniotomy clipping of the VA-PICA aneurysm was made and one month subsequently via right frontal craniotomy clipping of the internal carotid aneurysm was made. The postoperative course has been satisfactory (Fig. 3A, 3B).

#### DISCUSSION

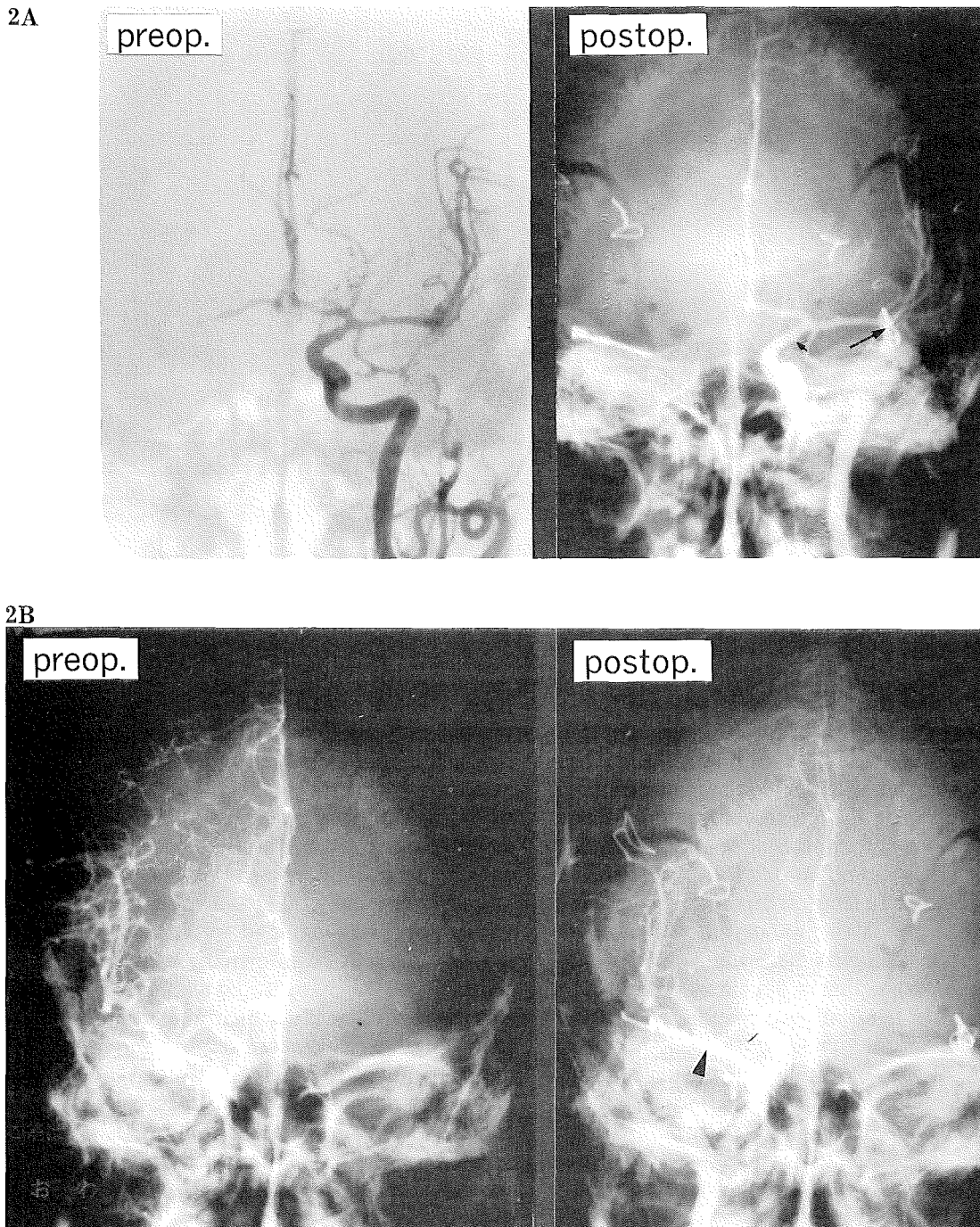
The incidence multiple aneurysms has been reported to be 19–50% in autopsy cases and 8–30% in clinical case<sup>6</sup>. Our incidence of 13.1%

can be considered to be average. Therefore, we have made it a rule to conduct, without fail, four vessel study on patients with subarachnoid hemorrhage in order to confirm whether the aneurysm is multiple or not.

Of the multiple aneurysms, the location of the ruptured aneurysm is studied by observing the site with a large hemorrhage on the CT scan and the size of the aneurysm and presence of cerebral vasospasm are examined by angiography prior to surgery. Definitive information on the exact location is not necessarily available<sup>5</sup>. If it can be ascertained clinically which aneurysm is ruptured, this would be extremely useful to the operating surgeon. In our cases when A Com A aneurysm and other aneurysms were present, A COM A aneurysm was prone to rupture. This is consistent with the findings reported previously by Heiskanen<sup>1</sup> and is considered to be an important clinical finding.

It has been reported that re-bleeding of ruptured aneurysm most frequently develops within 24 hours after the initial hemorrhage and that the prognosis of cases showing repetitive bleeding within a short period is poor<sup>2,7</sup>. The view that surgery should be conducted at the early stage so long as the level of consciousness of the admitted patient is favorable is strongly recommended.

With regard to multiple aneurysm, Heiskanen et al have reported on the treatment of aneurysms other than the ruptured aneurysm<sup>1</sup>. In their 10-year follow-up of 61 cases of subarachnoid hemorrhage having two or more aneurysms but with clipping given only to the ruptured aneurysm, unruptured aneurysm ruptured in 7 cases (11.5%) and 4 cases died. After more than 10 years after initial onset, hemorrhage developed in 6 cases and

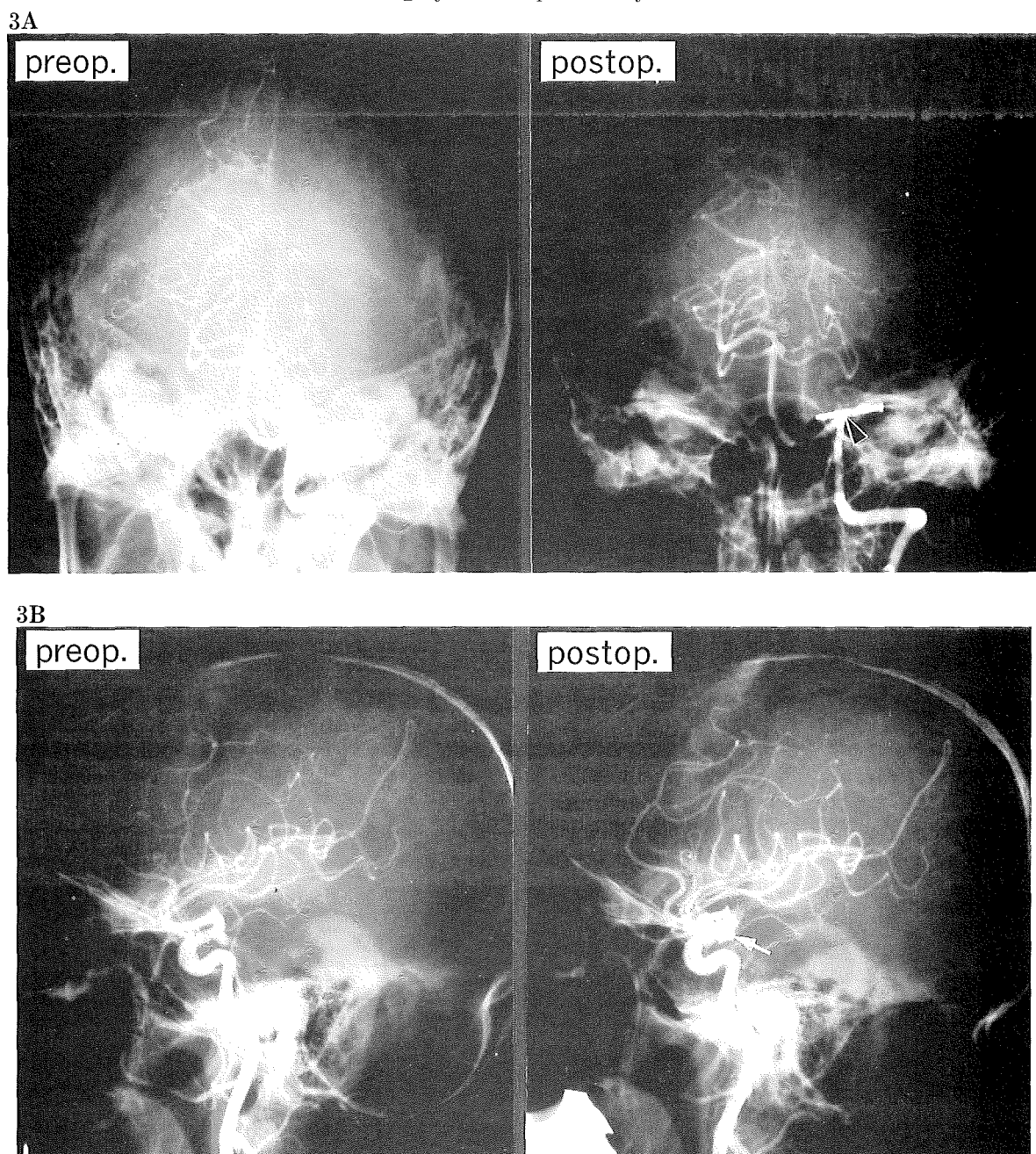


**Fig. 2A.** Clipping of the ruptured left MCA aneurysm (Arrow) and coating of the small left ICPC aneurysm (small arrow) were performed following left frontotemporal craniotomy. **2B.** In the same day, the right ectatic but unruptured MCA aneurysm was clipping via right frontotemporal craniotomy (Arrow head).

3 cases expired. In the follow-up of an average of 16 years, the annual incidence of subarachnoid hemorrhage was 1.3% and more than half of the patients died of hemorrhage. According to Moyes, of the 14 cases in whom surgical procedure was not conducted, bleeding did not develop in four aneurysms, but enlargement was observed during the follow-up of 1–10 years and re-bleeding developed in 4 cases and 2 cases died<sup>3)</sup>. The results of a cooperative study have shown that the risk of rupture of aneurysms having a diameter of 7 mm or more is high and that treatment of such cases

is desirable<sup>3,4)</sup>. These findings indicate the desirability of treatment of unruptured aneurysm and therefore if the condition of the patient permits, it is recommended that all the aneurysms be treated during one surgical procedure. According to the results of the present series, clipping of two or more aneurysms through two separate craniotomies is not inferior to those of clipping of the aneurysms during a single craniotomy. If the operating surgeon should feel that the date of surgery ought to be altered, such a change in schedule should naturally be made. In addition to clipping for prevention





**Fig. 3A.** On the 14th day after rupture, clipping of the VA-PICA aneurysm was made following suboccipital craniotomy (Arrow head). **3B.** One month subsequently, the right ICPC aneurysm was clipping via right frontotemporal craniotomy (Arrow).

of re-bleeding, decompression, ventricle drainage, and shunt procedure should be conducted for the improvement of such brain conditions as edema and hydrocephalus.

(This paper was presented in The 2nd international workshop on intracranial aneurysms held in Nagoya, 1989)

(Received April 28, 1989)

(Accepted July 12, 1989)

#### REFERENCES

1. **Heiskanen, O.** 1981. Risk of bleeding from unruptured aneurysms in cases with multiple intracranial aneurysms. *J. Neurosurg.* **55**: 524-526.
2. **Kassell, N.F. and Torner, J.C.** Aneurysmal re-bleeding: A preliminary report from the cooperative aneurysmal study. *Neurosurgery* **13**: 479-481.
3. **Locksley, H.B.** 1966. Report on the cooperative study of intracranial aneurysms and subarachnoid hemorrhage. Section V, Part II. Natural history of subarachnoid hemorrhage, intracranial aneurysms and arteriovenous malformations. *J. Neurosurg.* **25**: 321-368.
4. **Moyes, P.D.** 1971. Surgical treatment of multiple aneurysms and of incidentally discovered unruptured aneurysms. *J. Neurosurg.* **35**: 291-295.
5. **Ojemann, R.G. and Crowell, R.M.** 1983. Multiple, unruptured, and asymptomatic aneurysms, p. 233-239. In *Surgical management of cerebrovascular disease*. Williams & Wilkins, Baltimore.

6. **Suzuki, J. and Sakurai, Y.** 1979. The treatment of intracranial multiple aneurysms, p. 293–307. *In* J. Suzuki (ed.), Cerebral aneurysms, Neuron Publishing Co., Tokyo.
7. **Yasui, N., Suzuki, A., Ohta, H., Kamiyama, H. and Kawamura, S.** 1985. Re-bleeding attack of the cerebral aneurysm — clinical significance of the early aneurysmal re-bleeding. *Neurological Surgery* **13**: 61–68.