Surgical treatment of multiple aneurysms and of incidentally-discovered unruptured aneurysms

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Review of a series of 460 patients with spontaneous intracranial hemorrhage showed that 241 had demonstrable aneurysms and 38 had multiple aneurysms. The importance of demonstrating the entire circulation following ligation of one aneurysm is emphasized. Treatment of the 38 patients with multiple aneurysms is described. Ligation of unruptured aneurysms that are incidentally discovered is advocated in patients who are Grade 1 on the Botterell scale and who are well informed as to the risks.

Key Words: subarachnoid hemorrhage • asymptomatic aneurysms • multiple aneurysms

The natural history and treatment of intracranial aneurysms is summarized in Volume 3 of Progress in Neurological Surgery. A high degree of skill has been achieved in treating surgically accessible aneurysms in good-risk patients by experienced teams, and credit must be given to the use of magnification, better anesthetic techniques, and analysis of current neurosurgical experience. For example, Lougheed and Marshall have reported no deaths in a series of 40 patients, and Drake has reported further success in his treatment of basilar artery aneurysms.

The discovery and surgical treatment of unruptured aneurysms either incidentally or in the presence of other ruptured aneurysms is the essence of this paper. Mount and Bristman felt they should be surgically attacked and briefly reported 17 such cases. Hamby believed that the unruptured aneurysm should be dealt with after successful treatment of the ruptured aneurysm, but he gave no details of his experience. Heiskanen and Marttila believed that the risk of surgical treatment of the unruptured aneurysm is greater than the natural risk of hemorrhage. However, the results of treatment of unruptured aneurysms on which they based this contention do not take into account the important factor of the clinical state of the patient at the time of surgery. The risk of intracranial ligation of an unruptured aneurysm in a healthy, good-risk patient must surely be weighed against the possibility of subsequent rupture of the aneurysm and the emotional stress of the patient created by knowledge of this fact.

When McKissock, et al., discussed the subject of multiple aneurysms in 1964, they reviewed the published information and indicated that the percentage of patients with multiple aneurysms in their series was 13.7% as demonstrated angiographically and 28% in patients subjected to necropsy after death from spontaneous intracranial hemorrhage. The findings of 33% bilateral aneurysms by King, et al., were based on a
small number of patients. Hassler described the tendency of formation of bilateral aneurysms, and Drake found nine of 14 patients with carotid-ophthalmic aneurysms had multiple aneurysms. Dandy and others have made reference to multiple aneurysms.

In the Co-operative Study Locksley found multiple aneurysms in 18.5% of the patients subjected to angiography and in 22% of the patients in postmortem examination. Nishioka found that the potential danger of two or more aneurysms was not realized within the period of time covered by the study.

Clinical Material

Over a period of 12 years from January, 1958, to the end of June, 1970, we treated 460 patients with spontaneous intracranial hemorrhage. Of these patients, 241 had demonstrable aneurysms, and 38 of the 241 had multiple aneurysms. Five patients with incidentally-discovered single unruptured aneurysms were treated surgically without death or significant morbidity.

The 38 patients with multiple aneurysms represented 16% of all patients with confirmed aneurysms. Nine were men and 29 were women; the youngest was 26 years old and the oldest 72. The breakdown is as follows: nine patients died soon after the initial hemorrhage, 16 had multiple aneurysms treated at two separate operations, five had two aneurysms ligated at one operation, two had recurrent hemorrhage and died without surgical intervention, three are awaiting second ligation, and three have refused further surgical treatment.

Anterior circulation angiography was carried out 24 to 48 hours after subarachnoid hemorrhage had been established unless there were clinical findings suggestive of intracerebral hematoma; in these cases it was done immediately. Four-vessel angiography was always carried out either before or after surgery; this regime included visualization of both vertebral arteries at the time of postoperative angiography.

Analysis of Cases

Location of Aneurysms

Hassler found the commonest location of multiple aneurysms to be on both carotid arteries or on both middle cerebral arteries. The 38 patients in our series had 87 aneurysms: 11 were bilateral carotid aneurysms, four were on both middle cerebral arteries, four were on the carotid and ipsilateral middle cerebral arteries, three were on the carotid and contralateral middle cerebral arteries, four were on the anterior communicating and middle cerebral arteries, three were on the anterior and posterior circulation, and nine had other combinations.

Two of the patients with bilateral carotid and one with bilateral middle cerebral aneurysms also had an anterior cerebral or anterior communicating aneurysm. One patient with bilateral carotid aneurysms had three on one side and two on the other. Another had three aneurysms on one side and one on the other. One patient had three aneurysms on the anterior cerebral and anterior communicating arteries. Another patient with a carotid-ophthalmic aneurysm had a second aneurysm more distally placed on the same (left) carotid artery.

Fate of Patients with Initially Untreated Aneurysms

In the earlier period of this study only those aneurysms that were thought to have produced symptoms such as subarachnoid hemorrhage or third nerve palsy were subjected to intracranial ligation. Occasionally, an aneurysm was treated surgically only to find at operation that it was not responsible for any symptoms. Two aneurysms found close together were occasionally ligated at the same operation or later. But usually at that early time no attempt was made to treat a second aneurysm surgically after the first had been dealt with, providing it was obvious that the first aneurysm had been the source of the hemorrhage. Later, asymptomatic aneurysms were checked by repeat arteriography every 1 to 2 years.

In these two groups, a number of interesting developments were noted. Repeat angiography showed that four patients had developed enlargement of the unruptured aneurysm of sufficient degree that intracranial ligation was undertaken.

In one patient, a left carotid aneurysm was successfully ligated intracranially in the presence of a recognized aneurysm of the left middle cerebral artery. Her condition de-
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teriorated 5 days postoperatively, and she died 3 weeks later. Autopsy showed that the middle cerebral aneurysm had ruptured.

Another patient had a right posterior communicating aneurysm ligated at the age of 26. She also had a very small aneurysm of the left carotid artery near the posterior communicating artery. She had a further subarachnoid hemorrhage 5 years later, and angiography demonstrated that the second aneurysm had enlarged considerably. It was then successfully ligated.

Another patient had an aneurysm of the posterior communicating artery. There was some doubt as to whether it had been responsible for the subarachnoid hemorrhage, and, after ligation, posterior circulation angiography showed an aneurysm of the posterior inferior cerebellar artery. She declined further treatment and had a further hemorrhage after which the posterior inferior cerebellar aneurysm was successfully ligated.

One patient had an anterior communicating aneurysm which had been the source of a hemorrhage; 2½ years after its ligation she died following another subarachnoid hemorrhage. Postmortem examination showed rupture of a right middle cerebral aneurysm. Three patients are now awaiting admission for elective intracranial ligation of multiple aneurysms; two have had one aneurysm clipped, and one has had two aneurysms clipped.

There are three other patients who have second aneurysms after successful clipping of one aneurysm, and now refuse further surgery. They have survived 1, 2, and 8 years respectively since their initial hemorrhage and operation; it is not known whether the second aneurysms have enlarged.

Results of Surgical Treatment

Nine patients have had one aneurysm ligated: two died in the postoperative period, one apparently had a second ruptured aneurysm and died 3 weeks after surgical treatment of the first aneurysm, and one died from rupture of an unrecognized aneurysm of the middle cerebral artery 2½ years after intracranial ligation of an anterior communicating aneurysm. Of the other five patients, three have no neurological deficit, one has a mild deficit, and one a moderate deficit.

Five patients have had two aneurysms ligated at one operation: two of these patients died, one subsequently had a third aneurysm ligated at a second operation, one has done well, and the other has not.

Four of the five patients who died in the postoperative period were treated relatively early in the period under review. They were classified as Grade 2 to 3 (Botterell). In one patient the aneurysms were fairly adjacent and were treated at the same operation.

In 16 patients, one or more aneurysms were successfully ligated followed by repeat “elective” operations for another aneurysm. There were no deaths in this group, but two patients were considered to have developed a neurological deficit as a result of the elective procedures. One has some disturbance of intellectual function and moderate truncal ataxia. The other developed aphasia and right hemiplegia after discharge from the hospital. He was readmitted, and arteriographically at that time showed spasm of the left internal carotid artery intracranially and occlusion of the left anterior cerebral aneurysm. He has made some improvement over the past several months but so far is not able to go back to work. Of the other 14 patients in this group, two have minor neurological deficits which were present before operation and were considered not to have been made worse by the elective operation, and 12 have no neurological deficit.

Included in the 38 patients were nine who died following the initial hemorrhage without having the benefit of surgery except for one who had carotid ligation in the neck. Another of these patients had a large arteriovenous malformation and coexistent aneurysms of the anterior cerebral arteries which did not opacify in the original angiograms but did so after resection of the arteriovenous malformation. This patient had recurrent hemorrhage from the aneurysms while awaiting a decision as to further surgical treatment; he was being treated “conservatively” with bedrest in hospital when he died.

There are several additional patients, not included in the 38 patients reported, who have had one aneurysm successfully treated and who also have junctional dilatations in the region of the posterior communicating arteries. In view of Hassler’s findings and our own experience, these patients now have carotid arteriography every 2 to 3 years. If
the dilatations later become mature aneurysms, they will be treated. Five other patients with single unruptured aneurysms and without neurological deficit have been treated by elective surgery without any deaths or significant morbidity, but these patients also are not included in this series.

Discussion

This group of 38 patients with multiple aneurysms and five patients with incidentally-discovered aneurysms is too small for valid statistical conclusions to be made. A careful analysis of this group, however, does provide information from which inferences can be drawn and suggestions offered.

Of the 14 patients with initially untreated aneurysms, four were shown angiographically to have had progressive enlargement of the aneurysms over a period of 1 to 10 years without having had recurrent hemorrhage while under observation. This enlargement was felt to indicate that eventual rupture and hemorrhage would occur and that such patients should be seriously considered for prophylactic surgery providing their age and health were satisfactory and there were no specific contraindications. Four patients with multiple aneurysms had recurrent hemorrhage. One of these was shown to have had enlargement of the initially untreated aneurysm when angiograms were done following the recurrent hemorrhage; two died without surgical treatment for their second aneurysms, their conditions being too critical; and the other two had successful treatment of the aneurysm causing recurrent hemorrhage. Nine patients died soon after hemorrhage without intracranial surgery being possible. In summary, of the 29 survivors, eight patients (27.6%) showed evidence of enlargement of untreated aneurysms or recurrent hemorrhage or both. Thus, it is seen that unruptured aneurysms sometimes enlarge and rupture and constitute a significant hazard.

There were no deaths among the patients who had elective intracranial ligation of unruptured aneurysms, and only two of 16 were considered to have suffered any harm as a result of this elective procedure. The other five patients who had elective ligation of a single unruptured aneurysm suffered no ill effect.

We believe with others that the success of surgical treatment of patients with aneurysms depends almost entirely on the state of the patient at the time of surgery. The operative mortality and morbidity have been greatly reduced with improved surgical techniques such as magnification and improved anesthetic techniques, but the clinical state of the patient at the time of surgery continues to be significant. It seems logical to carry out elective intracranial ligation at a time when the neurosurgeon can choose optimal conditions rather than wait for a possible further hemorrhage when conditions may be less favorable.

Patients react differently to the knowledge of unruptured aneurysms. Most are sufficiently anxious about a future hemorrhage that they favor further surgery. It is our policy to explain to the patient all the factors involved and to recommend elective surgery if the aneurysm is accessible and the patient's clinical state and age are favorable.

Conclusions

The following suggestions are offered:

1. Angiograms on all patients should include oblique projections and at least one run with cross-compression to visualize adequately the anterior circulation.

2. Four-vessel angiography should be done at some time on all patients who have had a spontaneous subarachnoid hemorrhage.

3. An attempt to ligate more than one aneurysm at one operation should only be done if the patient's clinical and angiographic status is good.

4. If the unruptured aneurysm and the clinical state and age of the patient are satisfactory, elective surgical obliteration of unruptured aneurysms should be recommended after a thorough explanation of the risks involved in treating as opposed to not treating the aneurysm.

Summary

Of 241 patients in whom intracranial aneurysms were demonstrated, 38 (16%) were shown to have multiple aneurysms. Four subsequently showed enlargement of the unruptured aneurysms, four had subse-
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quent hemorrhages from their second aneurysms, and 16 had multiple aneurysms treated surgically by two separate operations. None of the “elective” patients died, but two suffered neurological deficits as a result of the second operation. Five other patients had elective clipping of an unruptured aneurysm; none died or had neurological deficit. The possibility of ligating more than one aneurysm at one operation, the emotional reaction of the patient with more than one aneurysm, and the advisability of ligating the unruptured second or third aneurysm are discussed in detail.

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References


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