Treatment of Multiple Intracranial Aneurysms, Microsurgical and Anaesthetic Techniques

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Multiple intracranial aneurysms present many difficulties in surgical judgement as to when and which of them should be operated on first. The authors suggest that all should be dealt with at one sitting and describe microsurgical and anaesthetic techniques. Four consecutive cases were treated in this manner with satisfactory result. The method of approach to the aneurysms, lumbar drainage, hypotension and late or no blood transfusion are the essentials in the techniques described.

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Once an intracranial aneurysm ruptures, it produces spasm of the arteries around it. Although the definite mechanism of the spasm has not been clearly established clear, it initially serves as a life protection mechanism. If the spasm succeeds in reducing circulation into the aneurysmal sac, allowing enough time for clot and fibrin to seal off the ruptured sac, the patient will come to us as a case of spontaneous subarachnoid haemorrhage. If this mechanism fails, and the bleeding continues, the patient will definitely not survive. The clot and fibrin are only a weak seal which can easily be broken. If the spasm wears off and full circulation flows into the sac again, second haemorrhage will occur. By this time, due to the already overworked and fatigued smooth muscle of the arterial wall, shutting off of the circulation into the sac can never be as effective. Therefore, more often than not, the second haemorrhage ends fatally. The neurosurgeon is then faced with a limited time span between the first and second rupture, which can never be accurately predicted. Earliest surgery to prevent the second rupture is most desirable, provided the patient is in a favourable condition.[1-4]

So far so good for a single aneurysm. But what about multiple aneurysms that are demonstrated after the first bleeding? Which was the responsible one? How should we defuse the multiple "time bombs"? In some cases, clinical findings and radiological evidence may point to the ruptured aneurysm which requires priority treatment. These are the focal signs, local spasm, size and shape of the aneurysms, the surrounding clot and extravasation of opaque medium.[5] But from our experience none of these are always helpful, and sometimes we have to toss the coin to select the priority.

In the past, it was conventional to attack the most likely ruptured aneurysm, then wait for a while and proceed to other aneurysms.[1-2] The waiting can be most painful, knowing that the undealt with aneurysm may rupture anytime, particularly when the first one that was operated on was not the one that had already ruptured.

With the application of the operating microscope, aneurysms can be clearly dissected and clipped with less trauma to the surrounding vessels and brain tissue. The approach to the aneurysms seems to be easier and requires a smaller craniotomy. With this in mind, we decided to operate on patients with multiple aneurysms in one surgical sitting. This one-stage surgery did not seem to cause any harm to the patient as described in some of the literature.[1-2] We have treated 4 consecutive patients this way and the result have been very satisfactory.

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CASE REPORTS

CASE 1. A 58 year old woman was admitted to Ramathibodi Hospital on 6.12.76 as a case of spontaneous subarachnoid haemorrhage. A lumbar puncture was done prior to admission and revealed frank blood stainded c.s.f. under pressure. The patient was drowsy and was classified under Botterel Scale grade II. There was no neurological deficit. Angiographies revealed three aneurysms, two at the origins of the posterior communicating artery on each side and one at the left trifurcation of the middle cerebral artery. The last one being the smallest. The approach was done through a right fronto-temporal craniotomy. With the help of the operating microscope the right posterior communicating aneurysm was clipped at the neck without difficulty. The dissection was then carried above the optic chiasma and the left posterior communicating aneurysm was approached and clipped above the left optic nerve. The craniotomy was then close and the patient was turned over to the right side. A small left fronto-temporal craniotomy was then made and the smallest of the three aneurysms at the trifurcation of the middle cerebral artery was identified. This aneurysm, contrary to the radiological finding was the one that had bled. It was again clipped at the neck. The total operating time was 6 hours. Blood transfusion needed for the operation was 400 cc. She made an uneventful recovery and was discharged on the 14th post operative day. She had no neurological deficit and is still attending our follow-up clinic. About 6 months after the surgery she appeared to be euphoric and required medical treatment for about 6 months but the euphoria gradually cleared up completely. We think that the euphoria may have been due to transient communicating hydrocephalus which later on became compensated.

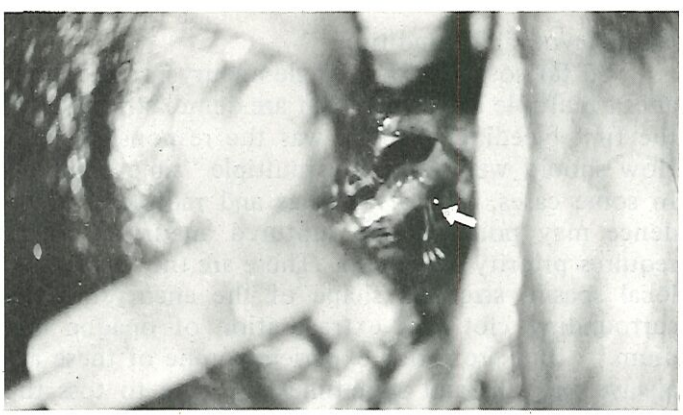

Fig. 1 Showing easy access to the right posterior communicating aneurysm. The arrow points at the clipped neck of the aneurysm. (Case 1).

Fig. 2 Showing the approach to the left posterior communicating aneurysm. The chiasma must be dissected clear and the neck can be clipped above the chiasma. (Case 1).

CASE 2. A 72 year old woman was admitted to Ramathibodi Hospital on 7.10.78 as a case of spontaneous subarachnoid haemorrhage. Frank blood stained c.s.f. was found on a lumbar puncture. There was no neurological deficit. She was rather drowsy on admission and classified as grade II on the Botterel Scale. Angiographies revealed 2 aneurysms at the origin of the right and left posterior communicating arteries. She underwent surgery on 10.10.78 and the two aneurysms were clipped through a right fronto-temporal craniotomy, the left aneurysm as in the previous case was attacked above the left optic nerve. It was this aneurysm that had ruptured. The operation time was 2 hours and 20 minutes and no blood transfusion was needed. She was given 300 mg. of Pentoxifylline daily by mouth immediately after surgery. Post operatively she developed mild right hemiparesis and partial left occulomotor nerve paresis. The post-operative angiograms showed that the aneurysms were clipped at the neck and the parent arteries were intact. This patient was discharged on the 7th post-operative day, and the administration of Pentoxifylline was terminated. The hemiparesis and the left occulomotor nerve paresis were minimal. They cleared up completely after 1 months.

CASE 3. A 61 year old man was admitted to Ramathibodi Hospital on 10.10.78 because of sudden headache and loss of consciousness. He gradually recovered consciousness and complained of marked neck stiffness. There was no neurological deficit. A lumbar puncture revealed frank blood stained fluid. The conscious level was graded under Botterel Scale grade II. Angiographies revealed aneurysms at the origin of the posterior

Fig. 3 Showing that the left posterior communicating aneurysm can also be clipped in between the two optic nerves, under the chiasma. The arrow shows the clip. (Case 3).

Table 1 Summary of case report

No	H.N.	Age	Sex	Mode of presentation	Neurological deficit	Botterel Scale	No of aneurysms	Site	Operation time & date	Amount of blood transfusion	Duration of stay after surgery	Duration of Follow-up months
1	635206	58	F	Rupture	nil	II	3	R & L Post. Com. L Mid. Cerebral	6 hr. (Two craniotomies) (2/1/77)	400 ml	14 days	39
2	826833	72	F	Rupture	nil	II	2	R & L Post. Com.	2 hr. 20 min. (10/10/78)	nil	6 days	20
3	828168	61	M	Rupture	nil	II	2	R & L Post. Com.	2 hr. 30 min. (12/10/78)	nil	6 days	20
4	903164	52	M	Rupture	L hemiparesis	III	2	L Mid. Cerebral L Mid. Cerebral	2 hr. 30 min (21/6/79)	nil	6 days	12

communicating artery on both sides. The clipping of the necks of the aneurysms was done through a right fronto-temporal craniotomy. Unlike the first two cases, the left aneurysm was approached in between the 2 optic nerves. The operation time was 2 hours and 30 minutes. No blood transfusion was needed. 300 mg. of Pentoxifylline was given orally each day until he was discharged. He made an uneventful recovery and until the present time has maintained regular follow-up. There was no neurological deficit. He was discharged on the 6th post-operative day.

CASE 4. A 52 year old man was admitted to Ramathibodi Hospital on 19.6.79 because of sudden headache and somnolence. There was minimal left hemiparesis. The lumbar puncture done in the ward revealed frank blood stained fluid. Angiographies showed two aneurysms, one at the right trifurcation of the middle cerebral artery, and a larger one at about 1.5 inch distal to the trifurcation, in the sylvian fissure. Right fronto-temporal craniotomy was done and the sylvian fissure was opened. The two aneurysms were clipped. The larger one was the one that had bled. The operating time was 2 hours and 30 minutes. No blood transfusion was needed. 300 mg. of Pentoxifylline was given per day by mouth until he was discharged on the 6th post-operative day having made a rapid recovery. There was minimal left hemiparesis which at the last follow-up appeared to have almost disappeared.

DISCUSSION

Surgical Technique

We are of the opinion that to operate on all the intracranial aneurysms in one sitting is not only technically feasible, but has also been proven harmless to the patient. With the application of the operating microscope during surgery the reach is far and wide. Through one craniotomy many aneurysms can be cleanly dissected and dealt with without much damage to the surrounding tissue. Once diagnosis of a ruptured intracranial aneurysm is made by angiogram, we operate on the patient as soon as possible, regardless of the level of consciousness. In some centres, surgery is temporalised until the patient's conscious level is satisfactorily improved.[3,4] Early surgery, in our opinion, helps better circulation as the c.s.f. is drained and washes out possible factors that may cause vasospasm.

To reduce the brain swelling and facilitate the deep approach to the aneurysm, a continuous lumbar drainage was used in all of the cases, after the anaesthesia, and before surgery. In all of the cases, except the second craniotomy of the first case, craniotomy was done on the right side and in the same manner. A low fronto-temporal craniotomy was made in the same fashion as for pituitary adenoma. The technique is similar but not altogether identical as previously described.[6] The frontal lobe was retracted upward and the optic nerve on the right was identified as a landmark and the arachnoid membrane was opened with sharp dissection over the optic nerve. Then the dissection was carried out further laterally to identify the internal carotid which was easily done as it was in close proximity to the nerve. This served many purposes. Firstly, should there be any rupture of the aneurysm during the dissection, temporary clipping of the carotid artery here can stop or slow down the bleeding. Secondly, it is a constant anatomical relationship from which the surgeon can start his orientation and dissection of the arachnoid membrane. The arachnoid should be opened as wide as possible before the aneurysm is approached for the reason that if the aneurysm bleeds, the blood will not be collected in the subarachnoid space, which has happened in many incidences of aneurysm surgery, and the brain volume suddenly increases obstructing the exposure.

Retraction of the brain should be done very gently and minimally at first, as in some cases the aneurysm rests its point of bleeding against the brain. Pulling the brain away from the aneurysm may start the bleeding again. From the main carotid trunk the dissection is then carried peripherally towards the neck of the aneurysm. In the case of bilateral posterior

communicating aneurysms, the right aneurysm can easily be dealt with as it is only a few millimeters peripheral from our starting point. If the neck is not readily seen gentle rotation of the carotid artery can offer a better view, and the neck of the aneurysm can then be clipped. We used spring clips in almost all of the cases, as the tips are finer and there is no need to regulate the pressure of the application according to the thickness of the aneurysmal wall as needed in the application of the normal clips. Bipolar coagulation of the neck of the aneurysm was sometimes used to reduce its size and facilitate the clipping.

To cross the midline to expose the left posterior communicating aneurysm is not as difficult as one would imagine. The left optic nerve is used as a reference point and the carotid artery is identified in the same manner. If the chiasma is post-fixed and the space in between the optic nerve is large, the aneurysm is clipped in between the optic nerve as in one of our cases. Otherwise the approach can be made above the left optic nerve.

Post-operatively, all the patients except the first case, were given 300 mg. of Pentoxifylline per day by mouth in divided doses. This we believe improves microcirculation into the diencephalon and therefore the consciousness of the patient is better and shorter hospitalization is needed. This is still debatable and needs further looking into but as of this moment we are well pleased with the quicker recovery of the patients. There was no post-operative haemorrhage in our series. However, we reserve the administration of Pentoxifylline to the cases whose aneurysms we feel confident in dealing with and extra care is taken to ensure hemostasis.[11]

Post-operative angiography was done in every case except the last one. All of them showed satisfactory clipping and the circulation in the mother arteries and branches was intact.

Anaesthetic Technique

All of the patients received general endotracheal anaesthesia, using sodium pentothal and succinylcholine induction, and nitrous oxide, oxygen and fluothane were used as maintenance. Hyperventilation was used intermittently as required to prevent brain swelling.[7,8] Usually the reduction in volume of the brain from the lumbar drainage was effective enough and required no further assistance such as manitol administration. Controlled hypotension was most necessary during the dissection and clipping of the aneurysms. The systolic pressure ranged between 60-80 mm. of Hg. This was achieved by the choice of using intravenous trimetaphan, sodium nitroprusside or increasing the concentration of fluothane inhalation. All the techniques described above are similar to those documented elsewhere.[8-10] If there was operative haemorrhage, blood transfusion was withheld or delayed, utilising resultant hypotension, provided that it was not too prolonged and did not result in impending irreversible shock.

A no-transfusion or delayed-transfusion technique was also employed. We are of the opinion that gradual transfusion immediately after the estimated blood loss, -say 10 ml. out, 10 ml. in - is more detrimental than useful. As neurosurgical operations rely to a large extent on hemostasis by packing and dependant on the patient's own clotting mechanism, too early transfusion, we feel, more or less interferes with this mechanism. We prefer no transfusion at all until the surgery is concluded, then the necessary amount of blood is given. This also proves economical as well, as many cases have ended up without requiring blood transfusion, as in cases 2, 3 and 4. A rapport between the surgeon and anaesthetist is therefore a basis of this technique.

CONCLUSION

We have treated 4 patients who had multiple intracranial aneurysms. One case had 3 aneurysms and the rest had 2 aneurysms. All of them received the same surgical and anaesthetic techniques. The microsurgery was done in the same sitting and did not cause any ill-effect to the patients. The fact that nearly all of the aneurysms were around the circle of Willis made the one-sitting surgery easier and most of the time, through one craniotomy. Hypotensive anaesthesia, together with the no-transfusion or delayed-transfusion technique seems to work very satisfactorily.

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