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Endovascular Treatment of Cerebral Aneurysms

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Introduction

Interventional neuroradiology has been developed so that cerebrovascular diseases are treated with less invasion and less risk.[5] Initially endovascular treatment was applied to proximal ligation for giant carotid cavernous aneurysm using detachable balloon. Detachable balloon technique was modified to occlude the berry aneurysm preserving the parent artery. The results were not satisfactory. Dr. Guglielmi, Italian neurosurgeon, developed electrically detachable coils for cerebral aneurysm treatment with an advice of Dr. Charles G. Drake and with an aide of Dr. Fernando Viuela at UCLA.[1] GDC treatment was introduced in 1991, which was available only in North America and Europe. Instead mechanically detachable coils were used in our country. 2 years later GDC treatment has started in Asia.[2,3] Results seemed promising compared with balloon technique. Our experience with endovascular treatment for cerebral aneurysms were reviewed.

Material and Methods

171 patients with cerebral aneurysms were treated with endovascular technique over last 5 years. There were 53 males and 118 females, with age between 24 and 82 (average 57.4 years old). 136 aneurysms were small in size, 29 were large and 6 were giant. 98 patients harbored their aneurysms on the anterior circulation an 73 on the posterior circulation. The aneurysm location were listed in Table 1. Carotid ophthalmic and basilar bifurcation were the predominant location of the aneurysm in this small series, which is different from the natural occurrence. Most of the patients were referred from other neurosurgical centers for endovascular treatment. The distribution of the aneurysms reflected this referral bias.

1. Endovascular procedure

155 patients were treated with endosaccular coil occlusion of the aneurysms and 16 were with parent artery occlusion. In endosaccular coil occlusion detachable coils were inserted into the aneurysm preserving the parent artery, using IDC in 50 patients and GDC in 105. Procedure was performed under general anesthesia in early treatment of SAH cases and otherwise under local anesthesia with modified NLA.

2. Subarachnoid hemorrhage

Of these 171 patients 80 had ruptured aneurysm and 91 had intact aneurysms. Of 80 ruptured aneurysms 8 were carotid cavernous, resulting in carotid cavernous fistula and 72 presented with subarachnoid hemorrhage (SAH). Of these 72 patients with SAH, 2 were grade 1 on admission, 26 were grade 2, 18 were grade 3, 18 were grade 4, and 8 were grade 5. 20 patients were treated within 48 hours of SAH, 14 within 7 days, 4 within 14 days, 8 within 30 days. 26 were treated after 1month of their last SAH.

3. Multiple aneurysms

11 patients harbored more than 2 cerebral aneurysms. Of these 11 patients, 7 suffered from SAH. Five of them had their ruptured aneurysm clipped and non-ruptured sac treated with coils. In two patients with SAH, ruptured and non-ruptured aneurysms were both treated with coils. Of four patients without SAH surgical clipping and endovascular therapy were performed in one and all the aneurysm were treated by embolization in three.

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Table 1. Location of the cerebral aneurysms treated with endovascular surgery

Anterior circulation		98 cases(57.3%)
Carotid	85 cases(49.7%)	
Cavernous	16 cases	
Ophthalmic	42 cases(24.6%)	
Pcom	18 cases	
Others	9 cases	
Anterior cerebral		13 cases(7.6%)
Acom	9 cases	
Others	4 cases	
Posterior circulation		73 cases(42.7%)
Basilar		51 cases(29.8%)
Bifurcation	34 cases(19.9%)	
Others	17 cases	
Vertebral		18 cases(10.5%)
Others		4 cases
Total		171 cases

Table 2. Results of endovascular treatment for SAH patients

Grade	No/minor deficit	Moderately disabled	Severely disabled	Vegetative state	Dead	Total
1	2	0	0	0	0	2
2	24	2	0	0	0	26
3	14	3	0	0	1	18
4	7	1	4	1	5	18
5	0	0	5	2	1	8
Total	47	6	9	3	7	72

Results

Clinical results of ruptured aneurysms with SAH were shown in Table 2. Of 28 patients in grade 1-2, 26 were neurologically intact or with minor deficit and 2 were moderately disabled. Of 36 patients in grade 3-4, 21 were neurologically intact or with minor deficit, 4 moderately disabled, 4 severely disabled, 1 vegetative state and 6 dead. Of 8 with in grade 5, 5 were severely disabled, 2 vegetative state and 1 dead.

Of 72 patients with SAH, good recovery were 47 (65.3%), moderately disabled 6 (8.3%), severely disabled 9 (12.5%), vegetative state 3 (4.2%) and death 7 (9.7%).

Results of early treatment within 48 hours of SAH were as follows : Of 5 patients in grade 1-2, all were neurologically intact (100%). Of 11 patients in grade 3-4, 7 were neurologically intact or with minor deficit (63.6%), 1 severely disabled (9.1%), 1 vegetative (9.1%) and 3 dead (27.3%). These dead cases were due to rebleeding in one and primary brain damage in two. Of 3 patients in grade 5, severely disabled in 1 (33.3%) and vegetative in 2 (66.7%).

Results of endosaccular occlusion of intact aneurysms were as follows; Of 84 patients with non-ruptured aneurysm, 79 were neurologically intact (94.0%), 3 were with some deficit (3.6%), which had existed before endovascular treatment, and 2 died (2.4%) due to aneurysm rupture during procedure in one and bleeding 2 years after treatment.

Parent artery occlusion was performed in 16 patients. 12 patients showed no neurological change following endovascular treatment. 3 patients developed major neurological deficit due to thrombo-embolic complications (18.8%), one of which suffered from fatal bleeding. Another patient died due to preexisted primary brain damage.

1. Complications

Nine patients developed thrombo-embolic complications. Four of them recovered completely. In five patients deficits were permanent. One patient with a giant carotid cavernous aneurysm showed visual field defect following parent artery occlusion. One patient with a ruptured large ophthalmic aneurysm developed hemiplegia due to incomplete heparinization. One patient with giant vertebral aneurysm developed hemiplegia after parent artery occlusion. One patient with giant basilar aneurysm developed hemiplegia following vertebral artery occlusion and suffered from fatal bleeding in the follow up. One patient with ruptured basilar bifurcation aneurysm became comatose immediately after coil occlusion of the aneurysm due to basilar apex thrombosis and died in 6 month.

Fatal aneurysm rupture occurred during the procedure in a patient with intact basilar bifurcation aneurysm.

One patient suffered from a massive retroperitoneal hemorrhage from a femoral puncture site.

Discussion

1. Posterior circulation aneruysms

Microsurgery of the cerebral aneurysms has been established and showed excellent results. However still many technical problems remain in the treatment of posterior circulation aneurysms. Endovascular treatment was introduced and has been performed more frequently for cerebral aneurysms of the posterior circulation.[5] In our series

posterior circulation aneurysms were 73 out of 171. Most of the cases were referred from other neurosurgical centers. Overall results are satisfactory considering absolutely higher incidence of posterior circulation aneurysms.[3]

2. Ophthalmic aneurysms

Another feature of our series are ophthalmic segment aneurysms. With advent of skull base surgery, cavernous aneurysms and ophthalmic aneurysms are operated on aggressively by skillful surgeons. Results seemed acceptable but there were complications including optic nerve injury or CSF leak. These complications could be avoided with endovascular procedure.[3]

3. Acute SAH cases

Early treatment of the ruptured cerebral aneurysms became feasible.[4] Great advantage is that immediate occlusion of the aneurysm is possible after angiography and that aneurysm is approached without compressing the brain. Dense clot remaining within the subarachnoid space is a problem to resolve. Following endovascular treatment lumbar drainage is placed and Urokinase is injected intrathecally. Subarachnoid clot is washed out. So far cerebral vasospasm seems less likely to occur.

4. Complications

Thrombo-embolic complication is a serious problem. Systemic heparinization is necessary, especially for broad neck aneurysms, during and after the procedure. Serial measurement of the active clotting time (ACT) during embolization is valuable to avoid this complication.

Aneurysm rupture is another serious problem. During procedure, strict blood control is necessary. With regard to this, general anesthesia is important in acute SAH cases. Gentle and fine manipulation of the catheter and guide-wire is essential.

5. Indication

Basilar aneurysms and ophthalmic aneurysms are good candidate for endovascular treatment.[3] Also Acom aneurysms could be a good candidate. Indication of carotid aneurysms is controversial. MCA aneurysms are usually difficult to treat with endovascular technique. Limitation of the endovascular treatment should be recognized. Giant aneurysms are out of indication of endosaccular coil occlusion. Parent artery occlusion with/without bypass surgery should be selected instead. Incomplete occlusion or "loose packing" of the aneurysm has no benefit preventing hemorrhage.

Microsurgery has also great advantage. When discussing indication of the endovascular treatment, advantage and disadvantage of both treatment should be considered. Informed consent should be included.

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