Endovascular treatment of ruptured dissecting aneurysms aimed at occlusion of the dissected site by using Guglielmi detachable coils

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Object. Surgical or endovascular occlusion of the parent artery proximal to an aneurysm has been recommended for treatment of dissecting aneurysms of the intracranial posterior circulation. However, dissecting aneurysms may rupture even after proximal occlusion because distal progression of thrombus is necessary to occlude the dissecting aneurysm completely, and this may be delayed by the presence of retrograde flow. In this article the authors present their experience in treating six patients with ruptured dissecting aneurysms.

Methods. The authors report on six patients with a ruptured dissecting aneurysm in the posterior fossa who were successfully treated by endovascular occlusion of the aneurysm by using Guglielmi detachable coils. The procedure was particularly aimed at occluding the dissected site.

Conclusions. At the present time, endovascular occlusion of the dissected site is a safe, minimally invasive, and reliable treatment for dissecting aneurysms when a test occlusion is tolerated and adequate collateral circulation is present.

Key Words • dissecting aneurysm • endovascular therapy • posterior circulation • Guglielmi detachable coil

Dissecting aneurysms of the vertebrobasilar circulation often produce subarachnoid hemorrhage (SAH), and their rebleeding has been reported to occur in 24% of cases associated with a high incidence of mortality. Generally, the first choice of treatment is proximal clipping, wrapping, or trapping via an open surgical procedure. However, some dissecting aneurysms are located near the midline and pose difficulties for achieving the appropriate surgical manipulation. Recently, a technique of proximal occlusion in which coils or balloons are used has been developed as an endovascular treatment for dissecting aneurysms, and the advances in endovascular surgery have afforded safe treatment of these aneurysms. However, proximal occlusion is not always appropriate for treating dissecting aneurysms, simply because of occasional postoperative rebleeding. In the present article, we demonstrate and discuss ruptured dissecting aneurysms of the vertebral artery (VA; five cases) and the posterior inferior cerebellar artery (PICA; one case), which were successfully treated with endovascular occlusion of the aneurysm. In these cases the procedure particularly focused on occlusion of the dissected site by using Guglielmi detachable coils (GDCs; Target Therapeutics, Inc., Fremont, CA).

Clinical Material and Methods

Patient Population

During the period between November 1996 and April 1998, six patients with SAH caused by a dissecting aneurysm of the vertebral circulation were admitted to Hyogo College of Medicine. Characteristics of these patients are summarized in Table 1. Five VA dissecting aneurysms (Cases 1, 2, 4, 5, and 6) were located distal to the PICA, which in two cases (Cases 4 and 6) were opacified by a retrograde route from the anterior inferior cerebellar artery (AICA). In another case (Case 3) the dissecting aneurysm was located in the proximal portion of the PICA. An adequate collateral circulation provided by the other VA or the AICA was shown on angiography in the five cases of VA aneurysm and the one case of PICA aneurysm, respectively. The patients’ Hunt and Kosnik grades on admission are shown in Table 1; Grade II was assigned to three VA dissecting aneurysms and Grade III to two VA dissecting aneurysms and one PICA dissecting aneurysm. In three patients presenting with acute hydrocephalus, we placed ventricular drains. After admission, normotensive and hypervolemic therapy was instituted as well as a regimen of calcium channel blockers in an effort to prevent the development of cerebral vasospasm. No apparent aneurysm rebleeding or symptomatic vasospasm was recognized in the six patients before endovascular treatment.

Endovascular Treatment

All endovascular treatments were performed in a dedicated interventional angiography suite with biplane fluoroscopy, digital subtraction angiography, and roadmapping capabilities. Procedures were performed with the
patient receiving a local anesthetic and light neuroleptic analgesia to allow continuous neurological monitoring. The endovascular approach followed a 30-minute preembolization tolerance test to nondetachable 1.35-mm silicone balloon occlusion of the parent VA just proximal to the dissecting aneurysms. A microcatheter (FasTracker 10; Target Therapeutics, Inc.) was advanced from the femoral artery coaxially through a No. 6.4 French Zeppelin guiding catheter equipped with an occlusion balloon (Micro Interventional System, Sunnyvale, CA) to the dissecting aneurysm. Endovascular occlusion of the aneurysm, particularly aimed at occlusion of the dissected site, was performed using GDCs that were delivered to the site by a No. 6.4 French Zeppelin guiding catheter controlled by the flow of the VA. As soon as the first coil was placed, systemic anticoagulation was achieved by administering an intravenous bolus injection of 100 IU/kg heparin, followed by continuous administration of 20 IU/kg/hour heparin for 72 hours to prevent embolic events. All patients underwent close neurological evaluation in the intensive care unit, and antiplatelet agents (ticlopidine or aspirin) were given for at least 3 months following treatment. Postoperative angiograms were obtained in all cases to ensure complete occlusion of the dissected site. Late follow-up angiograms were studied every 3 months. Plain x-ray films were obtained in all cases to document the location of the embolic material.

Results

The patient in Case 1 had a right VA dissecting fusiform aneurysm located distal to the origin of the PICA (Fig. 1a and b). Right vertebral angiography, which was performed before endovascular treatment, revealed no opacification of the aneurysm or right VA distal to the aneurysm, indicating progression of the dissection; however, retrograde blood flow from the left VA filled the dissecting aneurysm (Fig. 1c and d). The microcatheter was navigated through the left VA into the lumen of the aneurysm, and the aneurysm, particularly the dissected site, was occluded with GDCs (Fig. 1e and f). Similarly, in other cases GDCs were endovascularly deposited into the lumen of the aneurysm for the purpose of occluding the dissected site of the aneurysm, as shown in Figs. 2 and 3. All patients underwent successful occlusion of the dissected site without any neurological complications. The latest follow-up angiograms in each case demonstrated complete obliteration of the dissecting aneurysm (Table 1). There was no rebleeding of dissecting aneurysms, and the patients’ good clinical conditions have continued throughout the follow-up period (Table 1).

Discussion

Although dissecting aneurysms of the intracranial posterior circulation were thought to be extremely rare, they have been recognized with increasing frequency as a cause of stroke. The management of these aneurysms remains controversial because the natural course of the disease is not fully understood. Because of the high risk of rebleeding, early surgical treatment has been recommended. Generally, surgical treatment of dissecting aneurysms of the intracranial posterior circulation includes proximal clipping, trapping, and wrapping. Because the majority of VA dissecting aneurysms arise distal to the origin of the PICA and are located near the midline, surgical treatment occasionally becomes difficult. Yamaura demonstrated a correlation between the postoperative incidence of serious morbidity and the midline location of a VA–PICA complex aneurysm.

<table>
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<tr>
<th>Case No.</th>
<th>Age (yrs), Sex</th>
<th>Findings at Presentation</th>
<th>Clinical Grade</th>
<th>Location of Aneurysm</th>
<th>Outcome</th>
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<th>Clin FU (mos)</th>
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<td>63, M</td>
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* Ang FU = angiographic follow up; clin FU = clinical follow up; exc = excellent; HC = hydrocephalus.
The advances made in endovascular surgery, which was developed to treat pathological entities inaccessible to open surgery, are remarkable. Recently, it became possible to occlude aneurysms with detachable coils following diagnostic angiography. Although metallic coils, balloons, and liquid materials are also used for endovascular embolization of aneurysms, we prefer to use GDCs, mainly because this technique permits the shortest segment occlusion of the dissected site. In the dissecting aneurysm, the dissection plane initially extends between the intima and media and, eventually, the aneurysm ruptures through the thinner adventitia.

Therefore, our basic policy for endovascular embolization of a dissecting aneurysm is to place the permanent occlusion devices at the dissected site in the true lumen and then collapse the false lumen to induce thrombosis. This should occlude the dissection, reduce the risk of occluding surrounding perforator vessels, and eliminate the risk of recanalization from collateral vessels. The worst possible complication that could occur during the procedure would be aneurysm rupture. Perforation of the aneurysm wall may be caused by the guidewire, catheter, coil, or delivery wire. The manipulation of these tools within the false lumen of a ruptured dissecting aneurysm is very dangerous because a large portion of the aneurysm wall is composed of the thinner adventitia. Introduction of a microcatheter and placement of coils into the ruptured dissecting aneurysm carry the risk of rupture; however, if the coils can be carefully placed within the true lumen via the roadmap method, we believe the procedure is no more dangerous than coil placement in a ruptured saccular aneurysm. As the materials used in coils have improved, there have been more reports of successful occlusion of dissecting aneurysms by using detachable coils. The goal of treatment is to prevent repeated rupture; therefore, we should evaluate whether the long-term recurrent hemorrhage rate is acceptable.

When using proximal occlusion of the parent artery to treat a dissecting aneurysm, it takes time for the distal progression of thrombus from the proximal occlusion site to occlude the dissected site if the endovascular occlusion of the parent artery is far from the aneurysm. Consequently, the dissecting aneurysm may rebled even after proximal occlusion, particularly if retrograde flow from the distal VA and its branches prevents the distal progression of thrombus to the dissected site of the aneurysm. Actually, many investigators have reported rebleeding from dissecting aneurysms after proximal clipping.

Our endovascular treatment for dissecting aneurysms is accompanied by occlusion of the parent artery. Proximal test occlusion of the VA is necessary before endovascular occlusion of the dissecting aneurysm and often is tolerated because of the plethora of available collateral vessels. However, this does not imply that distal occlusion of the VA is tolerated. Consequently, test occlusion should be performed just proximal to the intended site of permanent occlusion. Occlusion of the parent artery was possible in the five patients who presented with a VA dissecting aneurysm (Cases 1, 2, 4, 5, and 6) in this study because there was adequate collateral blood flow through the other VA. It was also possible in the one patient who presented with a PICA dissecting aneurysm (Case 3; Fig. 3) because of excellent collateral filling from the AICA. Endovascular treatment may offer a theoretical advantage in permitting aggressive anticoagulation therapy following closure of the dissected site, and the anticoagulation therapy may delay thrombus formation to provide sufficient time to develop collateral circulation. Tolerance of test occlusion does not always eliminate the subsequent, delayed stroke involving perforating vessels, which are rich in the posterior circulation. Nevertheless all of our six patients, in whom the balloon occlusion test was tolerated, have shown no neurological sequelae. Therefore, we believe that our treatment is relatively safe as long as test occlusion...
sion is tolerated and angiography demonstrates an adequate collateral circulation.1,12,16 The recording of somatosensory and brainstem-evoked responses during test occlusion may be useful in the prediction of delayed neurological deficits.17,18 In addition, treatment may be indicated for patients suffering from repeated ruptures during the acute phase and for those with a high-risk systemic disorder, because endovascular treatment is less invasive than open surgery.

Our experience is limited to only six cases and the follow-up periods are short. However, we still believe that endovascular treatment aimed at occlusion of the dissected site is one of the best management options for dealing with dissecting aneurysms at present. In the future, the advanced development of the vascular stent will lead to treatment of dissecting aneurysms without interruption of the parent artery.

References


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