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Original Article

A coil placement technique to treat intracranial aneurysm with incorporated artery

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Abstract

Background: Endovascular coil embolization is an accepted treatment option for intracranial aneurysms. However, the coiling of aneurysms with an incorporated artery (IA) poses a high risk of IA occlusion. Here we report our experience of endovascular coil placement using a technique that avoids IA occlusion in aneurysms with IAs.
Methods: Over a 6-year period, 185 patients harboring 206 intracranial aneurysms underwent endosaccular coiling. Forty-two of these patients with 45 aneurysms were treated by coil placement to avoid IAs occlusion. We assessed the anatomy of the aneurysms and IAs, technical feasibility of the procedure, and degree of aneurysm occlusion. Clinical and angiographic outcomes were assessed as well.
Results: Aneurysms were located in the supra-clinoid intracranial internal carotid artery (n = 24), anterior cerebral artery (n = 6), middle cerebral artery (n = 7), and vertebrobasilar artery (n = 8). The IA was at the aneurysm neck in 34 patients, body in 10, and dome in 1. Immediate post-coiling angiogram showed preservation of blood flow through the IA in all aneurysms. Coil compaction with aneurysmal regrowth was found in 7 of 36 patients having follow-up conventional angiography. One patient had an IA territory infarction after embolization. All 42 patients were followed up (mean: 21 months) and showed no re-bleeding.
Conclusion: This technique is effective and safe in managing intracranial aneurysms with IAs. Although aneurysmal recurrence may occur in some aneurysms because of insufficient coiling, this technique is simpler to perform and requires less skill than other techniques. It can be an alternative option for treating some selected intracranial aneurysms with IAs.

Keywords: Aneurysm; Coil; Embolization; Incorporated artery

1. Introduction

Endovascular detachable coil embolization of intracranial aneurysms has increasingly become a selective treatment modality to manage intracranial aneurysm with promising results.[11−13] Despite increased clinical experience with this technique, and improvements in endovascular skills, access devices, and embolic materials, endovascular coiling of aneurysms still has inherent limitations when applied to some geographically difficult intracranial aneurysms such as those with an incorporated artery (IA). The most common complication of the endovascular coiling of aneurysms with an IA is ischemic stroke due to inadvertent occlusion of the vital IA. Because of this concern, aneurysms with IAs have been regarded as a major contraindication to endovascular coiling. To preserve the patency of IA and to minimize the risk of vascular occlusion, some device-assisted techniques have been

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sporadically described,[1–5,10] however, these techniques may fail because anatomical sites of the parent artery, aneurysm, and IA are too difficult to access.

The purpose of this study was to report our experience by using a technique of coil compartmentalization to manage complex intracranial aneurysms with preservation of IA blood flow.

2. Methods

2.1. Patients and clinical presentations

From January 2010 to December 2015, a series of 185 consecutive patients harboring 206 intracranial aneurysms underwent endovascular coil embolization in our institute. Forty-two of these patients (18 men and 24 women; aged 42–86 years [mean, 67 years]) had 45 aneurysms with IAs and received coil placement to preserve blood flow through the IAs. Twenty-six patients had asymptomatic aneurysms, seven presented with acute ischemic strokes, five had aneurysmal subarachnoid hemorrhages, and four presented with third cranial nerve palsy. The aneurysms were located in the supraclinoid intracranial internal carotid artery (n = 24), anterior cerebral artery (n = 6), middle cerebral artery (n = 7), vertebral artery (n = 6), and basilar artery (n = 2). The IA was located at the aneurysm neck in 34 patients (76%, Fig. 1), body in 10 (22%, Fig. 2) and dome in 1 (2%). The aneurysm size varied from 3.5 to 18 mm at their maximal dimension (mean: 7.6 mm); aneurysms were wide-necked in 36 patients (neck-to-dome ratio greater than 0.5 and/or aneurysm neck diameter greater than 4 mm). Information including patient's age and sex, clinical manifestations, anatomy of the aneurysm and IA, and aneurysm size is summarized in Table 1.

2.2. Techniques of aneurysm coiling

All embolizations were performed under general anesthesia using a femoral approach. A 6- or 7-F guiding catheter was placed into the parent artery via a 6- or 7-F femoral sheath. Digital subtraction angiography (DSA) and rotational angiography were performed, with reconstruction of their images to evaluate the angioarchitecture of the parent artery, aneurysm, and IA. A microcatheter was advanced into the aneurysm using roadmap guidance: a 2-tip 0.017-inch microcatheter (Headway, MicroVention, Inc. CA, USA or Echelon, Ev3, Inc, Irvine, CA, USA) and a 0.014-inch microguidewire (Traxcess, MicroVention, Inc. CA, USA) were used to access the aneurysm sac. One (n = 29) or two (n = 16) microcatheters were navigated into the aneurysm sacs depending on the size of the aneurysm (e.g., larger than 7 mm) to enhance the effect of aneurysm packing density. When feasible, the tip of the microcatheter(s) was placed into the distal part of aneurysm sac and/or away from the opening of the IA to avoid IA occlusion during coiling. Aneurysm coiling was commenced by selecting the proper detachable coils (Microplex, MicroVention, Inc. CA, USA). Typically, the first coil was selected to create a basket to support the aneurysm sac and bridge the aneurysm neck. A bolus of intravenous heparin was routinely administered after the first coil was detached into the aneurysm sac, and an activated clotting time of 1.5-times that of the baseline was maintained throughout the procedure. Smaller sized coils (two-thirds to three-fourths the maximal dimension of the aneurysm body) were selected to fill the aneurysm sac; if the coil loop extended into the aneurysm sac near the opening of the IA, the coil was repositioned or its shape and/or size was adjusted to avoid blockage of IA flow. The main principles of aneurysm coiling are loose packing of coils in the aneurysm sac near the opening of the IA and dense packing in other portions and/or the inflow zone of the aneurysm sac; in addition, any weakness of the aneurysm sac (e.g., pseudoaneurysms) should be totally obliterated by coiling and blood flow through the aneurysm should be totally blocked at the end of procedure. The endpoint of the endovascular procedure is re-insertion of microcatheter(s) back into the parent artery. The patency and hemodynamic blood flow of the IA and the effect of aneurysm coiling were checked intermittently by DSAs. In 5 patients with IA originating from a dome (n = 1), body (n = 5), or neck (n = 2), IA protection was improved by adjuvant use of stent-assisted (n = 4) and/or microcatheter-assisted techniques (n = 4). Immediate post-embolization DSA was routinely obtained to assess the aneurysm occlusion and patency of the IA. The angiographic outcomes were assessed as: total obliteration, neck remnant, or partial occlusion with contrast media flow into the aneurysm body/dome. The post-treatment antiplatelet therapy with lifelong aspirin 100 mg daily was given to prevent or delay IA occlusive events.

3. Results

A summary of the data on angiographic and clinical outcomes is presented in Table 2. Immediate post-embolization DSA demonstrated no instance of total aneurysm occlusion, residual neck remnant in 35 (78%, Fig. 1), and partial aneurysm occlusion with aneurysm body/dome opacification in 10 (22%, Fig. 2); the blood flow through all IAs was preserved without significant flow compromise. Two patients suffered from immediate thromboembolic complications in the M3 branch of the MCA after aneurysm coiling; affected arteries were recanalized by intra-arterial infusion of IIb/IIIa platelet inhibitor. No peri-procedural aneurysm rupture occurred. Follow-up DSA was available in 36 patients (mean: 15 months) and revealed free flow through the IA without occlusion. The morphology of the coiling aneurysm was stable in 29 patients (81%); coil compaction with aneurysm recurrence was observed in 7 (19%) of 36 patients; retreatment was not initiated owing to the small size of the recurrent aneurysm sac. No aneurysm bled or rebled in the clinical follow-up period (mean: 21 months). One IA arising from the dome of a posterior communicating artery aneurysm had a delayed territorial infarction, although a magnetic resonance angiogram showed the patency of the IA. The total clinical follow-up time ranged from 6 to 36 months (mean: 21 months) and exceeded 1 year post-treatment in 36 patients (86%).

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