



Long-term follow-up study of 35 cases after endovascular treatment for vertebrobasilar dissecting aneurysms



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ARTICLE INFO

Article history:

Received 21 November 2014

Received in revised form 2 July 2015

Accepted 5 July 2015

Available online 7 July 2015

Keywords:

Vertebrobasilar dissecting aneurysms

Endovascular treatment

Digital subtraction angiography

Long-term follow-up

ABSTRACT

Objective: Vertebrobasilar dissecting aneurysm (VBDA) management is challenging despite the availability of multiple treatment strategies. We reviewed our experiences using endovascular treatment for VBDA patients to assess the efficacy and safety of several VBDA treatment strategies.

Methods: Assisted by intra-arterial digital subtraction angiography, 35 patients in our hospital were treated using various VBDA treatment strategies, including stent-assisted coil embolization (20 patients), placement of single or multiple overlapping stents (5 patients) or coil embolization combined with proximal coil trapping of the dissected segment of the parent artery (CE + PT; 10 patients). We retrospectively reviewed the perioperative records of all 35 patients and the post-procedure angiographic and clinical outcomes of 31 available patients.

Results: Of the 25 cases with ruptured VBDAs, 14 underwent stent-assisted coil embolization, 2 underwent multiple overlapping stent placement and 9 underwent CE + PT. Perioperative complications occurred in four cases (16.0%), including one aneurysm rupture and one parent artery thrombosis during the procedure and two incidences of brainstem ischemia after the procedure. Clinical outcome evaluations were performed using the Modified Rankin Scale and resulted in the following scores: 0–2 for 22 patients (22/25, 88.0%), 5 for one patient (1/25, 4.0%) and 6 for two patients (2/25, 8.0%). No cerebral bleeding events or deaths occurred during the follow-up period. Of the 10 cases with unruptured VBDAs, six underwent stent-assisted coil embolization, three underwent single or multiple overlapping stent placement and one patient underwent CE + PT. All 10 of the patients with unruptured VBDAs had favorable clinical and radiologic outcomes without procedure-related complications.

Conclusions: For patients with ruptured VBDAs, the complication rate associated with endovascular treatment is acceptable. CE + PT is better than stent coiling in preventing aneurysmal rerupture, but is associated with a high incidence of ischemic stroke. For unruptured VBDAs, endovascular treatment is associated with good clinical outcome without perioperative complications, including rerupture and ischemic stroke. However, the high postoperative recurrent aneurysm risk suggests the necessity of long-term angiographic follow-up monitoring of VBDA patients who undergo endovascular treatments.

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1. Introduction

Vertebrobasilar dissecting aneurysm (VBDA) is an intracranial aneurysm characterized by subarachnoid hemorrhage (SAH), brainstem ischemia or compression of the surrounding brain tissues. VBDA malignancies are common and contribute to an elevated rate of mortality and morbidity if untreated. Untreated VBDA

increases the risk of respiratory failure, repeated SAH and ischemia [1,2]. Unfortunately, VBDA treatment is a significant challenge. This is because surgical access to the vertebrobasilar artery is difficult and because important perforators of the brainstem and lower cranial nerves often originate from the VBDAs [3,4]. Additionally, VBDAs often have no defined aneurysmal neck, making surgical procedures, such as direct clipping, difficult to perform. Surgical revascularization is also associated with poor long-term clinical outcome [5]. Therefore, surgical VBDA treatment is often associated with a high risk of complications [6]. However, with advances in and improvement of endovascular techniques, endovascular

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treatment of VBDA has been increasing used with promising outcomes [1,7,8].

Several studies have associated endovascular treatment of ruptured and unruptured VBDA with good clinical outcomes [1,7–9]. Wang et al. [9] reported that eleven VBDA patients (eight un-ruptured and three ruptured) were treated by endovascular management and all showed complication free clinical improvement or a stable outcome. Similarly, Lv et al. [1] reported that endovascular treatment of vertebral artery-posterior inferior cerebellar artery complex dissecting aneurysms (6 un-ruptured and 16 ruptured) led to satisfactory outcomes. Additionally, Peluso et al. [8] reported that, of 14 patients with symptomatic intradural vertebral dissecting aneurysms, none had recurrent hemorrhage or infarctions during the 6–13 month follow-up after endovascular treatment.

Although favorable outcomes in patients with VBDA have been achieved using endovascular treatment, there is no consensus regarding the best treatment modalities for VBDA. The available treatment modalities can be classified into two categories that are based on parent artery preservation: (1) reconstructive surgery with the preservation of the parent artery and (2) destructive surgery with the occlusion of the parent artery. Reconstructive surgery includes stent-assistant coil embolization and the placement of single or multiple overlapping stents. Deconstructive surgery refers to the occlusion of the parent artery with or without the involvement of aneurysmal embolization. Few studies have sought to answer which VBDA treatment modality is best or investigated the long-term clinical and angiographic outcomes of endovascular VBDA treatments.

In this retrospective study, we report the clinical outcomes of 35 patients with endovascularly treated VBDA (25 ruptured and 10 unruptured). We selected the endovascular treatment strategy in each case based on angiographic and intraoperative findings of the patient. The purpose of this study was to report the clinical outcomes, complications and long-term angiographic follow-up results of VBDA patients and to assess the efficacy and safety of the selected endovascular treatment strategies.

2. Methods

2.1. Study subjects

This retrospective study was approved by the Ethics Committee of the Second Hospital of Shandong University. The study included 35 VBDA patients (23 men and 12 women), with an average patient age of 50.9 years (range, 25–73 years). The patients underwent endovascular treatment at the Department of Neurosurgery of the Second Hospital between January 2007 and December 2013. Thirty-three patients had a single VBDA and two patients had two VBDA each, for a total of 37 VBDA (Tables 1 and 2). Additionally, saccular aneurysms occurred at other sites in two cases, including one case with one saccular aneurysm and one case with three saccular aneurysms. The inclusion criteria of the study were: (1) VBDA diagnosed by cerebral angiography; (2) VBDA associated clinical symptoms, including subarachnoid hemorrhage (SAH), posterior circulation ischemia and compression of the surrounding brain tissues; (3) dilation of the parent artery with or without proximal stenosis; and (4) endovascularly treated aneurysms. The exclusion criteria of the study were: (1) iatrogenic VBDA; (2) VBDA without dilation of the parent artery; (3) VBDA associated with vascularity or fibromuscular dysplasia, as confirmed by laboratory tests or angiography; (4) asymptomatic aneurysms or aneurysms with symptoms not associated with VBDA; and (5) aneurysms not treated endovascularly.

VBDA were categorized into five groups according to anatomic location: Group 1, the proximal end of the origin of the posterior inferior cerebellar artery (PICA); Group 2, the vertebral artery with PICA involvement; Group 3, the distal end of the PICA origin; Group 4, the basilar artery with or without superior cerebellar artery (SCA) or posterior cerebral artery (PCA) involvement; and Group 5, the SCA or PCA.

All patients underwent preoperative computed tomography (CT), CT angiography (CTA), magnetic resonance angiography (MRA) or digital subtraction angiography (DSA). VBDA features identified by the preoperative imaging included symmetrical or asymmetrical dilation of the parent artery with or without distal or proximal stenosis of the vertebrobasilar artery. The specific imaging characteristics of VBDA included local stenosis, thrombosis in the vascular wall, “double cavity sign” and “peal and string sign”. A single neurosurgical team with a rich experience in treating aneurysms evaluated all patients. Endovascular procedures were performed by the same experienced neurosurgeons.

2.2. Endovascular treatment

For patients with unruptured VBDA, aspirin (300 mg/qd) and Plavix (75 mg/qd) were given orally three days prior to endovascular intervention to patients with posterior circulation ischemia or compression symptoms. For patients with SAH, a loading dose of aspirin (300 mg) and Plavix (300 mg) was given intragastrically or intra-anally two h prior to the endovascular intervention. Plavix administration continued post operatively and stopped after six weeks. Aspirin dosage was reduced gradually to the lifetime maintenance level of 100 mg/qd.

Stent-assisted coil embolization was the first choice for VBDA treatment in both ruptured and unruptured VBDA. If stent-assisted coil embolization was judged difficult to perform by the neurosurgical team (5 patients), the placement of single or multiple overlapping stents were performed instead. For patients with good compensatory circulation of the parent artery and negative balloon occlusion tests, coil embolization combined with proximal coil trapping (CE + PT) of the dissected segment of the parent artery was performed. Balloon occlusion tests were performed as follows. For conscious patients, a 6F guiding catheter was inserted into the affected vertebral artery under local anesthesia. After systemic heparinization, a nondetachable Hyperglide balloon (ev3 Endovascular Inc. Irvine, CA, USA) was introduced to the extracranial segment of the vertebral artery to occlude the parent artery. The balloon was inflated for 20 min with monitoring of neurological findings. If the patients had no neurological symptoms, the test was negative. If consciousness disturbance or focal neurological deficits occurred, the test was stopped immediately. For unconscious patients, balloon occlusion tests were performed under general anesthesia. After the balloon was introduced to occlude the affected vertebral artery, angiography of the contralateral vertebral artery was performed. The test was negative if angiography showed symmetrical images of affected and unaffected vertebral arteries with clear images of the affected AICA and PICA [10].

After the femoral artery was catheterized, all patients underwent systemic heparinization (0.75 mg/kg heparin) under general anesthesia with tracheal intubation. The heparin dose was reduced by half each hour to a minimum of 10 mg, which was maintained for the rest of the surgery. A 6F or 7F ENVOY guiding catheter (Cordis Corporation, Fremont, CA, USA) connected to a three-way hemostatic valve was inserted via the femoral artery. A Prowler Plus microcatheter (Cordis Neurovascular Inc., Miami, FL, USA) was conducted through a Traxcess guidewire (MicroVention Inc., Tustin, CA, USA), super-selected to the parent artery and positioned 20–30 mm distal to the aneurysm. The microcatheter assisted by the guidewire was then super selected to the aneurysmal sac.

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