CASE REPORT

Combined external counterpulsation and endovascular stenting treatment for symptomatic vertebrobasilar artery stenosis: two case reports

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Abstract

Symptomatic vertebrobasilar artery (VBA) stenosis has a poor prognosis. Intravascular stents provide a new therapeutic approach, but the long-term outcome of stenting compared with medical outcome is controversial. External counterpulsation (ECP) is a noninvasive method to improve perfusion of vital organs. We report two cases of this combination with ECP treatment in addition to receiving endovascular stenting. Two patients experienced posterior ischemic stroke. Digital subtraction angiography revealed a severe basilar or vertebral artery stenosis. Computed tomographic perfusion revealed significantly decreased perfusion of posterior artery territories. Both of them underwent combined ECP treatment and endovascular stenting of the stenosed basilar or vertebral artery, without recurrent stroke within 30 days after stenting. The two patients were independent (modified Rankin scale ≤2) at the 12-month follow-up time. Combined ECP treatment and endovascular stent placement may be effective and safe for patients with symptomatic VBA stenosis who failed aggressive medical treatment.

INTRODUCTION

Symptomatic vertebrobasilar artery (VBA) stenosis portends a poor prognosis despite medical therapy [1–3]. Although angioplasty and stenting showed initial promise for the treatment of these patients [4–6], the Stenting and Aggressive Medical Management for Preventing Recurrent Stroke in Intracranial Arterial Stenosis (SAMMPRIS) trial revealed an unexpected higher rate of stroke and death within 30 days among patients treated with the wingspan stent than those treated with aggressive medical therapy alone (14.7 vs 5.8%, P = 0.002) [7]. The selection of a proper therapeutic strategy for symptomatic VBA stenosis remains a challenging clinical problem.

External counterpulsation (ECP) is a noninvasive method to improve perfusion of vital organs. In the ECP system, there are three pairs of pneumatic cuffs applied to the calves, lower thighs and upper thighs. The electrocardiogram (ECG) triggers cuff inflation sequentially from distal to proximal during diastole and releases cuff pressure before the start of systole by applying an ECG-triggered diastolic pressure of 250 mm Hg. The diastolic augmentation of the blood flow and the simultaneously decreasing systolic afterload, therefore, increase blood flow to the heart, brain and kidneys. The standard duration of ECP is generally several weeks (5 daily 1-h sessions each week for 7 weeks, for a total of 35 sessions). Our pilot study showed that ECP is feasible for the
treatment of ischemic stroke patients with cerebral large artery disease by improving clinical neurological deficit [8].

Taking our experience of ECP treatment in ischemic stroke with cerebral large artery stenosis, we report combined ECP and endovascular stenting treatment of two patients who presented with symptomatic VBA stenosis.

CASE DESCRIPTION

Case 1

A 76-year-old man with 4 months history of monthly attack of transient ischemic attack (TIA) was admitted to Prince of Wales Hospital in Hong Kong. A neurological examination revealed dysarthria with mild left hemiparesis (Grade 4). He had history of hypertension hyperlipidemia and nonsmoking. Magnetic resonance imaging (MRI) of the brain showed subacute infarct over right pons (Fig. 1A). Magnetic resonance angiography (MRA) showed signal void of distal basilar artery (BA) (Fig. 1B). Computed tomographic (CT) perfusion showed decrease in blood flow for bilateral posterior cerebral artery (PCA) territories. Digital subtraction angiography (DSA) showed that a high-grade stenosis of about 70% was noted in BA (Fig. 2A). Before admission, the patient was given oral prescription of aspirin 80 mg daily and simvastatin 40 mg daily for 4 months. After admission, he was given aspirin 80 mg daily, simvastatin 40 mg daily and 35 daily 1-h ECP treatment sessions. Then, a wingspan stent was successfully inserted into the most critically stenosed BA. Post-procedure arteriogram showed widened caliber of the stenotic segment of BA (Fig. 2B). At a 30-day follow-up, the patient was able to walk with frame. At a 12-month follow-up, the patient was independent [modified Rankin scale grade (mRS) ≤2], and the DSA showed no migration, restenosis or intimal hyperplasia at the site of BA stent (Fig. 3).

Figure 1: (A) MRI shows subacute infarct over right pons (arrow). (B) MRA shows signal void of left middle cerebral artery, distal BA and proximal left PCA and severe stenosis of right PCA (arrow).

Figure 2: (A) DSA shows a high-grade stenosis of about 70% in BA (arrow). (B) A wingspan stent with 3 mm diameter and 20 mm length was successfully inserted into the most critically stenosed BA. Post-procedure arteriogram shows widened caliber of the stenotic segment of BA (arrow).
Case 2
A 53-year-old man was admitted to hospital, complaining weakness of all four limbs with dysphonia for 3 months, which deteriorated to quadriparesis in 7 days. A neurological examination revealed dysarthria with right-sided hemiplegia (Grade 0) and moderate left-sided hemiparesis (Grade 3). The patient had a history of drinking, hypertension, diabetes, and nonsmoking. He had three recurrent posterior circulation strokes during the past 3 months. The private MRI showed extensive brainstem and cerebellar infarct. CT angiography showed severe stenosis in left vertebral artery (V2/3 junction to V3 segment) and moderate stenosis in middle BA (Fig. 4A). CT perfusion showed a very poor perfusion in the posterior circulation regions (Fig. 4B). Before admission, the patient was given oral prescription of aspirin 80 mg daily and atorvastatin 40 mg daily for 3 months. After admission, he was given aspirin 80 mg daily, clopidogrel 75 mg daily together with atorvastatin 40 mg daily and totally 29 daily 1-h ECP treatment sessions. The right-sided limb power increased gradually over time during ECP. After completion of 29 sessions of ECP treatment, the right-sided upper limb power increased to 4 grade and lower limb power increased to 3 grade. However, the DSA still showed a high-grade stenosis of about 70% in left V3 segment and 60% stenosis in middle BA (Fig. 5A). A wingspan stenting was successfully inserted into the severe stenosed segment of left V3 (Fig. 5B). After stenting, CT perfusion showed significant improvement of cerebral perfusion over the posterior circulation regions (Fig. 4C). At a 30-day follow-up, his condition was stable with wheelchair walking. At a 12-month follow-up, the patient was independent (mRS ≤ 2), although he rejected to perform DSA.

DISCUSSION
The warfarin–aspirin symptomatic intracranial disease (WASID) study demonstrated that the incidence of stroke events in the region supplied by the stenotic arteries was still high, even though the patients were treated with warfarin or aspirin [1]. The annual incidence of stroke due to stenosis of BA and vertebral artery was 10 and 7%, respectively. In recent years, endovascular stenting has been an effective strategy for the treatment of VBA stenosis due to the minimal invasion and high effectiveness [4, 5]. In the present cases, two patients received pharmacotherapy with statins and/or antiplatelet drugs to control the risk factors of stroke before admission, but the response was still poor. Then, they were treated with combined ECP and endovascular stenting treatment, achieving a success rate of 100%. There were no recurrent strokes after 30-day follow-up. The clinical symptoms and signs were significantly improved, showing favorable short-term therapeutics effectiveness.

It has been reported that the incidence of in-stent restenosis was as high as 29.7% within ~6 months after surgery, and 76% patients with in-stent restenosis were even asymptomatic [9]. In the present cases, one patient was found without in-stent restenosis even after 1-year follow-up. Moreover, both patients were independent at 12-month follow-up, which indicates that the long-term effectiveness is also high. The high technical success rate and favorable outcomes after stenting may be probably related to the ECP therapy, a new treatment aiming to improve cerebral blood flow. During ECP treatment, middle cerebral artery...
mean flow velocities of stroke patients increased not only on the infarcted side (9.64%) but also on the non-infarcted side (9%) when compared with baseline by elevation of blood pressure [10]. Flow augmentation induced by ECP suggests the improvement of cerebral perfusion and collateral supply from infarct ipsilateral and contralateral sides. However, the two cases were lack of transcranial Doppler monitoring on cerebral blood flow velocities in bilateral middle and posterior cerebral arteries, which may help to show the effects of ECP treatment on cerebral circulation. Therefore, we speculate that the poor posterior cerebral perfusion may be improved after a series of ECP treatment. To some degree, the favorable outcome may be attributed to improved cerebral perfusion and collateral supply via ECP treatment before stenting.

ECP operates through external pressure applied on pneumatic cuffs on lower extremities with advantages of easy manipulation, adjustable pressure and good tolerance. The commonest adverse effects of ECP are leg and lower back pain, hematuria and skin abrasion. However, based on the ECP registry database in our center, most patients tolerated ECP treatment well and were free of limiting side effects. The potential risks of increasing blood pressure induced by ECP may contain intracerebral hemorrhage and aggravation of edema. Sustained severe hypertension (blood pressure persistently >180/100 mm Hg) in our exclusion criteria of stenting and real-time blood pressure monitoring during ECP are helpful to reduce risks of these hypertension-related events.

Currently, large randomized controlled studies on endovascular stenting versus medical therapy for symptomatic VBA stenosis are still lacking. Although this case report will not provide direct treatment recommendation about the combined treatment in patients, it provides important preliminary data on the technical success of stenting and favorable outcome of patients treated with combined ECP therapy and endovascular stenting. Whether combined ECP and stenting provides any benefit compared with stenting in these patients can only be established in a larger randomized trial.

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**CONFLICTS OF INTEREST STATEMENT**

None declared.

**REFERENCES**


**Figure 5:** (A) DSA shows a high-grade stenosis of about 70% in left V3 segment and 60% stenosis in middle BA (arrow). (B) Post-stenting arteriogram shows widened caliber of the stenotic segment of left V3 segment (arrow).