Primary balloon angioplasty for chronic occlusion of intracranial internal carotid artery: A case report

Tianli Li, Zhaolong Zhang, Chengjian Sun, Guoping Liu, Xiaolong Zhao, Liming Shao, Xuan Zheng, Yixing Xie, Changxin Wang, Rui Xu

Department of Interventional Radiology, The Affiliated Hospital of Qingdao University, No. 16 Jiangsu Road, Qingdao, 266000, Shandong, China

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ABSTRACT

Chronic occlusion of large intracranial arteries is the main cause of ischemic stroke in China. Patients with symptomatic intracranial artery occlusion and hemodynamic impairment are at high risk of recurrent stroke. Chronic occlusion of the intracranial segment of the internal carotid artery is a common type of intracranial artery occlusion. Medical management is regarded as the standard treatment for this disease. With the development of endovascular treatment, some patients with chronic cerebral artery occlusion have achieved satisfactory results with endovascular therapy. We reported a patient with symptomatic chronic occlusion of the ophthalmic segment of the internal carotid artery. Simple balloon angioplasty was performed, and the occluded ophthalmic segment of the internal carotid artery was successfully recanalized without perioperative complications. At 4 months follow-up, the internal carotid artery remained patent and perfusion of the right cerebral hemisphere improved dramatically. In addition, we briefly reviewed the relevant literature.

1. Introduction

Chronic occlusion of cerebral arteries is a major cause of ischemic stroke.1 The Clinical symptoms relate to the extent of collateral circulation.2,3 For patients with occlusion of the internal carotid artery (ICA), the risk of ischemic stroke is high, despite receiving the best medical therapy. A meta-analysis of 44 studies showed that the annual risk of stroke is 5.5%, and the annual stroke and vascular death rates are 8.9%.4 If collateral circulation is poor, recanalization of the occluded artery would always help reduce stroke risk.5 Extracranial-intracranial (EC-IC) vascular bypass may help reduce the rate of stroke recurrence. However, a randomized carotid occlusion surgery study demonstrated that EC-IC bypass was not better than drug therapy.6 Since Terada et al. reported the first successful endovascular recanalization for chronically occluded ICA in 2005, an increasing number of studies have been published on the potential benefits of ICA revascularization.7

With the development of interventional techniques, endoluminal technology has offered many options for the treatment of intracranial artery occlusion. In most reports, stenting after balloon angioplasty was used for complete intracanal artery occlusion.8,9 The Stenting versus Aggressive Medical Management for Preventing Recurrent Stroke in Intracranial Stenosis (SAMMPRIS) study demonstrated that stent placement for intracranial artery stenosis has a high incidence of perioperative complications.10 Some studies have shown that submaximal angioplasty using an undersized balloon may limit the risk of perioperative complications.11 It has been suggested that primary angioplasty for chronically occluded intracranial arteries might be an effective option. We report the case of a patient with symptomatic chronic occlusion of the ophthalmic segment of the ICA who was successfully revascularized by balloon angioplasty.

2. Case report

A 47-year-old man who presented with left-limb weakness and slurred speech for 52 days was admitted to the Affiliated Hospital of Qingdao University on August 24, 2020. Upon admission, physical examination showed that the patient’s muscle strength score of the left upper limb was 1, that of the left lower limb was 4, and those of the right limbs were 5. His modified Rankin Scale (mRS) score was 3. Magnetic resonance imaging (MRI) revealed a chronic infarction lesion in the right basal ganglia and corona radiata (Fig. 1A). Magnetic resonance angiography (MRA) showed that the right internal carotid artery was occluded. Arterial spin labeling (ASL) revealed hypoperfusion in the right middle cerebral artery (MCA) area (Fig. 1B). The patient was diagnosed with chronic internal
carotid artery (ICA) occlusion. He received dual antiplatelet therapy (aspirin 100 mg/day and clopidogrel 75 mg/day) and aggressive lipid-lowering therapy after the stroke.

Digital subtraction angiography (DSA) of the cerebral arteries revealed severe atherosclerosis of the right internal carotid artery and persistent occlusion of the distal ophthalmic artery segment (Fig. 2A). The right MCA was supplied by the left internal carotid artery through the anterior communicating artery (Fig. 2B). An experienced neurointerventionist performed the procedure. Electrocardiography, arterial oxygen saturation, and blood pressure were monitored throughout the surgery. General anesthesia was induced. After vascular access was achieved, intravenous heparin was administered as a bolus of 75 U/kg. A guiding catheter (Envoy DA, Codman Neuro) was advanced into the right internal carotid artery. The Synchro 0.014-in micro-guidewire and Echelon-10 microcatheter (Stryker Neurovascular) were successfully navigated through the occluded lesion into the right MCA. Injection of the microcatheter proved that it was located in the true lumen of the MCA. A 300 cm Synchro 2 micro-guidewire was placed in the MCA M2 segment, and a 2.0 × 15 mm Gateway balloon was advanced to the site of occlusion/stenosis. The balloon was inflated slowly during the procedure, at 1 atm per 10 s to reach its nominal pressure, and was kept inflated for 60 s (Fig. 3A). A subsequent angiogram revealed recanalization of the occlusion. Five minutes later, the angiography of the right common carotid artery showed ICA and MCA patency (Fig. 3B and C). During the procedure, we maintained the blood pressure of the patients at 120–140 mmHg. The patient was observed in the intensive care unit, and neurological examinations were performed at regular intervals after the operation. Systolic blood pressure was strictly controlled at <140 mmHg during the intensive care unit follow-up. After the procedure, no new-onset neurological deficits were observed. Treatment with 100 mg aspirin daily for life and 75 mg clopidogrel daily for three months was recommended after discharge. At four-month follow-up, there was no recurrence of stroke or new-onset neurological deficits. Physical examination showed that the patient’s muscle strength in his left limbs was slightly ameliorated, with an mRS score of 3. ASL showed that perfusion in the right cerebral hemisphere was dramatically improved (Fig. 4). DSA showed that intracranial stenosis of the right ICA had improved compared to that immediately after the operation (Fig. 5).
Discussion

Chronic occlusion is an important cause of ischemic stroke subtypes. The symptoms and prognosis among these patients depend on the location of the vascular occlusion, the hemodynamic state across the lesion, and the quality of the collateral circulation. Hemodynamic depression is the main cause of recurrent ischemia in symptomatic chronic occlusion. Therefore, revascularization is the main treatment option for this condition. Medical therapy was the initial form of treatment for all patients with chronic occlusion. However, there is still a lack of studies on the efficacy and prognosis of drug therapies. EC-IC bypass has had limited success in preventing stroke in patients with chronic occlusion. Currently, endovascular recanalization is becoming a common form of treatment. Moreover, studies have shown that endovascular intervention may be the only option for vascular recanalization in patients with limited occlusion above the supraclinoid segment. This patient was a middle-aged man who had received aggressive medical therapy (a combination of antplatelet therapy and intensive lipid-lowering therapy). However, the patient’s symptoms recurred. Cerebral DSA showed severe stenosis of the right intracranial internal carotid artery due to a lack of blood flow. After recanalization of the ICA, the patient’s clinical state improved and there was no recurrence on follow-up.

Two primary endovascular modalities are used for chronic occlusion: primary balloon angioplasty alone and stenting. Perioperative complications are a major concern in endovascular interventions. The Stenting versus Aggressive Medical Therapy for Intracranial Artery Stenosis (SAMMPRIS) trial that compared aggressive medical management with aggressive medical management combined with percutaneous transluminal angioplasty and stenting (PTAS) was halted because of excessive periprocedural events during stenting. For chronic intracranial artery occlusion, there is ongoing controversy regarding the superiority of endovascular stent placement or medical management. Although recent trials have shown better outcomes of stent implantation compared to medical treatment in terms of both short-term efficacy and safety, peri-procedural complications during the perioperative period are critical in long-term prognosis. The efficacy of reintervention is limited by in-stent restenosis and stent thrombosis. In 2014, Amin Aghaebrahim reported that 24 patients with chronic occlusion underwent treatment (one patient underwent angioplasty and 23 underwent stenting). No patients experienced perioperative stroke, but six patients experienced perioperative complications. Currently, some centers are beginning to focus on the role of single-balloon dilation for the treatment of intracranial atherosclerotic disease. In a prospective study of 78 patients treated with single-balloon dilatation angioplasty, the procedure was successfully performed in 83.3% of patients, with a perioperative complication rate of 2.6% and an incidence of restenosis within 90 days of 9.2%, including symptomatic restenosis (3.1%). In a multi-center retrospective study, the success rate of single balloon angioplasty was 92% in 74 patients, with a three-month stroke or mortality rate of 8.5%. Furthermore, studies have shown that single-balloon dilation has a lower stroke recurrence rate than intracranial artery stenting. In this case, the occluded segment of the internal carotid artery was in the traffic segment with disuse atrophy of the internal carotid artery, which made it relatively easy to achieve successful recanalization when combined with the imaging assessment of the occluded segment.

Fig. 3. Balloon angioplasty was performed slowly using a Gateway Balloon Catheter after the microwire was successfully navigated into the middle cerebral artery (MCA) through the occluded internal carotid artery (ICA) with the assistance of a microcatheter (A). Angiography after balloon angioplasty showed that the ICA was recanalized with low residual stenosis (B, C).

Fig. 4. Perfusion imaging with arterial spin labeling (ASL) at a 4-month follow-up revealed improved perfusion of the right cerebral hemisphere.
Postoperatively, the vessel lumen was well maintained and complete opening of the responsible vessel was achieved. The patient had no stroke recurrence one month after surgery, while the distal segment of the middle cerebral artery was patent.

The treatment of chronic intracranial artery occlusion requires multiple factors, and accurate preoperative evaluation is a key condition for a good prognosis. The factors influencing endovascular intervention treatment cover many aspects, including mechanical devices, operation technique, and intervention time. The endovascular treatment options for chronic intracranial artery occlusion are controversial. This report provides an option for recanalization of chronic symptomatic intracranial ICA occlusions. However, more studies are needed to verify efficacy and safety.

Declaration of competing interest

The authors declare that there is no conflict of interest.

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