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Case Report

Retinal artery embolization after carotid artery stenting: report of a case and review of literature

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Abstract: Background: Retinal artery occlusion is an uncommon but serious complication during carotid artery stenting (CAS) for carotid artery stenosis, which induces the visual defect in patients. Case presentation: A 74-year-old man was admitted to our hospital because of intermittent dizziness and limb weakness in the past one month. Cerebral angiography revealed 86% stenosis on the start of the right internal carotid artery. CAS was scheduled with a distal protection device after once pre-ballooning, and then two post-ballooning. The next day after the CAS, the patient complained of blurred vision in the right eye and was diagnosed with the occlusion of branch of central retinal artery under fluorescein retinal angiography. The vision of this patient was partially recovered and discharged after Hess expansion, compound anisodine injection beside the superficial temporal artery, dexamethasone, lidocaine and atropine retrobulbar injection, and hyperbaric oxygen therapy. After 3 months, the fluorescein retinal angiograms showed the elimination of the retina edema and recovery of blood supply. Conclusions: This study suggests that a serial of treatment approaches may improve the visual defect and resolve the retina edema.

Keywords: Retinal artery embolization, carotid stenting, distal protective device, retinal angiography, visual defect

Introduction

Carotid artery stenting (CAS) has become increasingly considered as an alternative to carotid endarterectomy (CEA) for the treatment of carotid artery bifurcation stenosis. However, the migration of debris to the retina passing through an anastomosis from external carotid artery to ophthalmic artery may contribute to the complication of retinal embolization after CAS, which seriously affects the vision of patients [1, 2]. To date, the majority of published reports on CAS have concentrated mainly on the other procedural complication of cerebral emboli and only eight studies have specifically addressed retinal embolization previously, involving less than 20 patients [1-8]. Here we further present a rare case of Chinese patient who suffered blurred vision occurring at the second day after CAS, which was subsequently diagnosed as retinal artery embolization. Literature review was also shown in the discussion.

Case presentation

A 74 year-old-man was admitted to our department because of intermittent dizziness and limb weakness (identified by neck CT angiography on patient) in the past one month. The subject had a history of chronic gastritis, a 10-year-history of hypertension, and rest tremor of the right hand. On admission, physical examination demonstrated body temperature 36.6°C, pulse rate 85 beats/min, respiratory rate 19 breaths/min, and blood pressure 138/74 mmHg. This patient was conscious and had normal bilateral vision. Besides, vascular murmur was observed only on the right side of the neck. Carotid color Doppler ultrasound and neck CT angiography revealed evidence of carotid stenosis. Two days after admission, aortic arch and total cerebral angiography which were carried out to assess the complete vessel status and collateral circulation showed a beaded change at the beginning of the left internal carotid artery (ICA) with

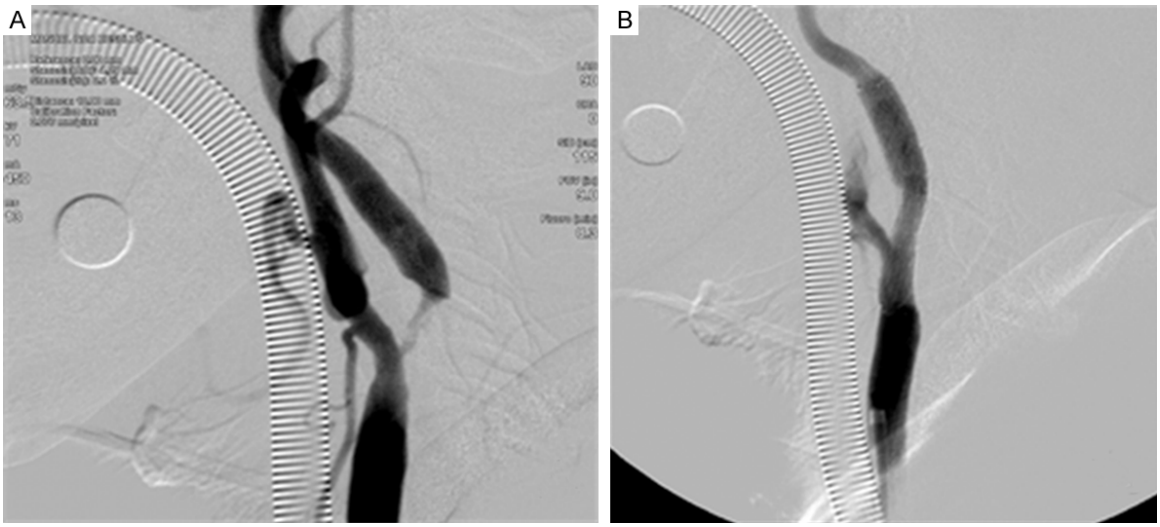

Figure 1. Cerebral angiography of the patient pre- and post- stenting. A: Right cerebral angiography showing 86% stenosis based on the North American Symptomatic Carotid Endarterectomy Trial method. B: Post-stenting right cerebral angiography showing the stenosis decreased.

distal interruption. The middle meningeal artery (MMA) and external carotid artery (ECA) through the base of skull and cortex compensated the intracranial carotid artery imaging in the arterial phase imaging. Cerebral angiography revealed 86% stenosis on the start of the right ICA based on the North American Symptomatic Carotid Endarterectomy Trial method (**Figure 1A**). The right side of the vertebral artery had no obvious stenosis in the orifice. Basal artery wall seemed coarse at arterial phase, and compensatory circulation was found from the back peripheral artery forward. Mild stenosis was observed in the orifice of the left vertebral artery.

The patient was administered with aspirin (0.3 g/day) and clopidogrel (75 mg/day) for 5 days before the CAS procedure. The procedure was carried out under general anesthesia. Under systemic heparinization, an 8 French sheath (Johnson & Johnson, USA) was inserted to the right common carotid artery via the right femoral artery puncture (Seldinger technique). Cerebral angiography revealed 86% stenosis on the start of the right ICA, tortuous intracranial arteries and open anterior communicating arteries at the arterial phase. The stent with appropriate length and diameter was determined based on the degree and length of the stenosis and the diameter of carotid artery immediately below the bifurcation detected on the baseline angiogram. We estimated that the protection device could not pass through the stenosis. ICA stenosis was pre-dilated with a 2 mm×20 mm balloon (Abbott Vascular, Santa Clara, CA, USA) without the protection device. After this primary dilatation procedure, the stenotic segment was then post-dilated using a 4 mm×30 mm and a 5 mm×30 mm balloon (Abbott, USA) with a 5 mm Emboshield NAV6 protection device (Abbott Vascular, Santa Clara, CA, USA). After the obvious benefit of dilation, a 7 mm×40 mm self-expanding stent (eV3 Endovascular, Plymouth, MN, USA) was placed across the lesion and complete dilatation of the stenotic lesion was achieved. Post-stenting intracranial angiography revealed stenosis on the opening of the right ICA disappeared (**Figure 1B**). After the operation, heparin was not neutralized and low molecular heparin calcium 0.4 ml was injected subcutaneously twice per day for 3 days.

After the operation, the patients suffered low blood pressure (100/70 mmHg) intermittently but the symptom had improved after the expanding of blood volume. On the next day of the CAS procedure, the patient complained of blurred vision of the right eye (**Figure 2A**). Fluorescein right retinal angiograms revealed the occlusion of branch of central retinal artery (**Figure 2B**). The vision of this patient was partially recovered and discharged after Hess expansion (being injected with Hydroxyethyl starch 200/0.5 and sodium chloride) [9], com-

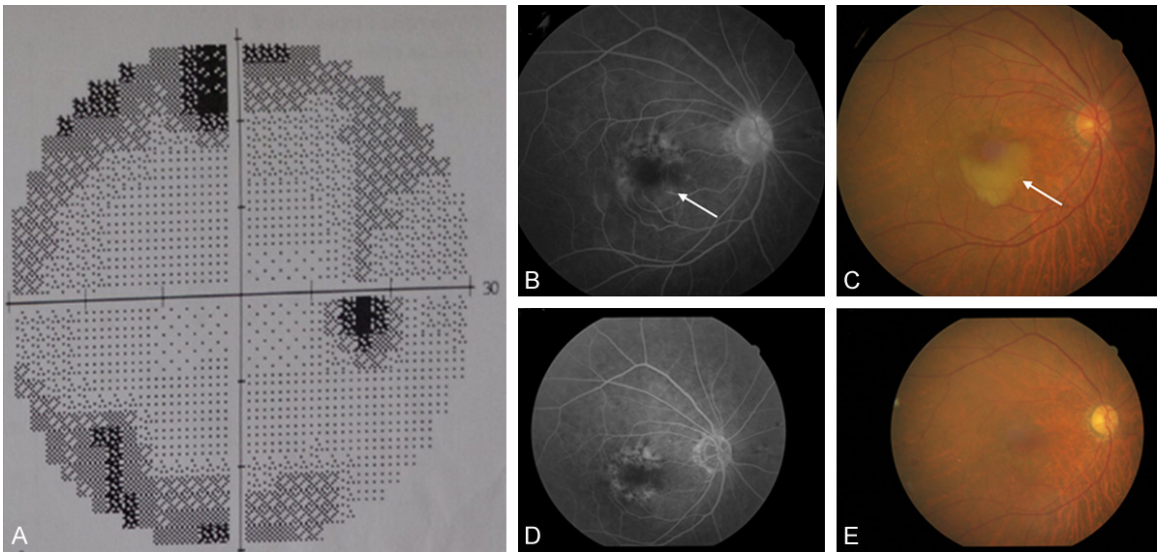

Figure 2. A: Visual field examination showed the patient with a reduced vision of the right eye; B, C: Fundus angiography showing white arteriole (arrow) not perfused and significant edema at the distal of occlusion arteriole (arrow); D, E: Fundus angiography showing the resolution of the retina edema and recovery of blood supply.

pound anisodine injection [10, 11] beside the superficial temporal artery with 2 mL once every day; dexamethasone, lidocaine, and atropine retrobulbar injection once per day for 3 days, and hyperbaric oxygen therapy for 10 days. After 3 months, the fluorescein retinal angiograms showed the elimination of the retina edema and recovery of blood supply (**Figure 2C**).

Discussion

Previous papers have referred that atherosclerotic stenosis was a common inducer for cerebral apoplexy leading to human deaths [12, 13]. CEA was considered as the most useful therapy method for atherosclerotic stenosis treatment [14], however, it brought huge risks for aging patients with cardiovascular diseases, carotid artery stenosis or occlusion [15]. Since the potential benefit of endovascular treatment (angioplasty with or without stenting) was first highlighted by the Carotid and Vertebral Artery Transluminal Angioplasty Study (CAVATAS) [16], evidence has accumulated to reveal that CAS may offer an alternative to CEA [17]. The endovascular treatment of CAS is usually carried out using a femoral catheter with the avoidance of an incision in the neck and subsequent cranial and cutaneous nerve damage. Hospital admission as well as recovery time after CAS may be less than with CEA, thus reducing costs. Additionally, CAS may be the only treatment method for those patients at high-risk after surgery because of the existence of comorbidity such as ischemic heart disease or for those patients with surgically inaccessible lesions [15, 17, 18]. Nevertheless, as a minimally invasive procedure, CAS is still associated with few complications, mainly including transient cerebral ischemia, bradycardia, myocardial infarction, minor embolic stroke, carotid artery spasm, and hypotension [19-21]. Retinal artery embolization is an uncommon but serious complication during CAS, with the incidence rate of 4% (6/118) in the study of Wilentz et al. [3] and 15% (5/33) in the study of Vos et al. [5]. At present, only 19 cases have been reported, among which only one case occurred in China (**Table 1**). In this study, we added another China man who developed retinal artery embolization after CAS. These explanations are limited to the embolism which occurred immediately after the operation.

Studies have shown that one of the advantages to treat carotid stenosis by means of CAS instead of CEA was the avoidance of general anesthesia [22]. However, the study of Nagata *et al.* had demonstrated that general anesthesia could induce hemodynamic stability under CAS, and may reduce the rate of occurrence of complications [23]. Besides, Feng *et al.* reported that general anesthesia was used when

Table 1. Literature review of patients suffer from retinal artery embolization after carotid artery stenting

Literatures	Published year	Country	Case	Status	Retinal site	Embolic protection device	Diagnosis	Treatment	Visual status
Wilentz et al.	2002	USA	4	Asymptomatic	Peripheral	Amplatz SuperStiff™ Guidewire, Boston Scientific Corp. (Théron)	FA	No treatment	Normal
			1	Symptomatic	Central	Amplatz SuperStiff™ Guidewire, Boston Scientific Corp. (Théron)	FP, FA	Heparin for 24 h	Partial blindness indefinitely
			1	Symptomatic	Central	Percusurge GuardWire system, Medtronic Inc.	FP, FA	Heparin for 24 h	Visual defect resolved
Islam et al.	2003	China	1	Symptomatic	Central	Percusurge GuardWire system, Medtronic Inc.	FA	Urokinase injection for 5 d	No neurological deficit but visual field defect still present
Yamasaki	2009	Japan	1	Symptomatic	Peripheral	Percusurge GuardWire system, Medtronic Inc.	FP	Heparin for 15 h, aspirin, ticlopidine, hyperbaric oxygen therapy for 1 week	No neurological deficit but visual field defect still present
Lee et al.	2009	Korea	1	Symptomatic	Peripheral	No reported	FP, FA	No reported	Right corrected visual acuity to 1.0, while the right visual field recovered slightly
			1	Symptomatic	Peripheral	No reported	FP, FA	No reported	Right visual acuity and the visual field defect not changed
Vos et al.	2010	Netherlands	5	Asymptomatic	Peripheral	Amplatz SuperStiff™ Guidewire, Boston Scientific Corp. (Théron)/unprotected device	FP, FA	No treatment	Normal
Liang and Luo	2010	China	1	Symptomatic	Peripheral	Unprotected device	FP, FA	Aspirin and clopidogrel once daily for 2 weeks	Visual acuity improved
Shin and Kim	2011	Korea	1	Symptomatic	Central	FilterWire EZTM 190 cm, Boston Scientific.	FP, FA	No reported	Visual acuity improved to 0.02
Karth et al.	2013	USA	1	Symptomatic	Peripheral	Distal filter SpiderFX, ev3 Endovascular, Inc.	FP, FA, OCT	No reported	Mild afferent pupillary defect
Ours	2014	China	1	Symptomatic	Central	Emboshield NAV6, Abbott Vascular Inc.	FA	Hess expansion, compound anisodine injection, dexamethasone, lidocaine, atropine joint retrobulbar injection for 3 d, and hyperbaric oxygen treatment for 10 d	Visual field recovered partially

FP, fundus photography; FA, fluorescein angiography; OCT, optical coherence tomography.

contralateral carotid artery occlusion existed [24]. In the present study, angiography results showed that the left ICA had complete occlusion. Collectively, we determined that the CAS procedure was done under general anesthesia.

Although the mechanism remains unclear, retinal artery embolization may be attributed to the debris in the stagnating blood between the Théron protective balloon and common carotid artery bifurcation that was flushed towards the ECA, but flowed to the retina through the accessory meningeal artery-ophthalmic artery anastomosis [1-3]. The blood supply of human orbit is mainly derived from the ophthalmic artery, but also by the infraorbital artery and the orbital branch of the MMA [25, 26]. Thus, the risk of retinal artery embolization may be high if the contribution of the MMA to the blood supply of the ophthalmic artery is high in patients with severe stenosis of the ICA. To avoid the debris aspirated with the blood in the Théron protective balloon, a PercuSurge system was developed in which the debris was aspirated with an aspiration cathether [22] and thus the retinal artery embolization incidence may be reduced. As expected, Wilentz et al. reported that retinal artery embolization occurred in 13.2% patients (5/38) who used the Théron system, but only in 1.25% patients (1/80) who used the PercuSurge system [3]. On the other hand, some researchers placed the distal filter devices (e.g. FilterWire EZ, SpiderFX, Emboshield Nav6) which are wire mesh and basketlike devices downstream from the stenosis and typically block particles larger than 70 mm [27]. However, the catheter must be threaded through the stenosis before deployment of the distal filter, and thus it does not block emboli flowing through vascular collaterals to cause retinal artery embolization [7, 8]. An Emboshield Nav6 distal filter device was used in our case. The blood supply of extracranial artery to the intracranial artery was obviously found. Therefore, the thrombus which caused the retinal artery occlusion might result through the passage of extracranial intracranial vascular anastomosis branches. In some studies in which the protective device was not used, the retinal artery embolization may be the result of multiple carotid angioplasties which worsened the unstable atherosclerosis of an ICA stenosis and caused an atherosclerotic change in the ophthalmic artery [7, 28].

Retinal artery embolization can usually result in partial or total blindness which can be confirmed by the fundus photography and fluorescein retinal angiography. Compared with the fundoscopy, the fluorescein retinal angiography may have more sensitivity. Thus, fluorescein retinal angiography alone or combination of fundus photography and fluorescein retinal angiography was commonly used for the diagnosis of retinal artery embolization (**Table 1**). Several approaches have been recommended for maximizing the restoration of normal vision and reducing intraocular pressure, such as ocular massage, anterior chamber paracentesis, thrombolysis (e.g. heparin, aspirin, ticlopidine, Urokinase, and clopidogrel), and hyperbaric oxygen inhalation (**Table 1**) [3, 6, 29]. However, their clinical curative effect is not optimistic and visual field defect can become an indefinite outcome. In our case, the patient was treated with Hess expansion, compound anisodine injection, dexamethasone, lidocaine, atropine joint retrobulbar injection, and hyperbaric oxygen treatment. The visual field recovered partially, but not completely. Thus, it is particularly urgent to further investigate the treatment strategy for retinal embolization.

Findings

Our study shows that retinal embolization is an uncommon, but serious complication during CAS. Anastomosis between external carotid artery and intracranial artery or ophthalmic artery may promote the debris migration to the retinal circulation, inducing the retinal embolization and blindness. Although several protective devices and treatment approaches have been used, the ideal device and excellent treatment method have yet to be defined, which need further investigation.

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Written informed consent was obtained from the patient for publication of this Case report and any accompanying images. A copy of the written consent is available for review by the Editor of this journal.

Disclosure of conflict of interest

None.

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