■ 症　　例　　日血外会誌 12：481–484，2003

Transthoracic Revascularization of the Totally Occluded Innominate Artery

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Abstract: Subclavian steal syndrome is usually associated with proximal subclavian artery stenosis and is characterized by retrograde perfusion of the vertebral artery to the distal subclavian artery. Total occlusion of the innominate artery is not common but this condition may also cause subclavian steal syndrome. We encountered a patient with innominate occlusion with angiographic subclavian steal syndrome, which was treated by an aorto-innominate artery bypass.（Jpn. J. Vasc. Surg., 12: 481-484, 2003）

Key words: Atherosclerosis, Carotid disease, Subclavian steal syndrome, Claudication

Introduction

Subclavian steal syndrome is usually associated with stenotic lesions of the proximal subclavian artery and retrograde perfusion though the ipsilateral vertebral artery via the circle of Willis[1)], but uncommonly involves innominate artery occlusion. Typical symptoms of subclavian steal are transient ischemic attack induced by motion of the ipsilateral upper extremity; however, it may present with absence of pulse, claudication of the affected upper extremity or without any symptoms[2)]. We encountered an unusual case of total occlusion of the innominate artery with a retrograde flow vial the vertebral artery to the right upper extremity.

Case Report

A 64-year-old female, with scleroderma, hyperlipidemia, and current smoking history, was referred to the vascular clinic complaining of claudication in the right arm. On physical examination, she had no palpable pulse in the right upper arm, but findings were otherwise not remarkable. She denied any syncopal episodes, and neurological examination was normal. Her laboratory findings were within normal limits, except for high serum cholesterol. Ultrasound of the neck and magnetic resonance angiogram demonstrated occlusion of the innominate artery. An angiogram showed total occlusion of the innominate artery and right common carotid artery (**Fig. 1**). On delayed images, a retrograde perfusion to the right upper extremity via the right vertebral artery was confirmed (**Fig. 2**). Cardiac stress test was negative. She was scheduled for elective revascularization of the innominate artery.

At surgery, the innominate artery was approached via a median sternotomy. The innominate vein was mobilized and retracted. The innominate, right common carotid, and right subclavian arteries were separately dissected and taped with vessel loops. A relatively large right vertebral artery was encountered and was also taped. The right recurrent nerve was dissected from the artery and preserved. After systemic heparinization, small De Bakey clamps were placed on the proximal innominate, right subclavian, and right common carotid arteries. The innominate artery was then transected.

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Received: Feb.19, 2003　Revision accepted: Apr.11, 2003

Fig. 1 Angiogram of the patient showing totally occluded innominate artery.

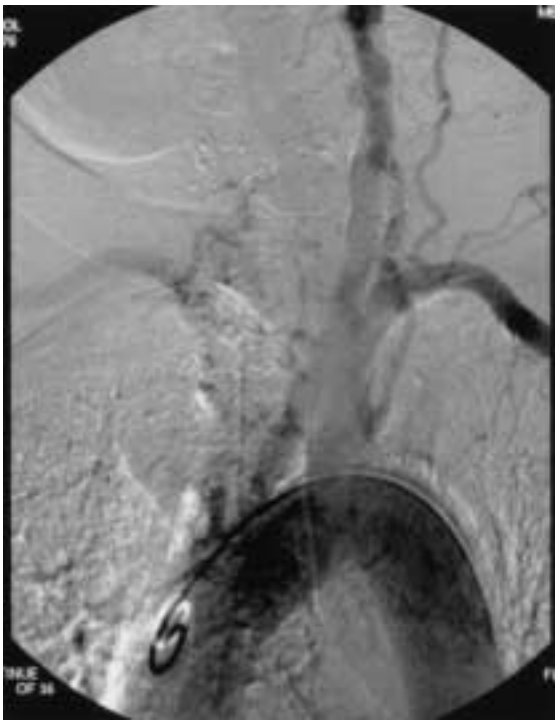

Fig. 2 Delayed phase angiogram showing retrograde flow via the vertebral artery filling the right subclavian artery.

The inner lumen was filled with atheroma and completely occluded. The proximal stump of the innominate artery was oversewn with 5-0 prolene. The distal innominate artery was longitudinally opened toward the bifurcation, and endarterectomy was performed. An 8 mm Dacron graft was trimmed as a wide hood and anastomosed from the posterior wall of the innominate artery with the hood extending up onto the bifurcation of the innominate artery. The De Bakey clamp was then released; good back flow from the right common carotid artery as well as from the right subclavian artery was confirmed. The pericardium was opened and palpation of the ascending aorta did not demonstrate any obvious atherosclerosis. Aortotomy was made on the ascending aorta after placement of a side-biting clamp. The graft was passed behind the innominate vein and anastomosed to the ascending aorta with 4-0 prolene (**Fig. 3**). All clamps were released and hemostasis was achieved. The chest was closed in the usual fashion. The postoperative course of the patient was uneventful and she was discharged home with good right upper arm pulse.

Discussion

Subclavian steal syndrome is known to be caused by a stenotic or occlusive lesion anywhere in the innominate or subclavian arteries proximal to the origin of the vertebral arteries, usually due to atherosclerosis of these vessels[3]. Typical neurological deficits associated with upper extremity motions are present in most of patients, while some may only experience claudication of the arm[2]. The occurrence of symptoms depends on the arrangement of the circle of Willis and collateral flow from the contralateral carotid artery. Our patient had a well-developed ipsilateral vertebral artery and non-diseased contralateral carotid system, which may have compensated for circulation of the brain; thus, she did not develop neurological symptoms.

The most common cause of the innominate artery occlusion is atherosclerosis. Other possible causes of innominate

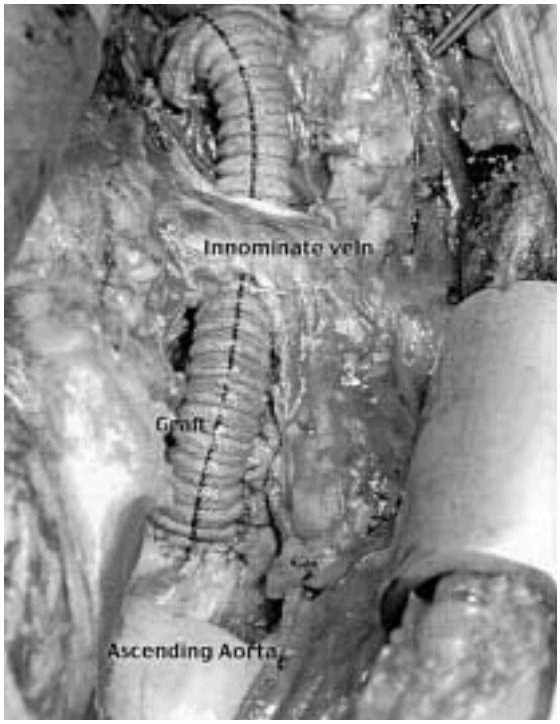

Fig. 3 Intraoperative photograph after completion of the aorto-innominate bypass.

artery occlusion include Takayasu aortitis, trauma, and fibromuscular disease[4]. Our patient had a history of scleroderma but pathohistology of the innominate artery did not demonstrate any evidence of arteritis, and the innominate artery was filled with atheromatous plaque; thus, a diagnosis of atherosclerotic innominate occlusion was made.

Absence of brachial pulse or discrepancy in blood pressure between the arms is sufficient to suspect innominate or subclavian disease. Ultrasound, 3-dimensional CT scan, and magnetic resonance angiogram are used to diagnose innominate or subclavian artery occlusion. Definitive diagnosis of subclavian steal syndrome should be based on aortogram findings: an occlusion of the innominate or proximal subclavian artery associated with retrograde flow of the ipsilateral vertebral artery filling the upper extremity[2]. Aortogram also can provide additional information about the contralateral carotid flow and the status of the circle of Willis.

The aim of innominate artery revascularization is to prevent embolic phenomena originating from the occlusive plaques. The natural history of innominate artery occlusion is not yet as well defined as carotid artery occlusive disease; however, patients with innominate artery occlusion carry considerable risk for stroke. Therefore, all patients with occluded innominate artery should be treated as soon as the diagnosis is made.

Transthoracic approach to reconstructing the innominate artery requires general anesthesia and median sternotomy. This operation allows complete visualization of the neck vessels and has been performed with acceptable risks: mortality rate of 2 ± 2% and perioperative stroke rate of 3 ± 4 %[5]. Furthermore, transection of the occluded vessel and oversewning are recommended to prevent postoperative embolic phenomena[6]. Interestingly, in the patients with innominate artery occlusion, the ascending aorta is almost always free of atherosclerosis, making proximal control with partially occluding clamp and safe[2]. However, considering the nature of atherosclerosis and avoiding atheromatous embolism from the ascending aorta, the site of graft placement should be carefully selected. Epiaortic echo may be helpful to detect small atheromatous plaques on the aorta.

Extra-thoracic approach, such as subclavian-subclavian, subclavian-carotid, and carotid-carotid bypass may be easily performed under local anesthesia without sternotomy, but these procedures do not prevent risk of neurological complication from the plaque emboli[7]. Furthermore, such an interneck vessel bypass may have inadequate inflow because of coexistence atherosclerosis in these vessels, causing early graft occlusions.

The 5-year survival after trans-thoracic innominate artery reconstruction is reported to be 73% and the graft patency rate of aortoinnominate bypass is more than 85% at 5 years[6, 8]. Catheter intervention has been reported with good initial results for the revascularization of stenotic or occluded innominate and/or subclavian artery; with a technical success rate of 97 ± 4%, stoke rate 0%, and procedural related mortality rate 0%[5]. However, the long-term results have not yet been determined. Contraindications of the transthoracic approach are the patients with a history of pervious sternotomy in which dense adhesions are expected in the upper mediastinum, or the patients with calcified aorta on which the side-

biting aortic clamp cannot be applied. These high-risk patients can be treated with extra-thoracic approach, or endovascular intervention[2, 9].

We have reported a case of innominate artery occlusion successfully treated with transthoracic aorto-innominate artery bypass.

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