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Left Carotid-to-Subclavian Artery Bypass Grafting for Recurrent Angina Caused by Coronary-Subclavian Steal Syndrome

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A 60-year-old man visited the outpatient clinic due to one month of recurrent exertional chest pain. Eleven years earlier he had undergone off-pump coronary artery bypass grafting using bilateral internal thoracic artery (ITA) Y-composite grafts based on the left ITA. Preoperative coronary angiography showed patent distal graft anastomoses and visualized the left ITA retrogradely. The arch aortography revealed near-total occlusion of the left subclavian artery at the level of the ostium. The patient underwent left carotid-to-subclavian artery bypass grafting using a 6 mm vascular conduit. Postoperative computed tomographic angiography revealed a patent bypass conduit between the left common carotid artery and left subclavian artery. The patient was discharged on postoperative day 4 with no symptoms or signs of myocardial ischemia.

Key words: 1. Carotid-subclavian artery bypass
2. Angina
3. Coronary artery bypass surgery

CASE REPORT

A 60-year-old man presented to the hospital with exertional chest pain. Eleven years earlier he had undergone off-pump coronary artery bypass grafting (CABG) using a bilateral internal thoracic artery (ITA) Y-composite graft based on the in situ left ITA. At that time there were no significant stenoses at both the right and left subclavian arteries. The left anterior descending artery and the first diagonal branch were sequentially anastomosed using the left ITA, and the posterolateral branch was revascularized using the right ITA.

Physical examination revealed a cold and pale left arm and a weaker left radial pulse than the right. The blood pressure in the right and left arms was 144/80 mmHg and 126/70 mmHg, respectively. Native coronary angiography showed retrograde visualization of the distal grafts through the patent distal anastomoses. Arch aortography demonstrated near-total occlusion of the left subclavian artery (LSCA) at the level of the ostium. Computed tomographic angiography also revealed near-total occlusion of the LSCA at the level of the ostium (Fig. 1). Myocardial single photon emission computed tomography (SPECT) demonstrated a reversible perfusion decrease in the apical to mid-anterior and mid-anterolateral walls, and persistent perfusion defects in the apex, whole inferior,

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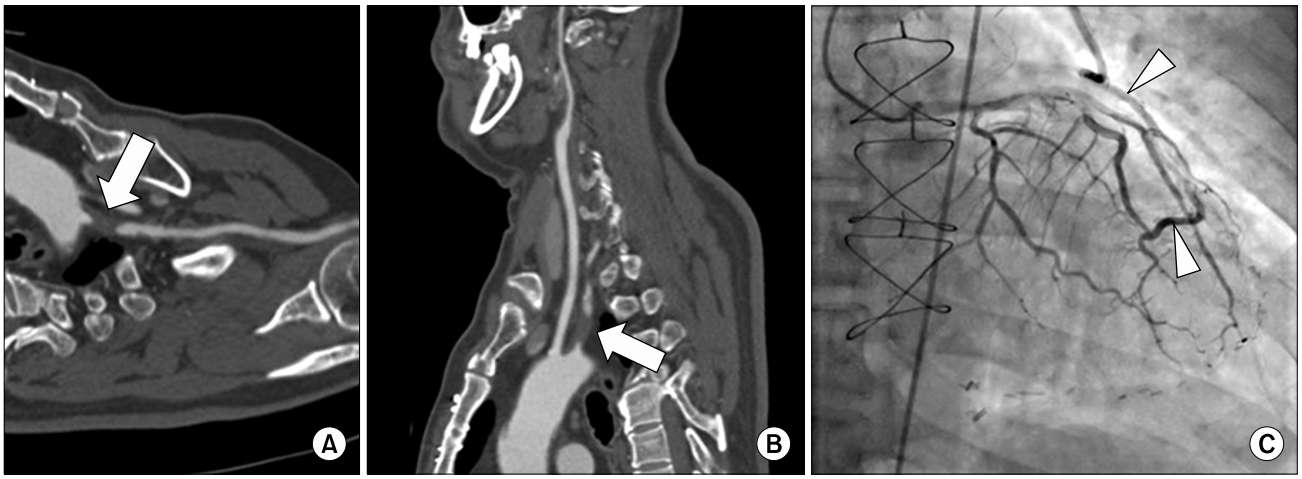

Fig. 1. (A, B) Preoperative computed tomographic angiography demonstrated near-total occlusion (arrow) at the ostium of the left subclavian artery. (C) Preoperative coronary angiography demonstrated retrograde visualization of the distal conduits (arrowheads) through patent distal anastomoses.

mid-basal inferoseptal, and inferolateral walls.

Bypass surgery of the left common carotid artery (LCCA) to the LSCA was performed using a 6 mm knitted vascular conduit (Hemashield; Boston Scientific Co., Wayne, NJ, USA) via a left supraclavicular incision. The patient was given heparin (1 mg/kg) before clamping of the LCCA. After the proximal and middle sections of the LCCA were clamped, the proximal section of the beveled vascular conduit was anastomosed to the side of the LCCA using a 6-0 polypropylene continuous suture. Because cerebral oximetry has been reported to be accurate enough for detecting early changes in cerebral blood flow that might result in cerebral ischemia [1], we used continuous cerebral oximetry during the operation. Cerebral oximetry demonstrated 57% perfusion in both sides of the brain after anesthetic induction, and it remained at 57% and 55% in the right and left sides of the brain, respectively, during the LCCA clamping of 22 minutes. The distal beveled conduit was anastomosed to the middle segment of the LSCA using a 6-0 polypropylene continuous suture.

The postoperative blood pressure in the right and left arms was 118/61 mmHg and 111/64 mmHg, respectively. Computed tomographic angiography performed on the third postoperative day revealed that the bypass conduit between the LCCA and LSCA was patent, and that the left ITA was well perfused (Fig. 2). The patient underwent antiplatelet therapy

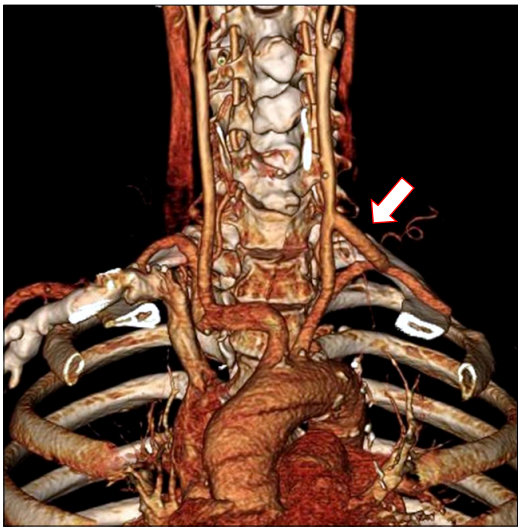

Fig. 2. Postoperative computed tomographic angiography. This revealed a patent bypass conduit between the left common carotid artery and left subclavian artery (arrow).

(Clopidogrel, 75 mg/day) until one day before surgery and resumed therapy on postoperative day 1. The patient was discharged on postoperative day 4 without any complications and was free of angina during the 2 months of follow-up. Myocardial SPECT was performed two months after surgery and demonstrated improved stress perfusion in the anterior and anterolateral walls compared with the preoperative findings (Fig. 3).

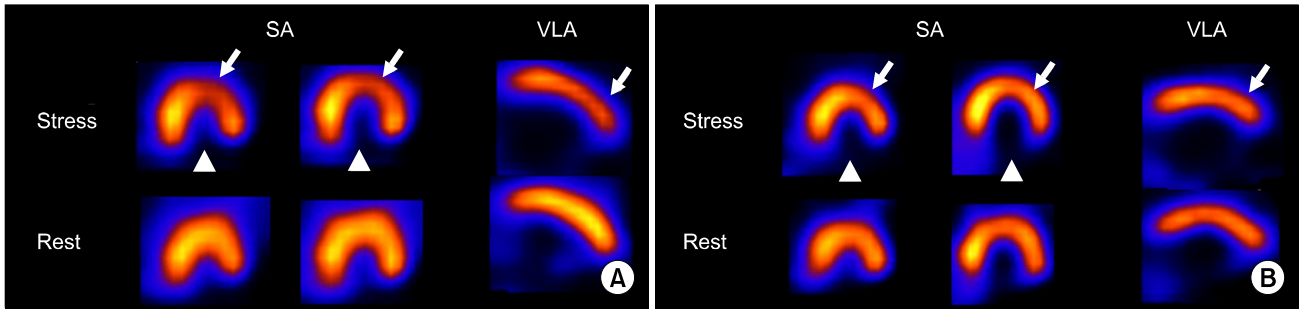

Fig. 3. (A) Preoperative and (B) postoperative myocardial single photon computed tomography (SPECT). Postoperative myocardial SPECT demonstrated improved stress perfusion in the anterior and anterolateral walls when compared with the preoperative SPECT (arrows). SA, short axis; VLA, vertical long axis.

DISCUSSION

Myocardial revascularization using the left ITA has become the standard for surgical coronary revascularization due to its improved long-term patency and lower perioperative and postoperative mortality rates. Recurrent angina in patients who have previously undergone CABG may result from an occluded or stenosed graft or from the progression of native atherosclerotic disease. Progression of LSCA stenosis has also been found to cause ischemia ever since using the left ITA for CABG had been widely adopted [2,3].

Coronary-subclavian artery steal syndrome is an uncommon phenomenon in which the coronary flow is diverted into the subclavian artery through the patent ITA conduit due to critical subclavian stenosis. The prevalence of significant LSCA stenosis in patients referred for CABG was reported to be 0.2% to 6.8% [4]. Atherosclerotic disease of the proximal LSCA is the most common cause of coronary-subclavian artery steal syndrome. However, several other pathologic processes, such as Takayasu arteritis and radiation arteritis, can also compromise the subclavian artery flow. Furthermore, the absence of LSCA stenosis may cause coronary-subclavian artery steal syndrome in association with an upper-extremity hemodialysis fistula [3]. Initial reports have described the incidence of coronary-subclavian artery steal syndrome as rare; however, several recent reports have shown that coronary-subclavian artery steal syndrome is more common than initially appreciated. In a busy cardiothoracic program, approximately 2 to 4 cases per year may be found. This reflects an increased awareness of the problem and an advent of more effective diagnostic methods [3].

Treatment options of coronary-subclavian artery steal syndrome include aorto-subclavian artery bypass, carotid-subclavian artery bypass, percutaneous interventions for the subclavian stenosis, and transposition of the ITA [3,5].

In the present study, LSCA occlusion was treated with LCCA-LSCA bypass grafting. Although some studies have suggested that performing percutaneous transluminal angioplasty for subclavian stenosis and using the ITA for coronary revascularization could be an effective treatment in patients whose subclavian artery stenosis was diagnosed preoperatively [4,6], percutaneous transluminal angioplasty of the LSCA during the postoperative follow-up period may result in obstruction of the left ITA by the stent itself, stent migration, or distal embolization. Aorto-subclavian artery bypass or transposition of the ITA seems beneficial in maintaining an adequate flow and long-term patency of the ITA. However, these strategies require redo-sternotomy and increase the risks of surgery. Therefore, we believe that carotid-subclavian artery bypass surgery may be an ideal treatment option for patients who develop postoperative coronary-subclavian artery steal syndrome due to progression of subclavian artery stenosis.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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