Coronary Subclavian Steal Syndrome

Treatment by Stenting of the Left Subclavian Artery

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SUMMARY

A 48-year-old Turkish male presented with worsening angina and a painful left hand eight years after coronary artery bypass surgery. Coronary angiography showed extensive coronary atherosclerosis with patent vein grafts to his diagonal branch and right coronary arteries. There was a severe narrowing lesion in the left subclavian artery before the origin of the left internal mammary artery (LIMA), which appeared patent. Percutaneous subclavian angioplasty and stent implantation to the left subclavian artery stenosis restored normal flow to the left hand and the LIMA with abolition of his ischemic hand symptom and marked improvement of his angina. (Jpn Heart J 2002; 43: 79-84)

Key words: Coronary subclavian steal syndrome, Stenting

THE left internal mammary artery (LIMA) is the most preferred arterial graft for surgical revascularisation of the left anterior descending (LAD) coronary artery.¹⁾ LIMA anastomosed to LAD is suggested in American College of Cardiology/American Heart Association (ACC/AHA) guidelines, as it has a resistance against atherosclerosis and a significantly higher long-term patency rate.²⁾ If there is a severe stenosis in the left subclavian artery before the LIMA ostium, LIMA flow decreases. Rarely, a subclavian steal may occur when the proximal subclavian artery narrows or occludes proximally and blood flows from the coronary circulation retrograde through the internal thoracic artery into the distal subclavian distribution. This reverse flow is called coronary subclavian steal syndrome (CSSS), and its frequency is 0.4%.^{3,4)} If CSSS occurs, ischemia could occur in the myocardial area perfused by the LIMA. Angina pectoris and left ventricular failure could occur secondary to myocardial ischemia. Before stent implantation had become common, carotid-subclavian bypass was used for the treatment of subclavian steal syndrome.⁵⁾ Nowadays, percutaneous revascularisation is a preferred alternative to surgery as a result of developments in stent engineering. In the present case study, we discuss how treatment of CSSS occurring after coronary bypass surgery is possible by stenting.

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CASE

A 48 year-old Turkish male patient was admitted to our clinic with complaints of worsening angina and a painful left hand. He had a history of anterior myocardial infarction 8 years previously and coronary bypass operation (LIMA-LAD, Ao-D₁, Ao-RCA) 2 months after the myocardial infarction. He had not had any complaints during the 5 years subsequent to the operation. Three years ago, he experienced chest pain due to strenuous exercise, which could be relieved by resting. He had been having rest angina for the last 15 days accompanied by numbness and weakness in the left arm. Blood pressure measurements could not be performed on that hand. He has had type 2 diabetes mellitus for the last 10 years. A physical examination revealed a pulse rate of 96 min and regular, blood pressure of 100/50 mmHg (right hand), an apical 1-2/6 systolic murmur, and moist rales at lung bases. Pulse and blood pressure could not be obtained from the left hand. His cardiac, renal, and hepatic parameters and hemogram were normal in biochemical analysis. ECG: sinus tachycardia, loss of R progression in V₁₋₆ leads and T wave inversion in V₄₋₆ leads. There was cardiomegaly and interstitial edema in the lung base segments on chest x-ray. Echocardiography: Ejection fraction 35%, first-degree mitral regurgitation, there was general hypokinesis in mainly anterior-anterolateral-apical segments in left ventricular wall movement analysis. The patient was admitted to our cardiology clinic with the diagnosis of unstable angina pectoris and left ventricular failure. He has improved with positive inotropic and vasodilator treatment (Dobutamine, nitrate, aspirin, heparin). After 4 days, he was taken to the coronary angiography laboratory. Right coronary proximal occlusion, circumflex coronary stenosis (90%), and LAD severe stenosis were observed in coronary angiography. Ao-RCA and Ao-D₁ saphenous vein grafts were patent, and a LIMA-LAD graft was patent but LIMA flow was weak because of the severe narrowness (90-95%) in the subclavian artery before the LIMA ostium (Figure A). The flow in the internal mammary artery was demonstrated during shooting of the left main trunk (LMT) and of the saphenous graft to the diagonal artery. We could barely demonstrate flow from the LAD to the internal mammary artery due to stenosis of the subclavian artery and to severe stenosis in the LAD. This could not be demonstrated technically on a hard copy of the recording. Nevertheless, a diagnosis of coronary subclavian steal syndrome was certain based on our observations during the procedure.

The left subclavian artery was normal in angiography conducted before coronary bypass surgery. These symptoms were thought to be related to stenosis in the subclavian artery causing CSSS. Therefore, it was decided that subclavian stenosis would be treated with percutaneous stenting. A 9 French (9F) sheath was advanced into the right femoral artery using a conventional method. A 9F JR4

Figure. Subclavia and LIMA before (A) and after (B) stenting.

guiding catheter (cordis) was advanced into the left subclavian artery ostium. A 0.014 inch guidewire (Angiomed Karlsruhe, Germany) was passed through the stenosis segment. The subclavian artery stenosis segment was very close to the LIMA ostium. Therefore, a 0.014 inch (Cordis) guidewire was passed through the LIMA as a reference point during stenting. Because a direct stent could not pass through the tight stenosis segment, a 5×20 mm balloon on the 0.014 inch guidewire was advanced to the lesion segment. Angioplasty was performed at 11 atm for 20 seconds and 13 atm for 20 seconds. An 8×30 mm self-expandable stent (SJ Medical) was then placed into the lesion area. The stent was deployed in reference to the LIMA ostium. As the stent expansion was facilitated by body temperature, we spent 5 minutes for full expansion. Control angiography revealed a residual stenosis of 30-40%, which is thought to be due to inadequate expansion of the stent so a high pressure was applied with a 9×20 mm Power Flex Plus balloon (SJ Medical) (15 seconds×14 atm). The stent was fully expanded and LIMA flow was improved in control angiography (Figure B). The patient had no complications on the second day after the intervention and was discharged under treatment with aspirin, ticlopidine, nitrate, atorvastatin, ACE inhibitor and hypoglycemic drugs. The patient has remained asymptomatic for about 5 months after the procedure and achieved a workload of 11 MET in an exercise stress test using the Bruce protocol.

DISCUSSION

Subclavian artery stenosis can occur in atherosclerosis, arteritis, exterior compressure and iatrogenic injury. Patients with atherosclerotic subclavian artery stenosis generally appear at the hospital with vertebro-basilar insufficiency and or left hand pain.^{4,5} In some CSSS cases, upper extremity exercise may cause

chest pain.^{6,7)} When classified according to stenosis rates, a subclavian stenosis of 50% or more accounts for 18% of all peripheral artery diseases.³⁾ We would like to emphasize that an 18% rate is very high. Therefore, if patients with ischemic heart disease have a bypass operation, the subclavian artery and LIMA should be visualized before the operation. If the LIMA flow is insufficient, endovascular intervention to improve the flow should be performed before using it as a graft during revascularisation. Surgical therapy has been preferred for subclavian artery stenosis. As a surgical technique, carotid-subclavian and carotid-axillary bypass is preferred. Percutaneous transluminal subclavian angioplasty (PTSA) was first applied in 1980 as an alternative to surgical management. Since that time, PTSA has become more common as an alternative to surgery.⁸⁾ The 5 year graft patency rate is 58-78% and the complication frequency is 5-23% in surgical treatment for subclavian stenosis.⁹⁻¹⁰⁾ It has been reported that the 3 year restenosis rate was 13% in PTSA cases.¹¹⁾ Surgical complications include pleural effusion, cervical lymphatic fistula, wound infection, Horner Syndrome, graft thrombosis, and stroke. The surgical mortality rate is 5%.⁹⁾ The success rate for PTSA and stent implantation in subclavian stenosis is nearly 100%. The application of PTSA is difficult in tight and chronic occlusion. However, recanalisation may be successful using laser guidewire and laser ablation.¹²⁾ CSSS is a rare disorder which is particularly observed after a bypass operation. Surgery, PTCA and primary stent implantation are other therapeutic options for CSSS.^{13,14)}

Myocardial ischemia and left hand pain cases may be treated successfully with stent implantation. For CSSS treatment with a stent, a Palmaz-Schatz stent was first applied and there were no complications.¹⁵⁾ There are several complications associated with endovascular treatment of CSSS, however, they are low when compared with those of surgical treatment. The complication rate is 5% during endovascular treatment and no mortality has been reported. The complications that may occur during endovascular treatment include hematoma in an arterial puncture area, thrombosis, dissection in a lesion area, extravasation of contrast material, arteritis, pseudoaneurysm, and vertebral artery or LIMA embolisation (1%).^{16,17)} Some of these complications (extravasation of contrast, pseudoaneurysm) may be treated with a balloon and graft coated stent.¹⁸⁾ The most severe complication during PTCA or stenting of the subclavian artery is embolisation to a vertebral artery or LIMA. Embolisation tends to occur on extremity arteries but vertebral artery embolisation can be seen at a low rate (1%).¹⁵⁾ A short balloon that does not cover the vertebral artery and LIMA ostium should be used to prevent embolisation during PTSA and dilatation time should not exceed 20 seconds. We have applied short durations of pressure with a short balloon catheter in order to be able to deploy the stent in a tight stenotic segment. There were no complications after predilatation and stent deployment.

Both vessel ostiums were under risk because of the close proximity of the vertebral artery and LIMA ostium to the tight stenotic segment. Aso, embolisation could occur in both vessels. We protected both vessel ostiums by considering that the reference point was the 0.014 inch guidewire in the LIMA ostium.

PTSA should replace surgery because of its convenience and low rates of complications and restenosis in the treatment of subclavian stenosis. It is also cost effective and has lower hospital stay rates. We believe that this case will contribute to the literature as it is the first case in our clinic, although similar cases have been reported elsewhere.

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