

## Percutaneous transluminal angioplasty and stenting of proximal left subclavian artery stenosis in a patient with coronary-subclavian steal syndrome

Koroner-subklavyen arter çalma sendromlu bir olguda proksimal sol subklavyen arter darlığına perkütan transluminal anjiyoplasti ve stent uygulaması

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Coronary-subclavian steal syndrome is a rare disease characterized by symptoms of myocardial ischemia, upper extremity claudication, and cerebrovascular insufficiency. A 57-year-old man who had undergone coronary artery bypass surgery with the use of a left internal mammary artery graft a year before developed angina pectoris of three-month history. He had complaints of increased chest pain induced by left arm movements and left arm incompetency. Physical examination showed a significant blood pressure difference between the right and left arms. Electrocardiography showed no recent ischemic changes. Cardiac enzymes were normal. On coronary angiography, vein grafts were patent. An aortogram showed proximal stenosis in the left subclavian artery and a selective subclavian angiogram showed diminished blood flow through the left internal mammary artery graft. Left subclavian artery angioplasty and stent implantation were performed, which resulted in complete patency of the left subclavian artery and sufficient re-flow through the graft. Subclavian steal syndrome disappeared.

*Key words:* Angioplasty; coronary artery bypass; stents; subclavian steal syndrome/therapy.

Subclavian artery stenosis is a rare cause of graft failure in patients with internal mammary artery (IMA) grafts. The internal mammary artery is the preferred conduit for myocardial revascularization owing to its favorable long-term patency and resistance to atherosclerosis.<sup>[1,2]</sup> Subclavian artery stenosis may occur following coronary artery bypass surgery (CABG). On the basis of angiographical and clinical studies, the incidence of subclavian artery stenosis following

Koroner-subklavyen arter çalma sendromu miyokard iskemisi, üst ekstremitede klaudikasyon ve serebrovasküler yetersizlik bulguları ile karakterize nadir görülen bir hastalıktır. Bir yıl önce sol internal mamaryal arter grefti kullanılarak koroner arter baypas ameliyatı geçiren 57 yaşındaki bir erkek hasta, üç aydır var olan angina pectoris yakınmasıyla başvurdu. Göğüs ağrısı sol kol hareketleriyle artış gösteriyor ve hasta sol kolunu yeterince kullanamıyordu. Fizik muayenede sağ ve sol kolda ölçülen kan basınçlarında belirgin bir farklılık bulundu. Elektrokardiyografide yeni geçirilmiş iskemik değişiklik gözlenmedi. Kardiyak enzim düzeyleri normaldi. Koroner anjiyografide ven greftleri açıktı. Aortogramda sol subklavyen arterde proksimal darlık, selektif subklavyen anjiyogramda ise sol internal mamaryal arter greftinde azalmış kan akımı saptandı. Hastaya sol subklavyen arter anjiyoplastisi yapılarak stent takıldı. Tedavi ile sol subklavyen arterde tam açıklık sağlandı ve greftte yeterli akım elde edildi. Subklavyen çalma sendromu bulguları kayboldu.

*Anahtar sözcükler:* Anjiyoplasti; koroner arter baypas; stent; subklavyen çalma sendromu/terapi.

IMA-CABG ranges from 0.5% to 1.1%.<sup>[3]</sup> The presence of subclavian artery stenosis may reverse the flow gradient between the subclavian artery and coronary bed, thus producing coronary-subclavian steal syndrome (CSSS). The syndrome is characterized by myocardial ischemia, upper extremity claudication, and cerebrovascular insufficiency. Treatment options for this condition include percutaneous transluminal angioplasty (PTA), intravascular stenting,

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and surgery. Percutaneous intervention to the subclavian artery is an effective treatment option to restore adequate flow in the IMA.<sup>[4]</sup> We present a case with left proximal subclavian artery stenosis accompanied by CSSS, which was successfully revascularized by percutaneous interventions.

### CASE REPORT

A 57-year-old man who had undergone CABG (IMA graft to the intermediate artery, saphenous vein grafts to the right coronary artery and to the first obtuse marginal branch of the circumflex artery) a year before developed progressive angina pectoris of three-month history following an uneventful early postoperative course. The patient was admitted to our cardiology department, complaining about increased chest pain induced by left arm movement and accompanied by left arm incompetence (ie. failure to handle objects).

Physical examination demonstrated left subclavian and left carotid bruits and a significant blood pressure difference between the right (180/100 mmHg) and left (140/80 mmHg) arms. A 12-lead electrocardiogram did not display any recent ischemic changes. Cardiac enzymes (troponin T, CK, CK-MB) were all negative. An exercise stress test yielded a positive result.

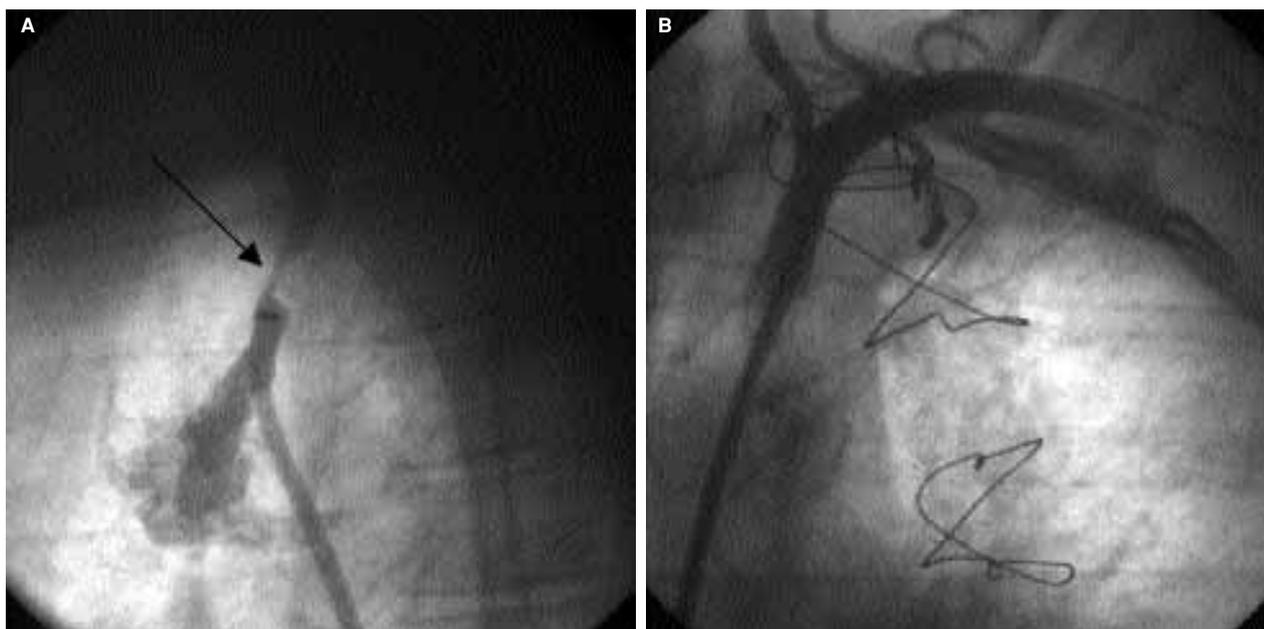
Coronary angiography demonstrated triple-vessel coronary disease with two patent vein grafts. An aortogram showed proximal stenosis (98%) in the left

subclavian artery and a selective subclavian angiogram showed diminished blood flow through the left internal mammary artery (LIMA) graft (Fig. 1a). After receiving informed consent of the patient, we performed left subclavian artery angioplasty and stent interventions.

An exchange guidewire was inserted and the stenotic lesion was predilated with an 8.0x40 mm balloon (Invatech, Saelor plus, Hersteller, Roncadelle, Italy) under 10 atmospheric pressure for 10 seconds. Then, a stent 9.0x38 mm in size (Ondostent, Cordis, California, USA) was implanted under 10 atmospheric pressure in 10 seconds. This resulted in complete patency of the left subclavian artery and sufficient re-flow through the LIMA graft (Fig. 1b). The subclavian steal syndrome resolved with no complications. The symptoms relieved immediately after the procedure and there was no difference between the blood pressures obtained in both arms.

### DISCUSSION

Coronary subclavian steal syndrome following CABG was first reported in 1974.<sup>[5]</sup> The syndrome has become widely known due to the increasing number of CABG operations. Several studies evaluated the pathophysiology and therapeutic alternatives of the syndrome.<sup>[6,7]</sup> Although it is considered an uncommon complication of myocardial revascularization with CABG, several authors feel that its inci-



**Fig. 1. (A)** The angiogram showing severe stenosis of the proximal subclavian artery with no filling in the internal mammary artery. **(B)** After stent implantation, proximal subclavian artery stenosis resolved and flow in the internal mammary artery was restored.

dence might be higher owing to the growing number of IMA grafts used.

If CSSS is observed within the first year of IMA graft, this may result from a possibly missed subclavian artery stenosis during CABG. Thus, routine subclavian arteriography should be added to cardiac catheterization before CABG. However, in some studies, a low incidence (0.44%) of CSSS was found after CABG with no significant relation between coronary artery disease and subclavian artery stenosis.<sup>[8,9]</sup>

The most common screening method for CSSS is physical examination. Detection of blood pressure difference between the right and left arms and a supraclavicular bruit should arouse suspicion and lead to further evaluation with duplex scanning and angiography. However, it should be noted that CSSS may also occur in the absence of these findings.

The gold standard diagnostic test for subclavian artery lesions is aortic arc angiography. Angiography may demonstrate late filling of the vertebral artery due to the retrograde flow from the circle of Willis and failure of contrast entry into the IMA. Filling of the left descending artery and a retrograde flow through the LIMA graft may also be observed. Duplex Doppler scanning is helpful to visualize subclavian steal from the vertebral arteries, but LIMA screening may not provide sufficient visualization.<sup>[10]</sup>

In the early 1980s, carotid-subclavian artery bypass grafting was considered a feasible and safe modality for the treatment of subclavian artery stenosis, with excellent patency rates.<sup>[11-14]</sup> Subclavian artery angioplasty for CSSS was first described and performed with success by Bachman and Kim<sup>[15]</sup> in late 1980s. Comparative results of angioplasty and surgery have not been reported for the treatment of CSSS. Several studies with large series of subclavian angioplasty procedures have demonstrated high rates of recurrent stenosis, ranging from 13% to 16%.<sup>[16-18]</sup> However, the rates of early recurrent stenosis have been remarkably low with primary stent implantation.<sup>[19-21]</sup> Thus, PTA and stenting have become an acceptable mode of therapy today, either to treat CSSS or to obtain adequate flow in the ipsilateral IMA before CABG.

In conclusion, we believe that routine subclavian angiography during coronary catheterization will lower the incidence of CSSS and IMA graft failure that develop after CABG operations. Additionally, PTA and stent implantation may be a favorable treatment method for subclavian artery lesions in experienced cardiac centers.

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