CASE REPORTS

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Angina as an Indication for Noncardiac Surgery: The Case of the Coronary-Subclavian Steal Syndrome

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THE presence of angina in patients scheduled for noncardiac surgery is considered a risk factor for perioperative cardiovascular complications.[1] Myocardial revascularization is an effective treatment for angina; when performed before noncardiac surgery, it decreases cardiac complications compared with medical therapy.[2,3] Patients who undergo myocardial revascularization with internal mammary artery (IMA) grafting demonstrate longer survival and higher resolution of symptomatology when compared with patients with vein grafts.[4-6] The most common practice is to graft the distal end of the IMA to an epicardial coronary artery to allow antegrade flow to travel from the subclavian artery toward the heart. However, if stenosis of the subclavian artery proximal to the take off of the IMA is present, angina may occur as a result of coronary-subclavian steal.[7] If the stenosis includes the carotid artery, then symptoms of cerebral ischemia can occur concurrently.

Here, we report the successful perioperative treatment of two patients diagnosed with unstable angina due to coronary-subclavian steal syndrome.

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Case 1

A 55-yr-old male presented with a history of recurrent transient ischemic attacks (TIAs) characterized by dysarthria, facial numbness, and weakness of the left arm. He had a history of hypertension, noninsulin-dependent diabetes mellitus, and coronary artery disease. Three years before admission, he underwent a three-vessel coronary artery bypass graft (CABG) with the left IMA for unstable angina, which resulted in a resolution of his symptoms. One year before admission, he began to experience crescendo angina, which progressed to 5 or 6 episodes per day despite an increase in his medications.

His blood pressure on admission was 150/100 mmHg on the right arm and 120/86 mmHG on the left arm. No cervical or supraclavicular bruits were heard. Neurologic examination revealed no focal deficits. Echocardiographic results revealed septal hypokinesis and a left ventricular ejection fraction (LVEF) of 40%. Carotid angiography showed 80% stenosis of the left common carotid artery. Aortic and coronary angiography revealed patent grafts and 80% proximal subclavian stenosis (fig. 1). Retrograde flow through the left IMA was observed, thereby establishing the diagnosis of coronary-subclavian steal (fig. 2).

The patient underwent a combined carotid endarterectomy-carotid-subclavian bypass. The anesthetic technique consisted of general anesthesia induced with sodium thiopental 5 mg/kg and fentanyl 1.2 μg/Kg and tracheal intubation with controlled ventilation. Maintenance of anesthesia was accomplished with oxygen, air, isoflurane, fentanyl, and vecuronium. Preoperatively, a cervical plexus block was performed with 20 ml 1% ropivacaine for postoperative pain relief. Intraoperative monitoring for myocardial ischemia included electrocardiogram leads II and V5 with automated ST-T segment analysis and transesophageal echocardiography. Electroencephalography and cerebral oximetry were used to detect cerebral ischemia. Mean arterial pressure was allowed to decrease as low as 80 mmHg with intravenous neosynephrine and nitroglycerin. We accepted this mean arterial pressure because of stable symmetric electroencephalographic findings, the absence of electrocardiographic changes suggesting ischemia, and our concern regarding excessive doses of neosynephrine. Esmolol was titrated to a heart rate < 80 bpm. The surgery proceeded without complications. Postoperatively, the patient exhibited complete resolution of his angina and TIAs, and was discharged 3 days later. At a 2-month follow-up examination, he remained asymptomatic.

Case 2

A 62-yr-old man presented with symptoms of dizziness, blurred vision, and confusion. He had experienced crescendo angina for the

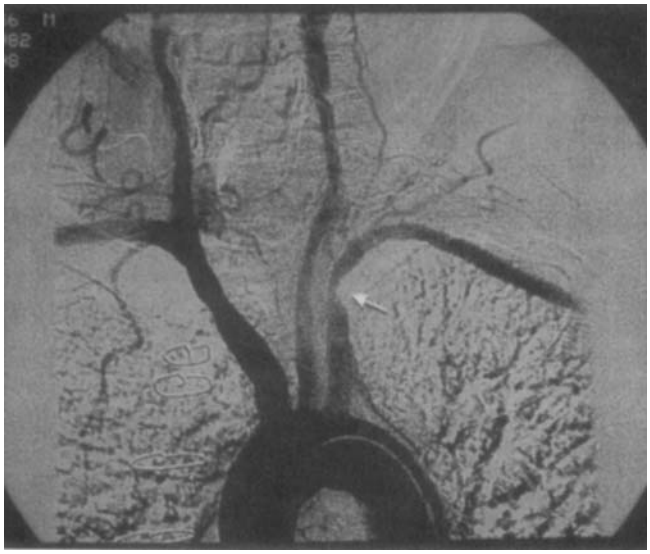

Fig. 1. Aortic arch angiogram demonstrating stenosis of the left subclavian artery.

previous 18 months that occurred with minimal exertion, despite medical therapy. The patient had suffered a myocardial infarction eight years prior, followed by subsequent CABG with a left IMA. On admission, his blood pressure was 162/88 mmHg on the right arm and 110/90 mmHg on the left arm. His left radial pulse was diminished when compared with the right radial pulse. No neurologic deficits were detected. Carotid Dupplex scanning revealed 75% stenosis of the left common carotid artery, which was confirmed by angiography. Cardiac catheterization revealed patent bypass grafts, good left ventricular function, and 80% subclavian stenosis. His bypass grafts were patent, but retrograde flow through the IMA was seen, thereby confirming the diagnosis of coronary-subclavian steal.

The patient underwent a left carotid endarterectomy with carotid-subclavian bypass, with general anesthesia induced with sodium thiopental 5 mg/kg and fentanyl 1 μg/kg. Maintenance of anesthesia was accomplished with oxygen, air, isoflurane, fentanyl, and vecuronium. Monitoring included a radial arterial catheter, transesophageal echocardiography, automated ST-T segment analysis, and electroencephalography. The patient remained hemodynamically stable throughout the procedure. His symptoms resolved postoperatively, and he was discharged 2 days after surgery. On follow-up examination, no recurrence of angina or TIAs was noted.

Discussion

The coronary-subclavian steal syndrome was first described in 1974 during a routine follow-up angiography in an asymptomatic patient 11 months after CABG surgery.[8] Since then, similar reports on patients with and without angina have appeared in the literature. The exact incidence of coronary-subclavian steal is unclear. Tyras and Barner[9] reviewed the coronary angiograms of 450 subjects following CABG with IMA grafting and observed reversal of flow in two patients, for an incidence of 0.44%. Although infrequent, the ever-increasing number of patients undergoing CABG with IMA grafts underscores the need for clinicians to recognize this unique disease state. Moreover, 6% of patients with coronary-subclavian steal are asymptomatic, and the diagnosis is first considered during physical examination or angiography for unrelated reasons.[9]

Recognition of the coronary-subclavian steal syndrome requires a high index of suspicion. Left arm claudication may be present, and cerebrovascular symptoms may indicate the existence of concomitant carotid artery disease, as in both cases reported. Simultaneous, noninvasive blood pressure measurements must be determined in both upper extremities. The presence of a systolic pressure differential greater than 20 mmHg strongly suggests subclavian stenosis. The risk of myocardial ischemia is greater with higher differentials for the same degree of stenosis; thus, upper arm exercise may unmask angina by increasing blood flow to the arm at the expense of the myocardium.

The absence of a pressure differential does not rule out significant subclavian stenosis. Olsen *et al.*[12] evaluated nine patients identified as having coronary-subclavian steal, and found that three patients had a differential lower than 20 mmHg, despite greater than 80% subclavian stenosis. Other signs include absent or diminished

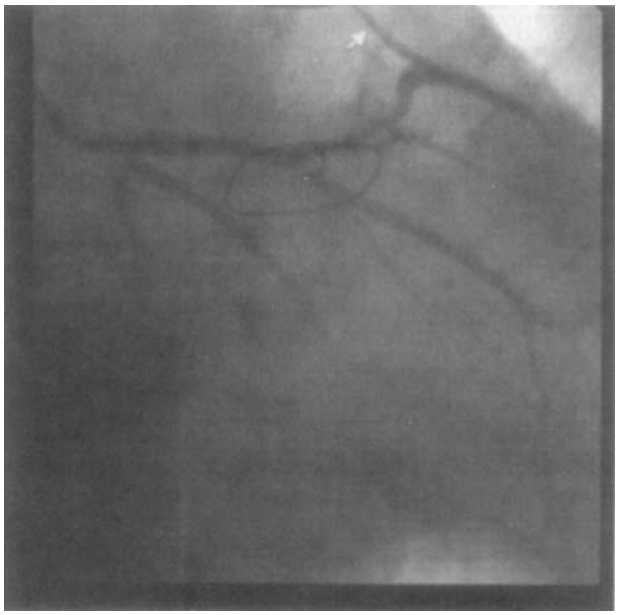

Fig. 2. Coronary angiogram of the left anterior descending artery (retrograde flow through IMA as shown by arrow).

ipsilateral radial pulse and cervical or supraclavicular bruits, although these are not always present.[9,10]

Whether anatomical evaluation of the subclavian arteries before CABG with IMA grafting should be performed is controversial. Some investigators recommend routine angiographic studies of the subclavian arteries,[11] whereas others state that the low incidence of subclavian stenosis (0.5–1.1%) does not warrant routine subclavian angiography unless suggested by history or physical examination.[9,12]

Carotid-subclavian bypass is the surgical procedure of choice for the management of coronary-subclavian steal syndrome,[12] because it has demonstrated improved long-term patency in many vascular series over the longer and more superficial graft of an axillary–axillary bypass[11,13]; however, the latter procedure offers the advantage of averting the risk of an intraoperative stroke that can occur with manipulation of the carotid artery.[14] Percutaneous transluminal angioplasty of the subclavian artery is an alternative to surgery, and has demonstrated good short-term outcome with a low recurrence of stenosis[15,16]; however, distal embolization to the hand, heart, or vertebral circulation can occur.

During preoperative evaluation, any patient with a previous IMA bypass graft should be considered a potential candidate for coronary-subclavian steal. Bilateral upper-extremity blood pressures should be performed, and a history of left arm claudication or angina induced with left arm exertion should be elicited. If the diagnosis is suspected on clinical grounds, it should be ruled out before an elective procedure by left heart catheterization or digital subtraction angiography. Once the diagnosis is confirmed, elective surgery should be postponed so that antegrade IMA flow can be restored with carotid-subclavian bypass or percutaneous transluminal angioplasty.

For patients undergoing carotid-subclavian bypass, intraoperative monitoring for myocardial and cerebral ischemia is of foremost importance. General anesthesia is the technique most commonly used. Maintenance of normal or slightly elevated mean arterial pressure will improve coronary and cerebral perfusion, whereas prevention of tachycardia will minimize the possibility of myocardial ischemia. Once reperfusion of the myocardium is achieved, a good outcome can be expected. Indeed, as exemplified in these two cases, both patients had an uneventful recovery and complete resolution of their symptoms.

References

1. Shah B, Kanlesh H, Kleinman BS, Rao TL, Jacobs HK, Mestan K, Schaafsma M: Angina and other risk factors in patients with cardiac diseases undergoing noncardiac operations. Anesth Analg 1990; 70: 240–7

2. Mahar LJ, Steen PA, Tinker JH, Vlietstra RE, Smith HC, Pluth JR: Perioperative myocardial infarction in patients with coronary artery disease with and without aorta-coronary artery bypass grafts. J Thorac Cardiovasc Surg 1978; 76:533–7

3. Eagle KA, Rihal CS, Mickel MC, Holmes DR, Foster ED, Gersh BJ, for the CASS Investigators and the University of Michigan Heart Care Program: Cardiac risk of noncardiac surgery: Influence of coronary disease and type of surgery in 3368 operations. Coronary Artery Study. Circulation 1997; 96:1882–7

4. Cameron A, Kemp HG Jr, Green GE: Bypass surgery with the internal mammary artery graft: 15 year follow-up. Circulation 1986; 74:III30–6

5. Lytle BW, Loop FD, Taylor PC, Simpfendorfer C, Kramer JR, Ratliff NB, Goormastic M, Cosgrove DM: Vein graft disease: The clinical impact of stenoses in saphenous vein bypass grafts to coronary arteries. J Thorac Cardiovasc Surg 1992; 103:831–40

6. Loop FD, Lytle BW, Cosgrove DM, Stewart RW, Goormastic M, Williams GW, Golding LA, Gill CC, Taylor PC, Sheldon WC: Influence of the internal mammary artery graft on 10-year survival and other cardiac events. N Engl J Med 1986; 314:1–6

7. Niemiera ML, Haft JI, Goldstein JE, Hobson RW: Retrograde internal mammary artery flow and resistant angina pectoris: Clues to the coronary-subclavian steal syndrome. Cath Cardiovasc Diagn 1986; 12: 93–5

8. Harjola PT, Valle M: The importance of aortic arch or subclavian angiography before coronary reconstruction. Chest 1974; 66:436–8

9. Tyras DH, Barner HB: Coronary-subclavian steal. Arch Surg 1977; 112:1125–7

10. FitzGibbon GM, Keon WJ: Coronary subclavian steal: A recurrent case with notes on detecting the threat potential. Ann Thorac Surg 1995; 60:1810–2

11. Otis S, Rush M, Thomas M, Dilley R: Carotid steal syndrome following carotid-subclavian bypass. J Vasc Surg 1984; 1:649–52

12. Olsen CO, Dunton RF, Maggs PR, Lahey SJ: Review of coronary-subclavian steal following internal mammary artery-coronary artery bypass surgery (see comments). Ann Thorac Surg 1988; 46:675–8

13. Ziomek S, Quinones-Baldrich WJ, Busuttil RW, Baker JD, Machleder HI, Moore WS: The superiority of synthetic arterial grafts over autologous veins in carotid-subclavian bypass. J Vasc Surg 1986; 3:140–5

14. Mozersky DJ, Sumner DS, Barnes RW, Strandness DE Jr: Subclavian revascularization by means of a subcutaneous axillary-axillary graft. Arch Surg 1973; 106:20–3

15. Motarjeme A, Keifer JW, Zuska AJ, Nabawi P: Percutaneous transluminal angioplasty for treatment of subclavian steal. Radiology 1985; 155:611–3

16. Shapira S, Braun SD, Puram B, Patel G, Rotman H: Percutaneous transluminal angioplasty of proximal subclavian artery stenosis after left internal mammary to left anterior descending artery bypass surgery. J Am Coll Cardiol 1991; 18:1120–3