Early multifocal stenosis after coronary artery snaring during off-pump coronary artery bypass in a patient with diabetes

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Off-pump coronary artery bypass surgery has gained popularity throughout the world. However, a cause for concern is that the coronary artery must be occluded to obtain a bloodless field and optimal visibility during anastomosis. Most often, sutures or tapes are used to snare the coronary artery extravascularly, upstream and downstream from the anastomotic site. We describe a case of early multifocal stenosis occurring at 3 sites of coronary artery snaring in a patient with diabetes.

Clinical Summary

A 69-year-old woman was admitted to our institution for unstable angina. Her risk factors for cardiovascular disease included long-standing diabetes mellitus with a requirement for insulin during the past 6 years, hyperlipidemia, obesity, and arterial hypertension. The right kidney and adrenal gland had been removed 7 years earlier for cancer. She was dependent on corticosteroids and had moderate renal failure. The coronary angiogram showed a tight proximal stenosis and calcifications of the right coronary artery (RCA), a stenosis of the midportion of the left anterior descending artery (LAD), and occlusion of the circumflex artery. The left ventricular ejection fraction (LVEF) was within normal limits.

A beating-heart double coronary artery bypass procedure was performed: a left internal thoracic artery (LITA) graft was used for the LAD and a reversed saphenous vein (RSV) graft for the RCA. A bloodless surgical field was obtained by placing needle-mounted silicone rubber bands (Retract-O-Tape; Quest, Allen, Tex) snared proximally and distally near the anastomotic sites to occlude the target arteries. The anastomoses were done under optimal heart stabilization with the Cohn stabilizer (Genzyme, Fall River, Mass). Immediately after the procedure, an inferior

myocardial infarction was noted with a new Q wave on the electrocardiogram and creatine kinase MB elevation to 110 IU/L. Nevertheless, the patient did well and was discharged on the seventh postoperative day after an echocardiogram that showed a satisfactory LVEF (56%).

On day 42, she was readmitted for chest pain and pulmonary edema. Echocardiography found evidence of severe left ventricular dysfunction. A repeat coronary angiogram showed that both grafts were patent but disclosed new tight stenoses upstream and downstream from the LITA-LAD anastomosis (Figure 1), a new tight stenosis upstream from the RSV-RCA anastomosis, and a 30% stenosis downstream (Figure 2). These new lesions were located at the sites of snare application. The LVEF was 35%. The case was discussed by a multidisciplinary team, and pharmacotherapy was considered as the best option given the patient's poor general condition. Follow-up is 16 months. She has been admitted several times for left ventricular dysfunction.

Comments

Methods for obtaining a bloodless surgical field during anastomosis in beating-heart coronary artery bypass surgery include intravascular and extravascular occluders, shunts, and gas-jet insufflation. However, temporary extravascular occlusion with polypropylene sutures or silicone tapes snared on a tourniquet is used by the vast majority of surgeons. Although snaring does not cause endothelial dysfunction in healthy coronary arteries,¹ abnormalities described after in vivo snaring of atherosclerotic coronary arteries include focal endothelial denudation, microthrombosis, and atherosclerotic plaque rupture.² These abnormalities may promote the development of intimal hyperplasia. A direct relationship has been reported between the severity of snare-induced arterial lesions and the severity of atherosclerosis in the treated arteries.³ Furthermore, a case of atheroma embolization from a snare application site has been reported.⁴ The same mechanism may have caused the intraoperative infarction observed in our patient, whose arteries were calcified.

Patients with diabetes usually have severe and extensive calcification of the arterial media, with a high risk of marked intimal hyperplasia and smooth muscle proliferation in response to arterial injury. The mechanism may be cell growth stimulation and excessive extracellular matrix production caused by mitogens, such as platelet-derived growth factor and insulin-like growth factor.⁵ Thus, in patients with diabetes, the arterial wall injury with potential plaque rupture caused by snaring may trigger severe focal intimal hyperplasia. Sometimes, the snares had been used both to occlude the artery and to reduce arterial motion. This may have caused severe lesions at the snaring sites, thereby increasing the risk of intimal hyperplasia. In our patient, arterial motion was

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Figure 1. Postoperative coronary angiogram showing lesions upstream and downstream from the LITA-LAD anastomosis 6 weeks after off-pump surgery (arrows). The anastomosis was patent, with no stenosis.

achieved with a dedicated retractor; however, this did not prevent arterial injury at the snare site.

Occlusive snaring of calcified coronary arteries in diabetic patients during off-pump coronary artery bypass surgery should be done with caution and, if possible, only upstream from the anastomosis to eliminate the possibility of downstream stenosis, which carries a high risk of graft failure and recurrent angina. Shunting or jet-gas insufflation may be valuable alternatives in these challenging patients.

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Figure 2. Postoperative coronary angiogram: New, tight stenosis upstream from the RSV-RCA anastomosis (arrow).