By applying percutaneous interventional methods precluding sternotomy, thoracotomy, and cardiopulmonary bypass, it seems possible to reduce mortality and morbidity in a highly selected patient group with aortic pathologic conditions.⁴ Potential complications of catheter-based interventions are evident.

Another interesting side aspect is the documentation of progression of the disease process from a localized aortic tear with an extensive intramural hematoma to a full-blown aortic dissection within 24 hours, as documented by three imaging techniques. The early result in our case is very encouraging, and the CT scan confirmed achievement of the hemodynamic and anatomic goals associated with successful conventional surgical repair. The durability of stent-graft repair remains to be proven. Further application in highly selected patients seems warranted.

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The dilemma of skeletonized internal thoracic artery sequential bypass versus proximal pedicled in situ internal thoracic artery plus coronary-coronary free internal thoracic artery bypass for multiple lesions of the left anterior descending coronary artery

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We describe a case in which the patient's large left anterior descending coronary artery (LAD) had proximal and distal stenosis. We speculated that a pedicled internal thoracic artery (ITA) graft would not have enough length for sequential bypass. Although the effects of skeletonization of the ITA on its long-term patency has not been established, we decided to use a free, short segment of pedicled left ITA as coronary-coronary bypass over a distal lesion on the LAD. The proximal remnant of left ITA was used as an in situ graft to bypass the proximal stenosis on the LAD. In our opinion, this technique may occasionally be an attractive approach when pedi-

cled ITA is not long enough to be used for sequential bypass grafting.

Clinical Summary

A 61-year-old man was admitted with progressive angina (New York Heart Association functional class III on admission). Hypertension, smoking, hypercholesterolemia, diabetes mellitus, and family history were all risk factors for coronary artery disease. Cardiac catheterization and angiocardiology revealed good left ventricular function (ejection fraction 0.60) with severe double-vessel disease. There was stenosis (80%) in the mid third of the right coronary artery, 70% stenosis of the proximal LAD, and long (3 cm in length) stenosis as great as 85% on the border zone between mid and distal thirds of the large LAD (Figure 1).

Bypass surgery with pedicled left ITA and vein graft was planned and accomplished. Vein graft was used to bypass the right system lesion. Because there were two stenoses on the LAD, we decided to use a short, free segment of the left ITA to perform a coronary-coronary bypass (proximal and distal connections were done as terminolateral anastomosis) over the distal stenosis. We also used the remnant of in situ left ITA to bypass the proximal LAD stenosis. The aortic crossclamp time was 43 minutes.

The patient's postoperative course and convalescence progressed without any difficulty, and he was discharged with no angina. A predischarge check angiogram done on ninth postoper-

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Received for publication Nov 24, 2003; accepted for publication Dec 16, 2003.

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J Thorac Cardiovasc Surg 2004;127:1810-2

0022-5223/\$30.00

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doi:10.1016/j.jtcvs.2003.12.020

Figure 1. Preoperative angiogram shows proximal LAD stenosis (70%, *arrow*) and 3-cm long stenosis (as great as 80%) between mid and distal thirds of large LAD (*double arrow*).

ative day showed patency of the in situ left ITA graft and the coronary-coronary free ITA graft over the distal stenosis on the LAD (Figure 2). The patient has been receiving regular follow-up for 3 months and is in New York Heart Association class I.

Discussion

The pedicled ITA graft is the criterion standard conduit for coronary artery bypass surgery, with its superiority as a direct result of its high resistance to atherosclerosis.¹ A 20-year follow-up study with angiographic confirmation in 90% of survivors demonstrated an 89% patency rate for pedicled ITA grafts.² Although total arterial myocardial revascularization is gaining popularity, skeletonization of ITA has recently been advocated to increase the number of arterial anastomoses. Additional advantages of skeletonized ITA are increased available graft length for enhanced sequential grafting, greater blood flow in the early postoperative period, and preservation of collateral blood flow to the sternum.^{1,3} Nonetheless, skeletonization of the ITA may induce mechanical and physical damage to the vessel wall, loss of the vasa vasorum (which may cause ischemia in the outer layer of the media), and loss of draining vein and lymphatic capillaries, which may induce stasis and edema in the vessel wall as well as accumulation of metabolism waste products. Development of significant atherosclerotic lesions secondary to these waste deposits may not be detected for years.¹ Theoretically, skeletonization of the ITA might adversely affect its long-term resistance to atherosclerosis and subsequently the patency rate. Calafiore's group^{4,5} reported on this problem in two occasions. Midterm results⁴ showed the same patency rate for both pedicled and skeletonized ITA grafts. However, angiographic follow-up was obtained for 15.8% of patients with skeletonized ITA conduits (133 of 842), with a mean of only 7.6 ± 2.3 months for this group. Long-term⁵ patency rate of

Figure 2. Postoperative angiogram in same patient (left anterior oblique view) shows proximal in situ remnant of left ITA (*black dotted arrow*) anastomosed to LAD (*black arrow*) and, distally, patent coronary-coronary free ITA graft (*double arrow*). Distal stenosis on native LAD is marked with *white dotted arrow*.

skeletonized ITA was reported to be greater than 99%, but angiographic control was limited to 5% of the patients (88 of 1737 survivors, follow-up 33.4 ± 24.7 months) at a mean of only 17.5 ± 18.4 months. Because there are long-term studies of pedicled ITA patency at 15 to 20 years available, and available studies of skeletonized ITA long-term patency are not conclusive enough, we consider the effect of skeletonization on long-term patency of the ITA graft has not yet been established.

In our case there were two stenoses (one proximal and one very distal) on the large LAD, running well over the cardiac apex. We usually hesitate to use skeletonized ITA because of our previously mentioned doubts. Although pedicled left ITA graft is sometimes too short to perform sequential bypass in cases of distal stenosis on the LAD, we used a free, short segment of pedicled left ITA for coronary-coronary bypass grafting over that distal LAD stenosis. Biglioli and colleagues⁶ have confirmed the physiologic restoration of coronary blood flow after coronary-coronary bypass grafting. Furthermore, progression of coronary disease at the site of proximal anastomosis (the most critical point of this technique) has never been observed in the largest series (143 patients, total of 148 coronary-coronary grafts) of coronary-coronary bypass grafting (Nottin and coworkers⁷ with a maximum follow-up of 7 years). The in situ remnant of left pedicled ITA was used to bypass the proximal LAD stenosis. A few cases have been reported with the same approach to the problem of double LAD stenosis.⁸ In that series, only 2 of 6 patients underwent follow-up angiography (3 and 8 years after surgery), and ITA grafts were patent (in situ as well as on coronary-coronary position).

We strongly believe that this technique may occasionally be an attractive approach when pedicled ITA is not long enough to be used for sequential bypass grafting.

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Activated recombinant factor VII for refractory bleeding during extracorporeal membrane oxygenation

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Hemorrhagic complications are a major concern for patients undergoing extracorporeal membrane oxygenation (ECMO) after cardiac surgery. Transfusions of platelets, fresh-frozen plasma and cryoprecipitates are commonly used to improve hemostasis, sometimes in association with antifibrinolytic agents or protease inhibitors.

Activated recombinant factor VII (rFVIIa; Novoseven, Novo Nordisk, Denmark) was originally envisioned for the treatment of bleeding in patients with hemophilia in whom inhibiting antibodies to factor VIII developed. Most recently, rFVIIa has also been successfully used among critically ill patients with impaired thrombin generation and severe hemorrhage after major trauma, liver failure or transplantation, and overdose of oral anticoagulants. We report the case of a child undergoing ECMO with refractory thoracic bleeding, which was controlled by a single dose of rFVIIa (30 µg/kg).

Clinical Summary

A term, 3.2-kg male neonate had dextro-transposition of the great arteries diagnosed on the first day after birth. Prostaglandin E₁ infusion was started, and a Rashkind atrial septostomy was performed on the second day after birth. The arterial switch operation was postponed until the 12th day of life because of intracerebral hemorrhages with subdural, subarachnoidal, and intraventricular components (diameter 8 mm).

The platelet count and coagulogram were within normal limits. Results of screening studies for congenital coagulation factor deficiencies were also normal. Although the child remained free of symptoms and repeated cerebral computed tomography showed a decreased size of the hematoma, he received seizure prophylaxis with phenobarbital. After uneventful anesthetic induction, an arterial switch operation was performed, with ligation of the arterial duct and closure of the atrial septostomy under cardiopulmonary bypass (221 minutes) with moderate hypothermia (29°C) and aortic crossclamping (83 minutes). Aprotinin was administered during surgery, followed by protamine during weaning. Abnormal circumflex coronary artery originating from the right coronary artery was felt to be responsible for persistent left ventricular failure, leading to unsuccessful weaning from cardiopulmonary bypass and the requirement for venoarterial ECMO support with a Carmeda coated circuit (Medtronic, Minneapolis, Minn). During the first 2 days, the postoperative phase was characterized by severe bleeding from the chest tubes (10 mL/kg/h), despite massive transfusion of blood products (7.7 mL/kg/h packed red blood cells, 4.1 mL/kg/h platelets, and 2.6 mL/kg/h fresh-frozen plasma) and calcium chloride.

Surgical reexplorations at 24 and 36 hours after the operation failed to reveal any active surgical bleeding site. Because of persistent hemorrhage from the thoracic chest tubes, aminocaproic

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Received for publication Dec 8, 2003; accepted for publication Dec 24, 2003.

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J Thorac Cardiovasc Surg 2004;127:1812-3

0022-5223/\$30.00

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doi:10.1016/j.jtcvs.2003.12.021