Surgical Technique

The "Fully No-Touch" Technique

for the Internal Thoracic–Coronary Artery Anastomosis

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Extreme technical accuracy is crucial in coronary artery surgery. Although late graft patency depends mostly upon the patient's own biochemical status in chronic ischemic patients who have undergone elective surgery, graft disease is certainly promoted by an inaccurate technique or by careless arterial harvesting, which may cause both intimal lesions and anastomotic strictures. We describe a technique of internal thoracic–coronary artery anastomosis that fully prevents contact between vessels and surgical instruments. In order to enable the suturing of a fully dilated vessel, intracoronary papaverine is injected into the clamped aortic root while the heart is still beating and before systemic cooling begins. The suturing technique applies some microvascular principles, the chief being a high number of stitches incorporating the least amount of tissue, to avoid bulk. ***(Texas Heart Institute Journal 1994;21:211-4)***

The internal thoracic artery (ITA) is recognized to be, by far, the most effective autologous graft for coronary anastomosis, in terms either of adaptable blood flow or long-term viability.

Extensive experience all over the world with this conduit has cleared excessive concerns about collateral bleeding and about its fragility, poor initial blood flow, risk of perioperative spasm, torsion, length, etc. In fact, this artery is the best autologous conduit available, even when compared with other arterial grafts recently arrived on the scene, such as the gastroepiploic, the inferior epigastric, the radial, and the intercostal.[1,2]

The only real concerns about use of the ITA should be those regarding full preservation of its intimal integrity and sound patency of the anastomosis. Careless harvesting of the graft and an inaccurate suture technique both lead to early graft failure, usually at the anastomotic site. Herein we discuss a method of preventing arterial injury during anastomosis that augments the "no-touch" technique reported by Galvin.[3]

Methods

Technique. When the ITA has been fully dissected from the chest wall and the 1st intercostal branch found and clipped, the artery is divided distally and rotated 180°, laid on a sponge, and clamped as proximally as possible with soft Dietrich clamps. The lumen is incised only enough to implant a 20-gauge catheter and then is injected with several mL of a solution composed of 150 mg papaverine hydrochloride diluted in 200 mL of normosaline. This maneuver enables detection of residual unclipped collateral vessels and completely distends the ITA wall. The incision is then extended to the appropriate length while the artery is handled only by its free end.

On full cardiopulmonary bypass, the aorta is clamped before systemic cooling is started, and 50 mL of normosaline solution is injected into the aortic root, along with 30 mg of papaverine. In our experience, intracoronary papaverine in the empty, beating, and normothermic heart (immediately before cooling) creates a sort of "warm vasoplegia" in which the arteries are dilated first and then cooled. Systemic cooling is moderate (30 °C). Myocardial protection is achieved with standard crystalloid cardioplegia and pericardial ice slush.

After the coronary artery has been opened, and exposed with stay sutures, the ITA is laid alongside it. The anastomosis is started at the proximal heel with con-

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tinuous 8-0 Prolene suture (Ethicon, Inc., Johnson & Johnson Italia; Milan, Italy) and is carried on around it (Fig. 1A). Then the vessel is rotated either by the surgeon's hands or by the assistant's forceps at the free end (eventually to be excluded from the anastomosis), before being lowered into position over the coronary opening by gentle traction on the 2 ends of the suture. When the running suture has reached the distal end (Figs. 1B and C), the redundant ITA is not cut in accordance with the practice of Galvin[3] and others: instead, the suture is continued by double-biting the wall of the ITA from its inner side (*only* the intimal and medial layers are incorporated, to avoid bulk) and then by including the wall of the coronary artery (Figs. 1D and E). The number of bites at the toe should be no fewer than 4, and preferably 6. The redundant portion of the ITA is used for gentle traction during completion of the anastomosis, enabling the surgeon to pull apart the internal thoracic and coronary walls and to confirm that needle insertion is correct. With the suture tied in place, the muscular pad is sutured to the epicardium on both sides with 5-0 Prolene, and the redundant arterial wall is not sutured (Figs. 1F and G).

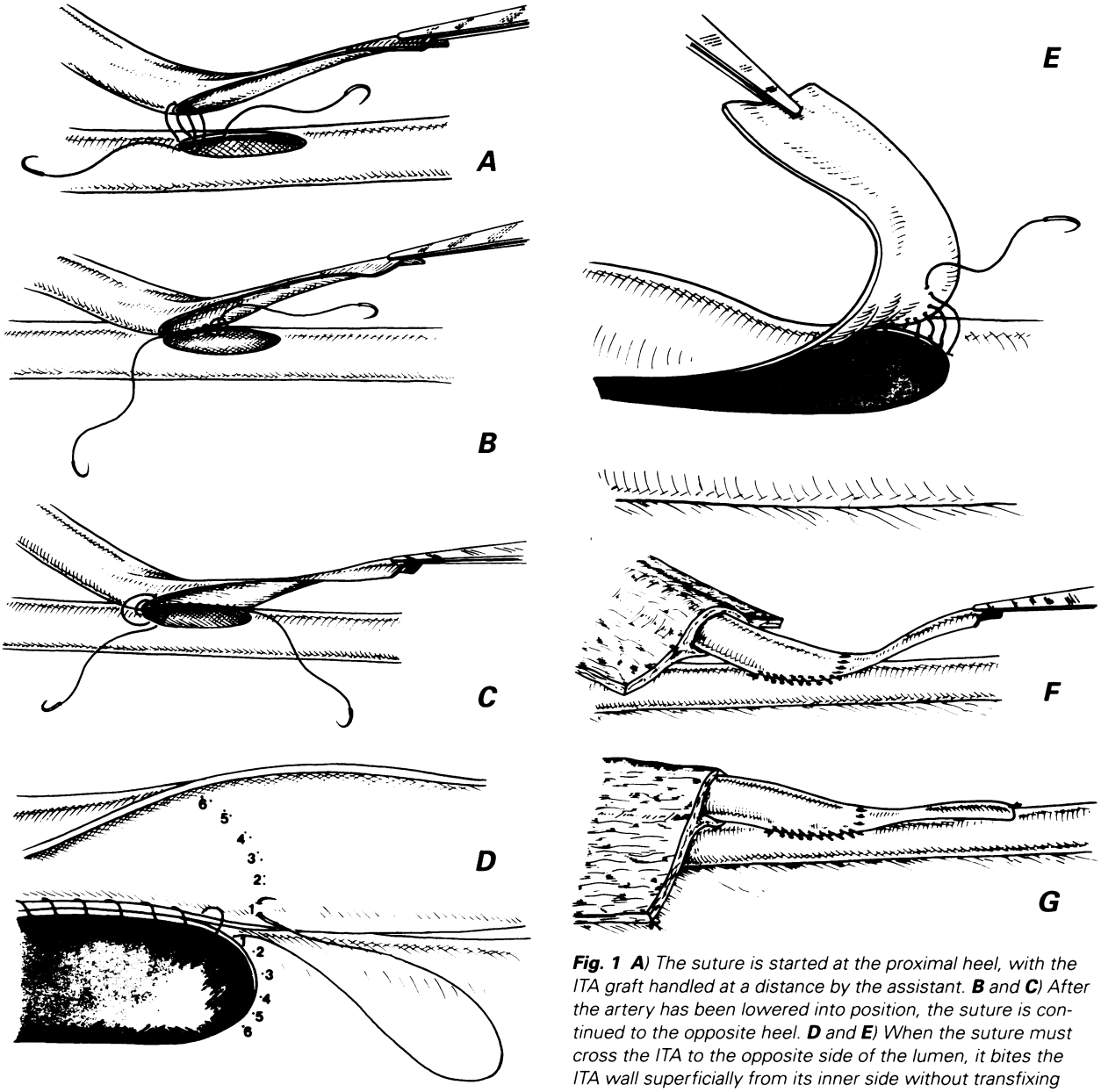

Fig. 1 ***A****) The suture is started at the proximal heel, with the ITA graft handled at a distance by the assistant.* ***B*** *and* ***C****) After the artery has been lowered into position, the suture is continued to the opposite heel.* ***D*** *and* ***E****) When the suture must cross the ITA to the opposite side of the lumen, it bites the ITA wall superficially from its inner side without transfixing the graft. Four to 6 stitches are needed to keep the distal coronary lumen wide open.* ***F*** *and* ***G****) When the suturing is complete, it is checked for residual bleeding by pulling gently on the redundant tissue of the ITA. The muscular pad is then fixed to the epicardium with 5-0 Prolene, and the redundant arterial wall lies on the epicardium (not shown).*

Patients. At our institution, during the last 3 years, 90% of all 917 coronary patients (n=825) received at least 1 ITA graft to the left anterior descending artery (85%), to the obtuse marginal artery (15%), or to the right coronary branch (5%). Thirty-five patients received a sequential ITA graft and 68 patients a bilateral ITA graft.

The "fully no-touch" technique has been applied irregularly since late 1991 by the 1st 2 authors of this paper, in about 215 of the 825 patients. From this population, 60 consecutive patients with 60 arterial and 92 venous anastomoses underwent digital angiographic studies within 3 months of operation.

In all patients, the diameters of the coronary artery were measured just proximal to the anastomosis (Fig. 2, large dotted line) and at the level of the anastomosis (Fig. 2, small dotted line). With respect to the anastomosis of the ITA, a 3% to 15% narrowing (average, 10%) was found between the 2 sections. Only 1 patient had a critical arterial anastomotic stricture.

Discussion

It is rather surprising that the use of single or bilateral ITA grafts has not reached a role of clear dominance worldwide; indeed, new autologous conduits,[1,2,4] such as the gastroepiploic artery, the inferior epigastric artery, the radial artery, and the intercostal arteries, are rising in popularity. A number of misjudgments have delayed acceptance of ITA grafts. The use of magnification has proved the ITA not to be friable but, on the contrary, to have a good degree of elasticity and resistance to shear lesions. Surgical trauma is minimized by the use of 8-0 Prolene sutures and needles. Full and careful harvesting of the ITA from its subclavian origin to its phrenic division and various pathways (anterior, transverse sinus, and subcaval) always affords adequate length to reach the distal coronary branches. The administration of intravenous nifedipine effectively treats perioperative spasms.

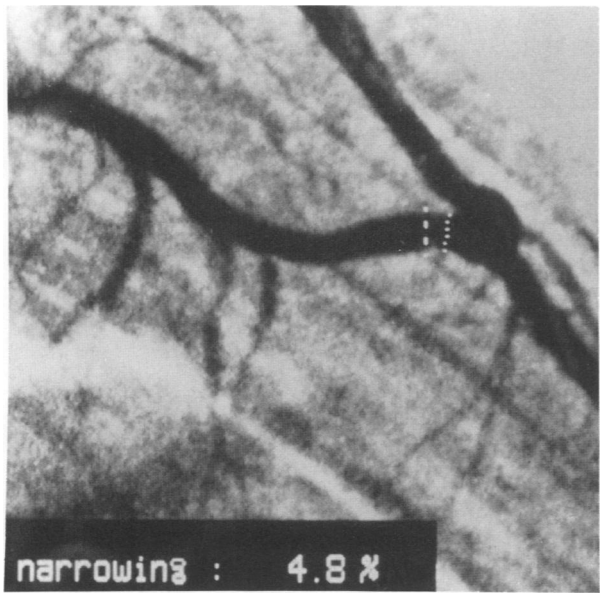

Fig. 2 *Postoperative digital angiogram. The 1st line (large dots) indicates the diameter of the coronary artery just proximal to the anastomosis, while the 2nd line (small dots) indicates the diameter at the level of the anastomosis. In this patient, the reduction in diameter at the level of the anastomosis was only 4.8%.*

In our judgment, the only real concerns are the avoidance of damage to the fine endothelial surface and the promotion of late patency through meticulous suturing. A minute lesion may start an evolving process of spasm, dissection, or late occlusion, despite any antiplatelet therapy.[5,6] Such a lesion can eradicate all the advantages of arterial over venous revascularization by causing such rare adverse effects of ITA use as bleeding, pleural opening, sternal ischemia, and infection.

Harvesting of the ITA is a virtually risk-free procedure if low-intensity electrocautery is adopted and a generous muscle pad is removed with the artery. The principal collateral vessels should be clipped and divided with scissors and not cautery, because they are good conductors of heat, which may spread down to the main vessel.

Construction of the anastomosis is another stage at which intimal damage may occur, through rough contact with surgical instruments. Handling of the vessel while completing the anastomosis is minimized by the no-touch technique advocated by Galvin.[3] Hoffman and Frater[7] also report on the usefulness of an inverted Y incision in the accurate tailoring of a vessel for anastomosis. Preservation of a long, incised portion of the arterial graft allows the surgeon to hold it away from the suture line; but if this portion is cut before the distal end is completed, grasping the skeletonized distal artery to expose the true lumen can be difficult. This problem is fully avoided if the redundant tissue is left in place and the suture at the toe bites the ITA wall from the inside, rather than penetrates and holds fast its free edge. When the distal ITA is pulled gently and no tension is exerted on the suture, the anastomosis is easily and safely completed, with full vision of the inner lumen.

The great number of bites at the distal end of the anastomosis (Fig. 1D) is justified in our judgment by the persistent risk of late stricture caused by careless suturing, especially in small vessels. An erratic suturing technique can be tolerated in large coronary vessels, but is a frequent cause of anastomotic stenosis[8,9,10] in thin-walled arteries of less than 1.5 mm in diameter. Proper optic magnification can aid close

suturing around the toe, which in turn keeps the coronary–thoracic artery anastomosis wide open. If too few stitches are passed at the toe, these can approximate the opposite walls of the coronary artery or induce a purse-string effect when they are tied. The postoperative digital angiogram (Fig. 2) clearly shows the absence of narrowing of the coronary lumen in the anastomotic segment. The use of papaverine both in the divided ITA and in the aortic root immediately after clamping prevents the partial vasoconstriction induced by cooling before cardioplegia is achieved.

Our 60 postoperative angiographic studies have shown only 1 case of anastomotic stricture (1.7%), with an average loss in vascular diameter of 10%, from the native vessel to the anastomotic segment.

Recently, we have extended this suturing technique to vein-graft anastomosis, especially when the vein is thick or there is a discrepancy in wall thickness between the vein and the coronary artery. Numerous and superficial bites—what we call a kissing suture—join the intimal layers of the 2 vessels, excluding the thickened wall from the anastomosis and preventing the possible curling of the vascular walls. Mid-term results are not yet available, but angiograms obtained before discharge again show an increase in anastomotic diameter and less distortion of the coronary vessel, when compared with the results of the usual transfixing suture. In all likelihood, the risk of late anastomotic failure is lower.

Conclusion

With only gentle handling and meticulous suturing, the ITA graft offers such superior long-term patency compared with venous conduits, and such greater ease in harvesting compared with other arterial conduits, that no ischemic patient should be considered an unsuitable candidate for single or bilateral ITA revascularization. Especially in smaller vessels, the suturing technique is more crucial than the choice of suturing materials, because faulty suturing can start a stenosing process at the anastomotic site. A microsurgical technique enables secure closure of a wider cross-sectional area of the anastomosis and may also improve late results with venous grafts whenever arterial conduits are unavailable. Suturing under magnification is improved if the coronary arteries are dilated before cooling.

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