14 Left-Sided Myocardial Revascularization with Bilateral Skeletonized Internal Thoracic Artery

R. Mohr, A. Kramer

14.1 Introduction

The current conventional and most commonly used operative procedure for myocardial revascularization includes one internal thoracic artery (ITA) together with one or more saphenous vein grafts (SVG) [1, 2]. The major surgical objective is to supply the left anterior descending coronary artery with an ITA in order to improve patient survival [3, 4].

ITA patency rate exceeds that of SVG and long-term patency remains high, in contrast to vein grafts which are subject to late closure as a result of progressive atherosclerosis [3]. Besides better survival, the superior patency rate is associated with better angina-free survival and decreased rates of reoperations and reinterventions [5].

Since SVG failure is a major drawback of coronary artery bypass grafting (CABG), surgical techniques of arterial myocardial revascularization with minimal use of SVG were attempted. Two popular techniques for achieving this goal are bilateral and sequential ITA grafting [6–8]. In most centers, the ITA is isolated from the chest wall as a pedicle, together with the vein, muscle, fat and accompanying endothoracic fascia [3, 4, 9]. Harvesting is relatively quick due to the fact that cautery is used to separate the pedicle from the chest wall. However, cautery damages the blood supply to the sternum, which in turn impedes sternal healing and exposes the sternum to the risks of early dehiscence and infection, particularly in operations in which both ITAs are used [10–13].

A surgical technique was recently developed wherein the ITA is dissected as a skeletonized vessel [14, 15]. The skeletonized artery is isolated gently with scissors and silver clips, without the use of cautery. Skeletonized ITA dissection leaves the vein, muscle and accompanying tissue in place (Fig. 14.1). The advantage is that the dissected artery is longer [16] and its spontaneous blood flow is greater than that of the pedicled ITA [17], allowing the use of both ITAs as grafts to all necessary coronary vessels [9]. In many cases, no additional vein grafts are required [9]. Another advantage of using ITA as a skeletonized artery is the preservation of collateral blood supply to the sternum, enabling more rapid healing and decreasing the risk of infection [18].

The use of left ITA as a bypass graft has been shown to result in better early patency rate and improved survival in all patients, including elderly patients [13, 19], but most published series have failed to show additional survival benefit with the use of bilateral ITA [1, 2].

The lack of survival benefits and the technical complexity of performing complete arterial revascularization with bilateral ITAs are the probable causes of the relative lack of popularity of this technique. The Society of Thoracic Surgeons (STS) database includes 153,000 CABG operations performed in the United States.
States and Canada, only 4% of which involved the use of bilateral ITAs [20].

In contrast to most previously published reports, three important large-scale studies have shown that long-term survival with bilateral ITA is better than that with single ITA. Lytle et al. reported that the 10- and 15-year survival rates of bilateral ITA patients were 84% and 67%, compared to 79% and 64%, respectively, for patients with single ITA (p<0.001). Reoperative and angina-free survival, as well as freedom from additional revascularization procedures, was significantly higher in the bilateral ITA subset [21]. In another study performed by Buxton et al. [22], the 10-year actuarial survival of bilateral ITA patients was 86 ± 3% compared to 71 ± 5% for a single ITA (p<0.001). In that report, the use of bilateral ITAs improved the rate of freedom from late myocardial infarction and reoperations. The third report by Schmidt et al. demonstrated that survival benefit with bilateral ITA operations is achieved by grafting the ITA conduits to coronary arteries supplying the left ventricle (left-sided revascularization) rather than to the right coronary system [8, 9, 21, 22]. Most were non-obese and non-diabetic patients and were preselected for this procedure according to their life expectancy. Most of them were young and only a few of them were older than 70 years.

The bilateral skeletonized ITA technique was adopted in the Tel Aviv Sourasky Medical Center in April 1996 as the preferred method for myocardial revascularization. Routine use of this ITA-harvesting technique enabled the surgeons to acquire the dexterity necessary for dissecting the skeletonized ITA and to minimize the time required for a learning curve. The routine use of SVG was stopped and since then vein grafts have been used as a third optional graft, in emergency CABG operations, or in cases with contraindications for the use of two ITAs.

From April 1996 to July 1999, 1,000 consecutive patients underwent bilateral skeletonized ITA grafting. They comprised 71% of the 1,408 patients who underwent CABG during this time period in the Tel Aviv Sourasky Medical Center. This was a non-selected group of patients: there were 770 males and 230 females; 420 patients were older than 70 years and 312 were diabetic. Myocardial preservation technique was intermittent warm cardioplegia.

The average number of grafts was 3.1 per patient [2–6]. The gastroepiploic artery was used in 231 patients and 158 saphenous vein grafts were implanted in 142 patients.

### 14.2 Harvesting and Preparation of the Skeletonized ITA [16]

In our harvesting technique, we follow instructions and recommendations given by Cunningham et al. [15]. The ITAs are dissected as skeletonized arteries [14] before heparin administration to decrease the risk of damage and hematoma formation in the region of the side branches during dissection. A standard median sternotomy incision is used with only rare application of bone wax. Later dissection of the ITA is easier if meticulous hemostasis is obtained on the sternal edges to avoid bleeding into the surgical field. We favor the use of the special ITA retractor for ITA take-down because of the good exposure of both left and right ITAs obtained with minimal trauma to ribs and chest wall.

We favor elective opening of pleura before ITA dissection in order to facilitate exposure. Though it is possible to completely skeletonize the ITA from its origin to its distal bifurcation without opening the pleura, dissection of proximal ITA with its anterior and pericardial branches is easier and safer when the pleura is open.

To avoid thermal injury to the ITA, it is extremely important to keep the cautery setting on low throughout the dissection. Cautery may be used to cut the endothoracic fascia and expose the underlying ITA. Using the tip of the cold cautery as a dissector, the artery can be gently separated from the chest wall leaving the accompanying veins, fascia and adipose tissue in place. Forceps rarely touch the artery itself but may grasp the small remnants of soft tissue that cling to the adventitia of the ITA. The initial cut in the endothoracic fascia is extended inferiorly until the terminal bifurcation of the ITA into its lateral musculophrenic and medial superior epigastric branches is visualized. Terminal bifurcation usually occurs at the sixth intercostal space. These terminal branches are left intact to allow blood flow through the ITA until it is ready for use. Branches are divided between clips using scissors. Care is taken not to place the clip flush with the ITA. Once branches are controlled, scissors or low cautery are used to divide the remaining medial and lateral soft tissue attachments. After the distal portion of the artery is freed, an additional cautery cut in the endothoracic fascia is made to allow dissection superiority.

The proximal third of the ITA occasionally has large anterior perforating branches that may initially seem too short to allow satisfactory clip application. With careful dissection proximally and distally to the branch, suitable length can usually be obtained. One must not apply excessive traction on the ITA as these branches can tear easily, causing serious bleeding. If insufficient branch length precludes safe application of two clips, it is best to apply a clip to the ITA side of the branch. The branch is then separated and the cautery is used to ob-