Skeletonized internal thoracic artery grafts and wound complications

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There is increasing evidence that patients who receive bilateral internal thoracic artery (BITA) grafts have better long-term outcomes than those receiving single ITA grafts.^{1,2} However, surgeons have resisted the idea of routine BITA grafting for multiple reasons. BITA grafting increases the difficulty and usually the duration of the operation. These objections are not fundamental and have become less important with effective myocardial protection and increased experience with microsurgical and arterial grafting techniques. The most real, persistent, and serious objection to BITA grafting has been an increased risk of sternal wound complications.^{3,4}

Multiple retrospective clinical studies of patients undergoing bypass surgery have documented an increased risk of sternal wound complications associated with BITA grafting, and some series have specifically identified diabetes as a factor associated with a greatly increased risk,^{3,4} an observation that has often led surgeons to avoid BITA grafting in diabetic patients. The disadvantage of this policy is that it withholds from diabetic patients a strategy that may be of particular benefit to patients with severe and diffuse coronary artery disease. The increased risk of wound complications appears to be caused by sternal ischemia. Anatomic studies predict a decrease in sternal blood flow resulting from BITA dissection and, in fact, perioperative flow studies have confirmed that sternal blood flow is decreased perioperatively by ITA dissection, more after BITA grafting than after single ITA grafting.⁵⁻⁹ Traditionally, at most institutions the ITA has been dissected as a pedicle that includes the artery along with accompanying veins, some of the parietal pleura, and, distally, some intercostal muscle. Electrocautery has often been used for dividing branches. However, skeletonizing techniques have also been used during which the ITA is dissected as an isolated artery rather than as a pedicle, and electrocautery is usually avoided. Some evidence exists that skeletonization may decrease sternal ischemia. A contemporary anatomic study has shown that some of the 4 to 6 sternal branches of the ITA and some intercostal branches may arise from the ITA as a common trunk. If that common trunk can be preserved during ITA dissection, then sternal collateralization may be improved.¹⁰ A recent clinical study using technetium 99m methylene diphosphate bone scanning and single photon emission computed tomography appears to show that dissecting the left ITA as a pedicle graft reduced blood flow to the sternum more than dissecting the left ITA in a skeletonized fashion.⁹ With the dual purposes of preserving sternal blood supply and achieving increased ITA length, a number of groups have adopted skeletonization techniques for ITA preparation.¹¹⁻¹⁵

In this issue of the *Journal*, Matsa and associates¹³ report on a series of 765 patients (including 231 diabetic patients) undergoing bypass surgery during a 2-year period who received BITA grafts with skeletonized ITAs. The overall incidence of sternal complications was approximately 2%, and diabetic patients were not at increased risk. These authors have concluded from this experience that skeletonizing the ITAs does improve sternal blood supply and removes diabetes as a risk factor for sternal complications. They may be right. However, these data do not yet remove the issue of wound complications from deliberations concerning the advisability of BITA grafting in diabetic patients. First, patient selection continued to be involved in the application of this technique as this was not a consecutive series of

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patients undergoing bypass grafting. We cannot glean from the manuscript what proportion of the total patient population received BITA grafts and what their criteria were for exclusion, but patient selection was involved. Second, only 14 (6%) of their 231 diabetic patients were receiving insulin, only 1 patient received a perioperative intra-aortic balloon, and only 7 (3%) diabetic patients were undergoing a reoperation. Thus, the composition of this diabetic group seems to be different from that of diabetic patients presenting for bypass surgery in some other centers. In the small subgroup (20 patients) that many surgeons consider to be at particularly high risk, obese diabetic women, there was an increased risk of wound infection at the relatively high level of 15%. Thus, although skeletonizing the ITAs may improve the rate of wound complications, the overall incidence of 2% for major wound complications was not negligible and the high-risk group was still at high risk.

Is there a down side to skeletonizing ITA grafts? This technique takes longer than dissecting the ITA with a pedicle, and there is a learning curve. The authors of this study note that some proximal ITA grafts were damaged, although they did not specify how many. Are patency rates equivalent with skeletonized and nonskeletonized grafts? Calafiore and associates¹⁴ have shed some light on this issue by reporting favorable early graft patency data for patients who received skeletonized composite ITA grafts, although the number of ITAs that were damaged during dissection in their series was not recorded. We do not have any late graft patency data concerning skeletonized ITA grafts.

Are there other avenues for decreasing the risk of sternal wound complications associated with BITA grafting other than skeletonizing ITA grafts? Clearly there are. Patient selection is the most obvious, and even the enthusiastic authors of this report exclude obese diabetic women from BITA grafting. Strong observational data suggest that tight perioperative glucose control may decrease the risk of sternal complications for diabetic patients, although BITA grafting has not been specifically studied.¹⁶ Two studies have documented the effectiveness of perioperative intranasal mupirocin in decreasing sternal complications, although, again, BITA grafting was not specifically addressed.^{17,18} Many surgeons believe in the importance of a tight sternal closure and the avoidance of bone wax. Meticulous wound opening and closing technique is also likely to contribute to favorable outcomes. A sure way to avoid sternal complications is to avoid a median sternotomy, and differently invasive operations may be useful in a subset of diabetic patients. Port-Access multivessel bypass operations can avoid a median sternotomy. However, to achieve bilateral ITA grafting through alternative incisions is likely to require a thoracoscopic right ITA preparation, and the diffuse distal disease present in many diabetic patients makes ideal exposure a desirable goal.

On balance, the skeletonized ITA technique is not a panacea for avoiding wound problems. However, the bulk of the evidence, both clinical and experimental, seems to indicate that it can contribute to decreasing them. Certainly, the increased ITA length available with skeletonized grafts, together with the concept of composite ITA grafting, greatly expands the extent of ITA revascularization that can be achieved.^{11,19} There is a learning curve to skeletonizing ITA grafts, and the technique is sometimes very difficult, particularly in patients undergoing reoperation who may have extensive endothoracic scarring or edema. However, surgeons who are serious about extensive ITA grafting will need to become comfortable with this strategy because it appears to allow expansion of the patient population that can be safely revascularized with BITA grafts while at the same time keeping the incidence of wound problems manageable.

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