

Does Bilateral Pedicle Internal Thoracic Artery Harvest Increase the Risk of Mediastinitis?

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Purpose: Bilateral *in situ* internal thoracic artery (ITA) bypassing may result in excellent myocardial revascularization without increasing the risk of deep sternal wound infection. Although there have been concerns with the use of pedicled bilateral ITA, the risk of infection may not be greater than the use of skeletonized ITA. **Materials and Methods:** The present study was retrospectively undertaken to determine if pedicled BITA grafts are associated with a higher risk of sternal wound complications. A total of 207 patients who underwent bilateral ITA bypasses with or without existing diabetes mellitus, and 162 patients of those received bilateral pedicled ITA and 98 patients received unilateral ITA bypass grafts. **Results:** No sternal wound complications were noted in either the bilateral ITA or unilateral left ITA groups. **Conclusion:** Bilateral pedicled ITA harvesting was not associated with a greater incidence of infectious sternal complications compared to patients receiving unilateral ITA bypass grafts.

Key Words: Internal thoracic arteries, coronary artery bypass, surgical wound infection, sternum

INTRODUCTION

Superior survival benefit, greater freedom from re-intervention, and less repeat operations have been reported with bilateral internal thoracic artery (BITA) grafting.^{1,2} Pedicled, as opposed to skeletonized

right internal thoracic artery (RITA) grafting, may not be enough to reach the left or right coronary arteries without tension. Furthermore, bilateral pedicled harvesting of the internal thoracic arteries (ITAs) may carry a higher risk of sternal wound infection.³⁻⁶ It is noteworthy that a strikingly higher incidence of deep sternal infections is reported in patients with double-pedicled arterial grafts.^{3,6} In light of these reported disadvantages of bilateral pedicled grafts, ITA skeletonization has been advocated to minimize sternal devascularization and wound healing problems while maximizing the harvested length of the ITA.^{3,6} In the current study, coronary artery bypass grafting (CABG) was performed primarily with bilateral internal mammary and gastroepiploic arteries. Our initial experience showed a higher delayed incidence of diffuse skeletonized RITA graft stenosis, which prompted us to use it as a pedicled graft. RITA was also mainly used as an *in situ* graft rather than a composite graft whenever possible. Deep sternal wound infections were not found to be a problem in those pedicled bilateral ITAs. Although this might have partly been due to relatively small patient population, the ITAs may safely be used as pedicled grafts with careful attention to infection prophylaxis. Some of the advantages of pedicled grafting include ease of handling, decreased harvesting time, and a lower tendency for graft dissection. Furthermore, bilateral pedicled grafting may not necessarily compromise sternal perfusion. By minimizing injury to the branch vessels supplying the sternum and the surrounding muscles, we believe that pedicled BITA grafts

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can safely be used. Because of superior survival benefits of BITA and potential benefits of pedicled BITA, its use should be encouraged more if it is not a cause of delayed sternal healing or deep wound infections.

MATERIALS AND METHODS

Patients

The present study included 207 patients undergoing CABG using *in situ* bilateral ITA between 1 April 2003 and 30 April 2008 (67% of all 305 CABG procedures performed). Pedicled BITA were used in 162 patients [78% of BITA harvested (162/207); males, 124; females, 38]. The single left internal thoracic artery (LITA) was used in 98 patients [32% of all CABG (98/305); males 53; females, 45], of which skeletonization was performed in only 26 patients [8% (26/305)]. Patients with concomitant heart procedures (valvular, aortic, and aneurysmectomy) and use of a skeletonized vessel in the BITA (45/207) were excluded from this study. ITA graft patency was assessed in 144 patients by either coronary angiography or CT angiography 1 year postoperatively.

The mean age was 66 years in the BITA pedicle group and 61 years in the LITA group. There were 177 males and 83 females. One hundred eighty-six patients had diabetes mellitus [DM; 186/260 (71%)] and the BITA pedicle was used in 121 of the patients [121/186 (65%)]. DM was not a consideration in the decision to use pedicled BITA.

Surgical procedure

BITA grafts were preferentially used as *in situ* grafts for left-side myocardial revascularization. All ITA harvesting procedures were performed by 1 surgeon, using the same surgical technique. When ITA was harvested as a pedicled conduit, a generous pedicle containing the ITA, accompanying veins, fat, and lymphatics were mobilized with a Harmonic Scalpel (Ethicon Endo-Surgery, CVG, Cincinnati, OH, USA). The pedicle was usually resected at the epigastric bifurcation junction with the ITA. A longitudinal incision in the endothoracic fascia was performed on the medial side of

the accompanying vein with very low voltage unipolar electrocautery to avoid thermal damage to the muscle and outer fascia. The tip of the curved Harmonic scalpel blade was used to dissect and coagulate the ITA branches while the tip was used to transect. Dissection was carried out until the full length of the IMA was mobilized, leaving the fascia and lateral soft tissue attachments preserved.^{7,8}

Surgery was performed under either off-pump coronary artery bypass (OPCAB; 55 cases) or conventional cardiopulmonary bypass (normothermic; 205 cases). On-pump beating heart surgery was performed in 21 cases while conventional CABG was performed with antegrade and retrograde cold blood cardioplegia. Eight stainless steel wires were used for sternal closure. Three wires were passed through the manubrium while the remaining wires were passed through the intercostal space in the lower sternum. Measures to prevent surgical infection included avoidance of excessive bone wax usage and implementation of strict aseptic techniques. Postoperative prophylactic antibiotics were used in most of the cases (about 83%) for an average of 4.1 days with a 3rd generation cephalosporin. Whenever a question of intraoperative contamination was raised, gloves were replaced immediately and vancomycin was applied topically to the mediastinal surface prior to sternal closure.

RESULTS

Stroke occurred in 2 patients; due to a massive gas cerebral embolic event related to air introduction by the blower during on-pump beating heart bypass in one patient and atheromatous embolism after conventional cardiopulmonary bypass in another patient. Both patients died from pneumonia. There were 43 cases of re-exploration for bleeding. This high reoperative rate was thought to be related to high-dose preoperative loading of clopidogrel. In our hospital, all emergent CABG patients are loaded with high doses of clopidogrel in the emergency room before consultation with the cardiac surgeon. Postoperative low-cardiac output syndrome was also diagnosed in 41 patients.

The ITA graft patency was assessed 1 year post-

Table 1. Patients Characteristics and Operation Results

	Pedicled BITA	LITA only
Counts	162 (man; 124 women; 38)	98 (man; 53 women; 45)
Age (yrs)	66	61
On-pump/off-pump	133/29	72/26
DM/IDDM	121/73	65/41
Emergent operation	27	43
Postoperative stroke	1	1
Bleeding reoperation	26	17
Postop LV dysfunction	19	22
IMA reintervention	1	3
Hospital mortality	2	4
Deep wound problem	0	1 (not infection)

DM, diabetes mellitus; IDDM, insulin dependant diabetes mellitus; BITA, bilateral internal thoracic artery; LITA, left internal thoracic artery.

Patients using skeletonized bilateral internal mammary arteries were excluded in this table.

operatively in 144 patients using either coronary angiography or CT angiography and the ITA grafts were patent in 138 cases. Four patients required surgical re-intervention due to ITA graft stenosis in 1 RITA and 3 LITAs.

Of the 162 pedicled BITA patients and 98 LITA only patients inclusive of 186 DM patients, there was no deep sternal wound infection (0/260). There was 1 case of sternal non union but this patient did not receive BITA grafting. There were 6 early mortalities [6/260 (2.3%)]. Because there was no deep sternal wound infection, no statistical analyses were performed with regards to the incidence of infection (Table 1).

DISCUSSION

The patency of *in situ* LITA is reported to be superior to free ITA grafts. *In situ* LITA bypass is currently considered as the gold standard for arterial conduits. BITA grafting has been associated with better long-term survival and decreased major cardiac events.¹ Studies using RITA and LITA to bypass preferentially important vessels of the left coronary system showed excellent results,^{1,9-13} superior graft patency, and greater long-term free-

dom of cardiac events and reoperations.^{1,9,13} Implantation of bilateral *in situ* ITAs has an added advantage of maintaining 2 separate ITA blood supplies to the myocardium, while avoiding additional anastomoses to fashion a composite graft. The left anterior descending artery was routinely revascularized with the *in situ* RITA; long-term results show that important left coronary vessels are revascularized with both *in situ* ITAs.^{1,9-12,14,15} Additional length of the RITA to the LAD could be gained with closure of the sternum. The use of the RITA to the LAD may be a better use of this graft rather than to the right coronary artery (RCA), since the latter has been associated with inferior results.^{12,13,16}

Recent reports have shown superior survival benefit and freedom from recurrent angina with RITA usage,^{17,18} while other reports have raised concerns on the potential for increased risk of wound infection and dehiscence with extensive sternal devascularization.^{19,20} Several studies identified BITA grafting, especially in DM patients, as a risk factor for mediastinitis after CABG. They suggested avoiding BITA grafting in diabetic patients.²¹ Unlike pedicled ITA harvesting, skeletonization reduces the extent of chest wall devascularization and sternal wound related infectious

complications, leaving veins, muscles and surrounding endothoracic tissue in place, and thereby decreasing the potential risk of postoperative wound complications. Indeed, occurrence of sternal wound infection appears consistently low after routine use of bilateral skeletonized ITAs.^{3,22} The sternal and anterior intercostal branches of the ITA originate either directly or as a common trunk from the ITA. The skeletonization of ITAs may preserve sternal and intercostal branches arising as a common trunk from the ITA, thus maintaining some collateral flow to the sternum.²³ Substantial collateral blood flow to the sternum can be maintained in the absence of the ITA, provided that the sternal-anterior intercostal trunk is left intact. Skeletonization of the ITA often results in preservation of this common trunk, particularly if meticulous dissection is performed.⁶ However, we believe that the damage to the branch vessels in pedicled dissection is not different from that occurring with the skeletonization technique. Furthermore, the sternal-anterior intercostal trunk may be preserved in pedicled dissection in the current series, the branches were transected 1 or 2 mm from the ITA as with the skeletonization technique. Ura et al.²⁴ reported excellent results with BITA pedicled grafting, showing a very low incidence of mediastinitis (1.3%), especially in diabetic patients (2.1%). Therefore, we believe that the pedicled dissection may not be particularly more deleterious than the skeletonization technique, provided that careful attention is given to preventing infection.

The small patient cohort was a limitation in the present study. Patients who underwent pedicled BITA dissection had no more risk for wound complications than left ITA only patients. This may act to strengthen the positive influence of BITA with regards to these complications. Although BITA was not found to be a risk factor for wound complications in this study, a multivariable model, including data from the entire series, demonstrated that harvesting method (skeletonization versus pedicle ITA) as well as DM may be independent predictors of wound complications in a larger series of many other studies. Although the current results seemed to suggest that the bilateral pedicled ITA graft usage does not result in a greater risk of complications than the skeletonized grafts

or unilateral ITA graft use, further studies on a larger patient cohort should be conducted for a more definitive identification of the risks associated with bilateral pedicled grafts.

In conclusion, with careful attention paid to infection prevention such as avoiding excessive bone wax and implementing strict aseptic technique, the use of bilateral ITA pedicles may be safe and may not necessarily increase the risk of sternal wound related complications, or lead to compromise in graft performance.

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