

# Minimally Invasive Axillary-Coronary Artery Bypass

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## ABSTRACT

**Background:** Some patients with proximal obstructive lesions of the left anterior descending coronary artery who are suitable for minimally invasive coronary bypass surgery do not have an available left internal mammary artery because it has already been used for a graft, is diseased or has been damaged. The ascending aorta is not accessible for proximal graft anastomosis from a small anterolateral thoracotomy used to expose the coronary artery. The aim of this report is to show that the axillary artery is suitable for the proximal anastomosis in minimally invasive coronary bypass operations.

**Methods:** Ten patients had minimally invasive axillary-coronary artery bypass to the anterior descending coronary artery. Cardiopulmonary bypass was not used. The saphenous vein was used in nine and the radial artery in one.

**Results:** Satisfactory grafts were achieved in all patients without mortality or major complications.

**Conclusion:** Grafts from the axillary artery can be used successfully for minimally invasive bypass to the anterior descending coronary artery.

## INTRODUCTION

The term "minimally invasive" applied to coronary bypass surgery generally means that sternotomy and cardiopulmonary bypass are avoided. Bypass to the anterior descending coronary artery is now widely practiced using the left internal mammary artery for a graft and a small

left anterolateral thoracotomy to expose the heart. Some patients needing bypass only to the anterior descending coronary artery and otherwise suitable for a minimally invasive operation do not have available the left internal mammary artery because it has been used, is diseased or has been damaged. A small anterolateral thoracotomy over the heart does not provide suitable access to the ascending aorta for the proximal anastomosis of some other conduit. In ten patients, we have used the left axillary artery for the proximal anastomosis.

## MATERIALS AND METHODS

### Patients

Ten patients had coronary bypass grafts from the axillary artery to the anterior descending coronary artery. Seven were male and three female. Five were over 80 years of age. Seven had had coronary bypass operations; two of them three times. Five patients had failed left internal mammary grafts to the anterior descending coronary artery, one patient had a functioning left internal mammary graft to a circumflex branch, and in one patient the internal mammary artery was damaged during its thoracoscopic dissection in preparation for a minimally invasive bypass operation. For three patients of advanced age (84, 87 and 88 years), saphenous vein grafts were elected as the most expeditious and least traumatic way of achieving the goal. Nine patients had saphenous vein grafts and one who had had three coronary bypass operations and no remaining saphenous vein had a radial arterial graft.

### Technique

The left axillary artery is exposed by an infraclavicular incision, working either superiorly (no tributaries need to be divided) or inferiorly (some tributaries require division) to the axillary vein. The graft is sutured end-to-side to an incision in the axillary artery, which begins on the superior surface and runs medially and inferiorly. An opening is

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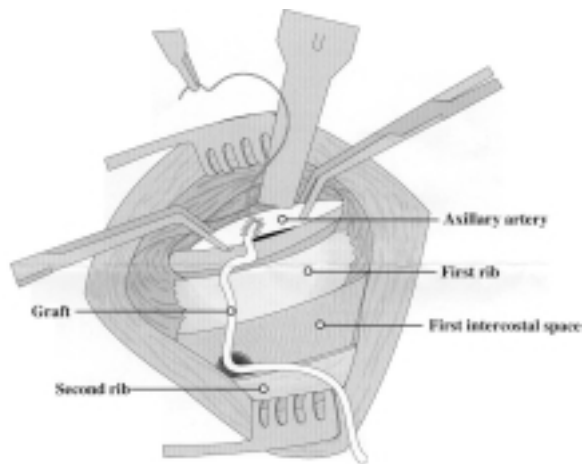


Figure 1. Anastomosis of the graft to the axillary artery and creation of opening through the first intercostal space.

made in the first intercostal space (Figure 1, ⊙). The graft is passed posterior to the axillary vein and through the opening in the first intercostal space.

An inframammary incision is made and the pleural cavity entered through the fourth or fifth intercostal space over the anterior descending coronary artery. A long curved clamp is inserted through this incision and the tip passed through the first intercostal space incision and used to pass a latex tube. The end of the graft, marked by a line of methylene blue spots, is tied to this tube and pulled through to the heart, thus avoiding twisting. The course of the graft is visualized by thoracoscopy and enough length assured so that it will not be stretched by the expanding lung. The pericardium is opened parallel to the anterior descending coronary artery. The anastomotic site is stabilized by a “foot” stabilizer. The artery and adjacent myocardium are encircled by a 3-0 Gore-Tex (W. L. Gore and Associates, Flagstaff, AZ 86001) suture snare proximal and distal to the

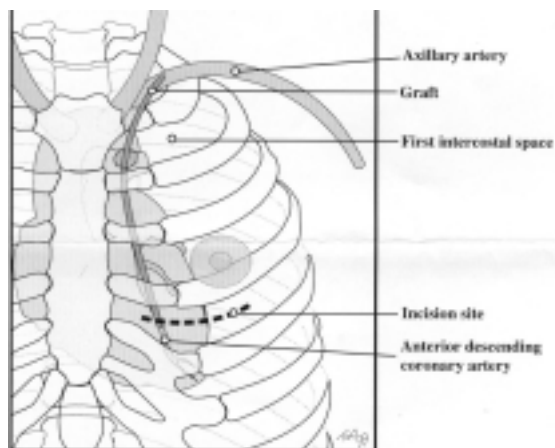


Figure 2. Axillary-coronary artery bypass graft.

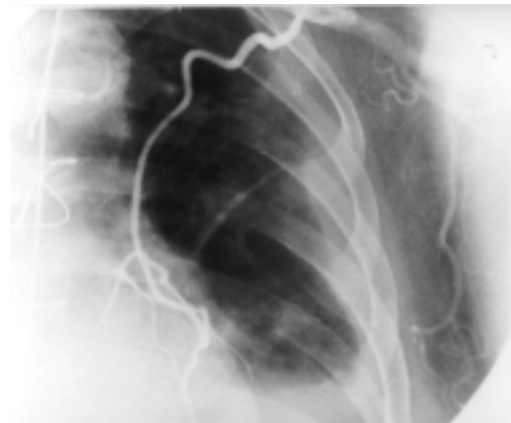


Figure 3. Arteriogram of radial artery axillary-coronary artery bypass graft.

site for arteriotomy and the snares tightened just enough to stop blood flow. The graft is connected to the coronary arteriotomy with running or interrupted monofilament sutures end-to-side (or side-to-side and the end ligated) (Figure 2, ⊙). Cardiopulmonary bypass is not used.

The patency of the graft is assessed by a doppler at operation, prior to hospital discharge, and four to six months later.

## RESULTS

There was no mortality or serious complications. All grafts were shown patent by doppler studies done at the completion of the graft and just prior to hospital discharge. Eight patients related complete relief of their angina and two had significant improvement.

## DISCUSSION

Cooley [Cooley 1997] described axillary-coronary artery bypass grafting using saphenous vein. Knight et al. [Knight 1997] and Bhimji et al. [Bhimji 1998] each reported one case of axillary to anterior descending coronary artery bypass using saphenous vein anastomosed first to the coronary artery and passed through the thoracotomy in the bed of the resected fourth costal cartilage and external to the ribs to the axillary artery. Coulson et al. [Coulson 1997] reported a case where a saphenous vein was connected to the anterior descending coronary artery and brought through an opening in the chest wall made by excising a segment of the second rib and on to the axillary artery. Tovar et al. [Tovar 1998] used a saphenous vein graft anastomosed first to the axillary artery and passed into the thorax through an opening made by resecting a part of the first rib. In all of our operations we did the axillary anastomosis first, then passed the graft through a generous opening in the first intercostal space, removed the axillary clamp so that

the graft would elongate under pressure and, aided by thoracoscopic visualization, adjusted its length so that expansion of the lung would not create undue tension.

Wolf et al. [Wolf 1999] described minimally invasive coronary bypass surgery using saphenous vein grafts in eleven patients. Proximal anastomoses were from right or left common carotid arteries in six patients, left subclavian artery in one patient, left internal mammary artery in one patient, right axillary artery in one patient, and left axillary artery in two patients who are included in this series.

We used a radial artery graft in one patient who, in three coronary bypass operations, had used all of his greater saphenous veins and his left internal mammary artery that had failed. The graft was 22 cm in length of which 20 cm was required. An arteriogram (Figure 3, ☉) two months later showed a satisfactory result.

Two of our patients, aged 87 and 88 years and bedridden with angina, had severe three vessel obstructive coronary disease, the latter with main right coronary occlusion and critical main left coronary stenosis, with extensive collateralization. Both were substantially improved by a single graft to the anterior descending coronary artery with minimal operative morbidity. This approach, though inconsistent with a policy of "complete revascularization", led to a satisfactory result.

## REFERENCES

1. Bhimji S, Yeh D, Wiest M, Zumbro L. Extra-anatomic minimally invasive axillary coronary artery bypass. *Surg Rounds* 581-6, December, 1998.
2. Cooley DA. Critique: Limitations and pitfalls. Slides 11 and 12. 1997 Adult Cardiac Surgery Symposium, American Association for Thoracic Surgery, Annual Meeting, Washington, DC, May 4, 1997.
3. Coulson AS, Bakhshay SA. Subclavian artery origin for a coronary bypass graft. *Contemp Surg* 50:65-6, 1997.
4. Knight WL, Barisden CE, Reiter CG. Minimally invasive axillary coronary artery bypass. *Ann Thorac Surg* 63:1776-7, 1997.
5. Tovar EA, Blau N, Borsari A. Axillary coronary artery bypass grafting. *J Thorac Cardiovasc Surg* 115:242-3, 1998.
6. Wolf RK, Miyaji K, Flege JB. Saphenous vein graft for minimally invasive coronary bypass surgery. *J Thorac Cardiovasc Surg* 117:822, 1999.

## REVIEW AND COMMENTARY

### 1. Editorial Board Member AR11 writes:

This manuscript should be of immense interest to read-

ers, especially those heavily involved in minimally invasive revascularization.

While your complications using the axillary artery appear to be few, this has not been the reported experience of those surgeons using this vessel for aortic surgery (as a cannulation site). Perhaps a discussion of the risks in using/exposing this vessel might be in order, or contrast why you seem not to have the problems reported by others (seromas, brachial nerve injuries, arterial dissections, hematomas, etc).

### Authors' Response by John B. Flege, Jr., MD:

We had no significant complications related to the axillary dissections. We made a skin incision large enough not to compromise exposure. We were very careful about hemostasis. We did not use unipolar electrocautery, either for cutting or coagulation, deep in the wound. We relied mainly on bipolar electrocautery for hemostasis, except for larger vessels, especially veins, which we ligated. We attribute the paucity of complications to strict adherence to standard surgical principles such as adequate exposure, good lighting, sharp dissection, meticulous hemostasis, and avoidance of unipolar electrocauterization in proximity to nerves.

### 2. Editorial Board Member EE455 writes:

A Doppler study generally does not provide strong evidence of graft failure; it is only a gross appreciation of intrathoracic graft patency. It is subject to difficulties in a sample collection as well as in interpretation. The authors provide a control angio, which shows a beautiful lie of the graft. My questions are: Is it always that nice? Are there any surgical tricks to avoid graft kinking at the intra thoracic entry point? Do the authors have experience with more than one control angio?

### Authors' Response by John B. Flege, Jr., MD:

We had no postoperative arteriograms other than the one illustrated. We made a generous graft entry portal through the first intercostal or interchondral space to allow the graft to pass obliquely through the chest wall toward the mediastinum to reduce the risk of kinking. The graft was marked with a linear row of methylene blue dots and drawn through the chest wall to the heart with a long curved clamp, careful to avoid twisting. The proximal anastomosis was done first and the clamps removed so that the graft was pressurized. Its position was inspected by thoracoscopy and its length adjusted so that it would lie along the mediastinum until it reached the pericardium and not be displaced by the expanding lung. Visualization of the blue dots assured that the graft was not twisted. Thoracoscopy is a valuable aid for this procedure.