

Xiphoid MIDCAB: Report of the Technique and Experience with a Less Invasive MIDCAB Procedure

(#1999-2438 ... March 8, 1999)

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ABSTRACT

Background: Coronary bypass surgery on the beating heart has been in existence since the inception of coronary revascularization. The advent and evolution of the heart-lung machine and cardioplegia have greatly advanced and expanded the realm of bypass surgery, allowing surgeons to perform precise coronary anastomoses in a still field of the arrested heart. The minimally invasive direct coronary artery bypass (MIDCAB) has been used primarily for grafting the left internal mammary artery (LIMA) to left anterior descending artery (LAD) and is gaining acceptance as a less invasive option. Dr. Frederico Benetti in Argentina championed the resurgence of beating heart surgery in 1985, and pioneered the left anterior thoracotomy MIDCAB procedure, which he has further refined to a xiphoid approach. The xiphoid incision is a simpler, less painful approach than that through a left anterior thoracotomy.

Methods: An incision is made through the xiphoid and, if necessary, into the tip of the sternum allowing the left side of the chest to be elevated. The distal LIMA is identified and dissected proximally to about the third interspace to give enough distance for a tensionless anastomosis. The pericardium is opened and the heart positioned to expose the LAD. Local stabilization for the LAD is obtained and the LIMA-to-LAD anastomosis is performed.

Results: The xiphoid MIDCAB approach was used for LIMA-to-LAD anastomosis in ten patients ranging in age from 52 to 86 years (mean age 73 years). Three patients underwent angioplasty of additionally obstructed vessels (so-called hybrid procedures) following initial MIDCAB. Despite high preoperative-risk profiles and Parsonnet

scores, there were no deaths. However, two of the three hybrid patients had major complications resulting in a prolonged hospital stay.

Conclusions: Initial clinical experience with xiphoid MIDCAB proves it is a feasible alternative to intercostal MIDCAB with the possible advantages of reduced pain and chest wall complications. Further investigation into this surgical approach is warranted.

INTRODUCTION

Coronary bypass surgery on the beating heart has been in existence since the inception of coronary revascularization. The advent and evolution of the heart-lung machine and cardioplegia have greatly advanced and expanded the realm of bypass surgery, allowing surgeons to perform precise coronary anastomoses in a still field of the arrested heart. Dr. Frederico Benetti in Argentina championed the resurgence of beating heart surgery in 1985 [Benetti 1991] and pioneered the left anterior thoracotomy minimally invasive direct coronary artery bypass (MIDCAB) procedure [Benetti 1995]. The MIDCAB procedure has been used primarily for grafting the left internal mammary artery (LIMA) to the left anterior descending artery (LAD), and is gaining acceptance as a less invasive option. Dr. Antonio Calafiore has further validated this approach with the results of his limited access small thoracotomy (LAST) operation [Calafiore 1996].

In the left anterior thoracotomy incision, the chest is entered through the fourth or fifth intercostal space, and the LIMA is harvested proximally to the subclavian vein. The pericardium is then opened and the LAD identified and grafted. This approach has been successfully performed with the aid of mechanical stabilizers. However, patients have experienced more early postoperative pain than originally expected. Alternatives to the "standard" MIDCAB such as the "H-graft" [Cohn 1998] and "T-MIDCAB" have been successful in patients with high preoperative risk factors [Coulson 1998]. Dr. Benetti has

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Presented at the second annual NewEra Cardiac Care conference, Scottsdale, AZ, January 8-10, 1999.

recently proposed a further refinement of the original MIDCAB in which a xiphoid approach is taken to the distal LIMA and LAD. The xiphoid MIDCAB appears to be a simpler, less painful approach than that through a left anterior thoracotomy. We began using the xiphoid approach for MIDCAB at the Washington Hospital Center in January 1998 and describe our technique and results in this report.

METHODS

Surgical Technique

A vertical midline 6- to 8-cm skin incision is made over the xiphoid (see Figure 1). The xiphoid process is then divided and the incision is extended into the lower sternum if necessary. The Rultract® mammary artery retractor is used to elevate the left side of the costal margin and identify the distal LIMA (see Figure 2). All efforts are made to leave the pleura intact during the dissection. The LIMA is harvested at a level proximal to the third to fourth interspace. Heparin (10,000 units) is given; the mammary artery is divided distally and prepared for grafting.

The pericardium is then opened and the edges retracted with sutures. This allows the heart to be elevated and rotated medially, using a saline-filled latex glove placed deep to the left ventricle (see Figure 3). The LAD is then stabilized with a mechanical stabilizer and an arteriotomy performed (see Figure 4). The appropriately sized intracoronary shunt is used to allow distal perfusion during the anastomosis, or proximal occlusion may be obtained by use of a pledgeted silastic tape surrounding the LAD. Distal occlusion is never used. A bloodless field is obtained with the use of a CO₂ blower. The LIMA-to-LAD anastomosis is performed with running 7-0 Prolene® and the pedicle tacked to the epicardium. The ventricle is then allowed to fall back into the pericardial well, and a trough is cut in the pericardium to prevent kinking of the LIMA pedicle. A small soft drain is then placed in the pericardial well extending into the pleura (if it is open). The patients are usually extubated in the operating room and remain in the intensive care unit overnight. In hybrid cases the percutaneous intervention is usually performed on the first postoperative day.

RESULTS

Ten patients, 3 men and 7 women, underwent LIMA-to-LAD grafting by the xiphoid MIDCAB approach (see Table 1). Their ages ranged from 52 years to 86 years with a mean age of 73 years. All surgeries were first-operations, and most patients had multiple co-morbidities with Parsonnet scores ranging from 3 to 41.5 [Parsonnet 1989]. Three patients were hybrids with percutaneous intervention on the first postoperative day (see Table 2). Postoperative length of stay ranged from 3 days to 29 days, with the older and hybrid patients requiring longer stays. There were no deaths, but two of the hybrid patients had

Table 1. Results

#	Sex	Age (Years)	Parsonnet Score
1	M	67	3
2	F	82	33
3	F	81	32.5
4	M	59	8.5
5	F	84	31.5
6	F	62	9.5
7	F	52	21
8	M	78	21.5
9	F	78	25
10	F	86	41.5

major complications resulting in a prolonged hospital stay. The first had pericardial tamponade and low cardiac output after receiving heparin on the first postoperative day for the placement of an intracoronary stent. This complication required re-exploration and drainage. The second patient also had bleeding and low cardiac output after percutaneous intervention, requiring placement of an intra-aortic balloon pump.

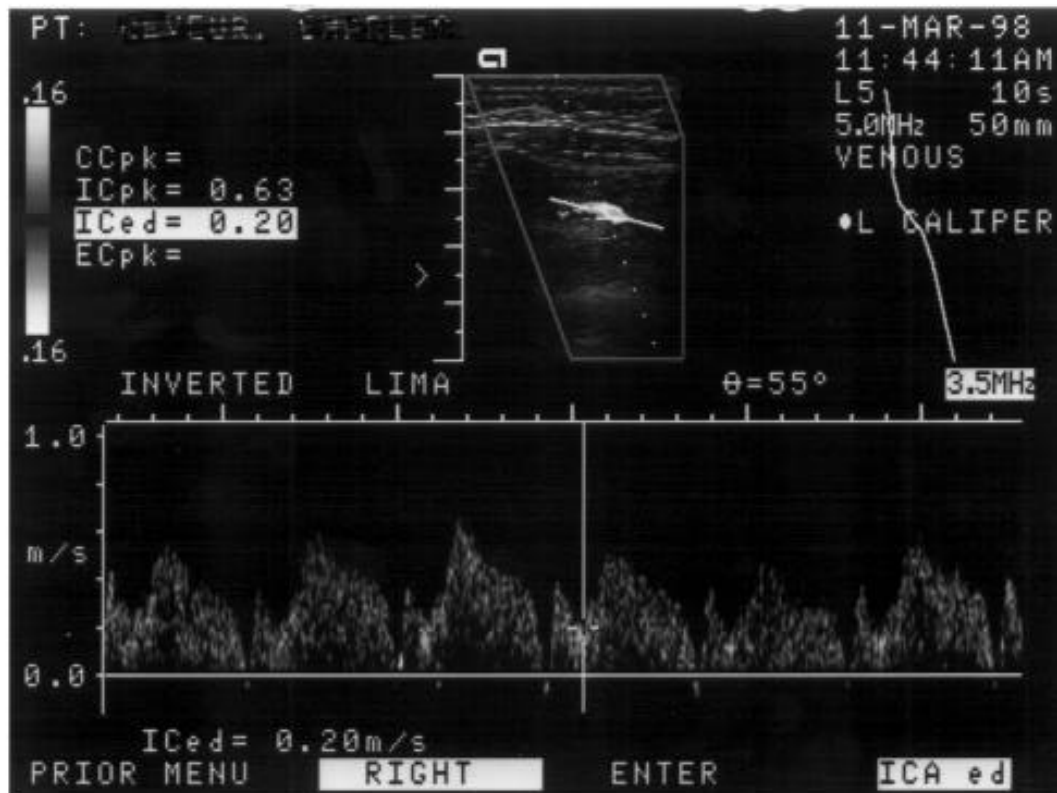
Postoperative angiograms in the hybrid patients showed that the LIMA-to-LAD anastomoses were patent. Transthoracic Doppler evaluation was done in three non-hybrid patients showing good diastolic augmentation, suggesting anastomotic patency (see Figures 2a, 2b). After our initial experience with the patient who suffered delayed tamponade, a soft drain was left in the pericardial well until the day after percutaneous revascularization in all subsequent hybrid patients.

DISCUSSION

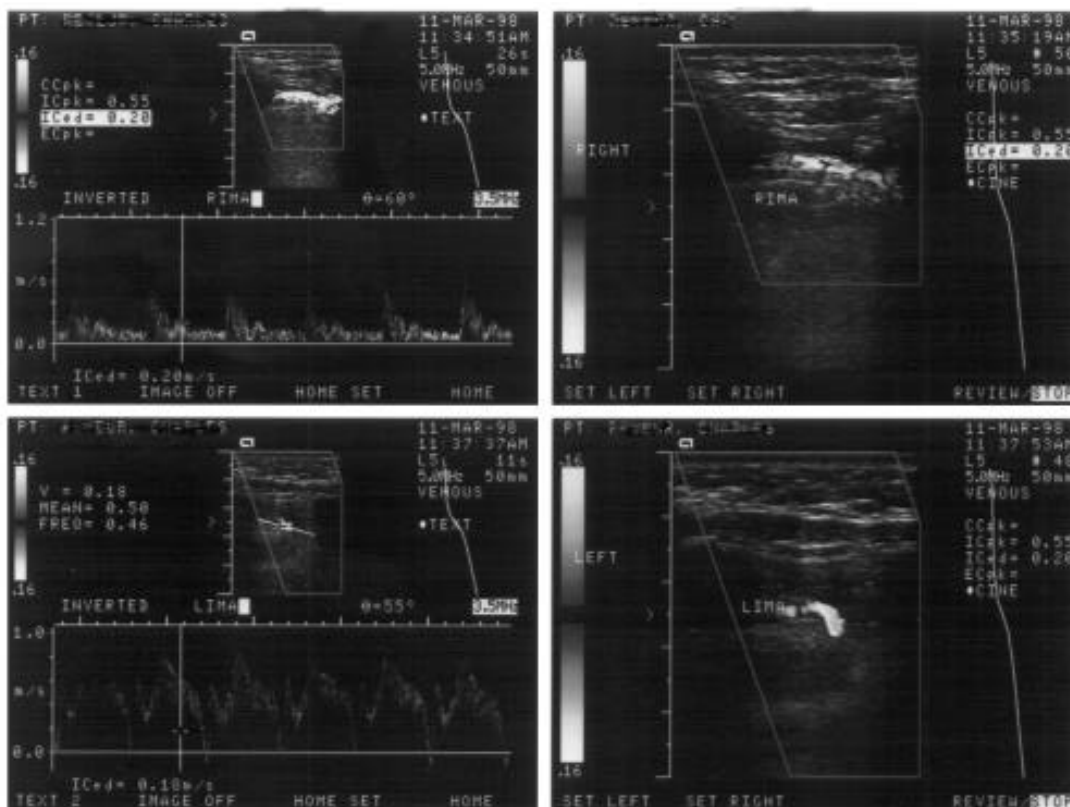
Xiphoid MIDCAB is a safe and effective approach for grafting the LIMA to the LAD. The proximity of the distal LAD and distal LIMA to the left costal margin makes the anatomy favorable for this approach. In our initial

Table 2. Results

#	Hybrid	Blood Transfused	Complications	Length of stay (days)
1	No	No	None	3
2	No	No	Atrial Fibrillation, <i>C.difficile</i> diarrhea	8
3	Yes	Yes	Cardiac Tamponade, re-exploration, prolonged intubation	29
4	No	No	None	3
5	No	No	Atrial Fibrillation	14
6	No	Yes	None	4
7	No	No	Post-pericardiotomy syndrome	4
8	Yes	Yes	Post stent arrhythmia, IABP	6
9	Yes	Yes	Atrial Fibrillation	5
10	No	No	None	3



Figures 5a. Diastolic flow in completed LIMA-LAD xiphoid MIDCAB graft verified by transthoracic doppler evaluation.



Figures 5b. The diastolic flow component is easily differentiated in the LIMA when compared to the ungrafted RIMA, which is mostly systolic flow.

group of patients there were no mortalities and the post-operative complications were not compounded by the xiphoid incision. It is our subjective impression that, by avoiding chest wall incisions and intercostal retraction, pain is lessened.

The xiphoid approach to isolated LIMA-to-LAD anastomosis deserves further pursuit with controlled studies, comparing the morbidity and mortality from this procedure to alternative approaches for hybrid or isolated surgical revascularization.

REFERENCES

1. Benetti FJ, Naselli G, Wood M, Geffner L. Direct myocardial revascularization without extracorporeal circulation. Experience in 700 patients. *Chest* 100:312-6, 1991.
2. Benetti FJ, Ballester C. Use of thoracoscopy and a minimal thoracotomy, in mammary-coronary bypass to left anterior descending artery, without extracorporeal circulation. Experience in 2 cases. *J Cardiovasc Surg (Torino)* 36(2):159-61, 1995.
3. Calafiore AM, DeGiammarco GD, Teodori G, Bosco G, D'Annunzio E, Barsotti A, et al. Left anterior descending coronary artery grafting via left anterior small thoracotomy without cardiopulmonary bypass. *Ann Thorac Surg* 61:1658-65, 1996.
4. Cohn WE, Suen HC, Weintraub RM, Johnson RG. The "H" graft: an alternative approach for performing minimally invasive direct coronary artery bypass. *J Thorac Cardiovasc Surg* 115(1):148-51, 1998.
5. Coulson AS, Bakhshay SA. The "T-MIDCAB" procedure. Use of extension grafts from the undisturbed internal mammary artery in high-risk patients. *The Heart Surgery Forum* #1998-7137 1(1):54-9, 1998.
6. Parsonnet V, Dean D, Bernstein AD. A method of uniform stratification of risk for evaluating the results of surgery in acquired adult heart disease. *Circulation* 79 (Suppl 1):I3-I12, 1989.

REVIEW AND COMMENTARY

1. Editorial Board Member NC124 writes:

LIMA-LAD off the pump anastomosis can be performed by many approaches with good results; however, it represents only a small segment of the overall population that needs surgical coronary revascularization. I really do not see any practical difference between this approach and a T or inverted L distal ministernotomy.

Please talk about the retraction to safely view the LIMA over the upper abdominal wall; it must generate some post-op pain. What is the practical difference between a distal ministernotomy and this approach?

Authors' Response by Mercedes K.C. Dullum, MD:

These incisions (ministernotomies) actually cut out into the interspace; the xiphoid approach does not T-out so there is less trauma. With better endoscopic ability, it can

eventually be limited to only incising the xiphoid.

A Rultract is used and elevated slowly and less extensively than normal, and visualization improves as the dissection of the LIMA progresses. There is minimal post-op pain and less than the standard MIDCAB incision. The incision is not carried to the abdominal wall. The only difference between the xiphoid and distal ministernotomy is that the sternum is not incised as high or T-out.

2. Editorial Board Member XA5 writes:

I wish there were a better description of the technique, especially getting from the subxiphoid incision to the IMA and heart.

Authors' Response by Mercedes K.C. Dullum, MD:

The incision is over the xiphoid, not subxiphoid into the abdomen. The attachments to the xiphoid are divided to allow elevation of the xiphoid and more room in which to work. A mini-retractor is used and, on opening the pericardium, the LAD is not initially visualized. By placing sutures on the pericardial edge and then a glove (which is filled with warm saline) behind the heart, the heart is gently rotated into the incision and the LAD is brought into view.

3. Editorial Board Member YT31 writes:

The LIMA is taken down to the third or fourth intercostal space. I would like to see some comments on the size of the LAD and LIMA at the site of the anastomosis as it is in the distal 1/3 of the vessel.

Small numbers but the high complication rate in the hybrid cases is of some concern.

Authors' Response by Mercedes K.C. Dullum, MD:

The LIMA is smaller distally but usually dilates with papaverine and frequently can be divided proximal to the bifurcation. The LAD is large enough to graft as you can frequently get quite high on the LAD.

I share your concern about the complications in the hybrid patients, but these have been very few since our initial cases where I learned to leave a drain in until 24 hours after the PTCA/stent and all the anticoagulants/platelet inhibitors have worn off. I had a major complication from bleeding with my first hybrid patient who was an elderly lady. She initially did well with her LIMA-LAD but the next day in the cath lab had an extensive anticoagulation regime including heparin and platelet inhibitors (which I found out is their usual practice especially with stents). She bled postop with resultant tamponade requiring re-exploration twice (the first time we did not open her fully and they continued with their aggressive anticoagulation). I had pulled my drain prior to her angioplasty, however. Since that incident, I always leave a Blake drain in until at least 24 hours after percutaneous intervention and remove it if there is less than 50cc drainage over 24 hours. There is also blood loss with percutaneous intervention, which can be quite significant, and frequently these patients need transfusion.

4. Editorial Board Member NL11 writes:

Small series of a hybrid approach to myocardial revascularization with 20% incidence of major complications. What is wrong with doing full myocardial revascularization by surgical means on or off pump?

Authors' Response by Mercedes K.C. Dullum, MD:

I agree that full surgical revascularization is the best option and I always offer this to the patients. The hybrid patients are usually older with the possibility of more morbidity from a sternotomy and also, by the time they are referred to me by the cardiologists, the patients have it firmly fixed in their minds that they are going to receive hybrid revascularization.

5. Editorial Board Member JZ39 writes:

This is a provocative study. I am not sure I agree with the approach, but I am anxious to learn if they are right, which makes this great.

I would like the authors to comment on the amount of pain the patients had. Also comment on how many high mammary branches they saw at angio and if there was any evidence of "steal". I personally don't believe in steal but perhaps they learned something they could share to strengthen the paper (as they did not attempt to harvest the mammary all the way up).

Why wasn't the PTCA part of the hybrids done first?

It doesn't seem like anything that I want to do to a patient at this stage of its development. Results are of extreme concern in this group of rather sick patients.

Authors' Response by Mercedes K.C. Dullum, MD:

I agree, and am waiting, for our long-term follow-up.

There was much less pain than the traditional left anterior thoracotomy MIDCAB and the sternotomies, especially in the older patients.

We did see some high mammary branches at angiography. We, however, have not had any evidence of "steal" either by angiography or clinically.

I did the LIMA to LAD first so that patients would be more stable, especially in the high-risk cases for PTCA/stenting. The cardiologist said that the patients either had to have a MIDCAB or CPS to allow them to do the percutaneous intervention safely.

I share your concern about the complications, particularly in the hybrid patients, but these have been very few since our initial cases. I think that this technique does need more development, but feel that in the group of higher risk patients, I was able to successfully revascularize the LAD in a less morbid approach and had I done full sternotomy and CPB they might not have fared as well. As one of my partners said, "No matter what approach I use, they are still fragile 80-year olds!"