

## Endoscopic Radial Artery Harvest: A New Approach

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### ABSTRACT

**Background:** Although early attempts to use the radial artery (RA) as a conduit for cardiac revascularization met with disappointing results, recent data have shown the RA to achieve very good short-term patency as well as promising mid-term patency results. The recent increase in the frequency of coronary reoperations, with their limited options for vascular conduits, has also stimulated an interest in the RA graft. The success of minimally invasive vein harvesting techniques encouraged us to develop a minimally invasive technique for harvesting the RA from the forearm, which is reviewed in this article.

**Methods:** The endoscopic harvest technique was employed on more than 120 nonselected patients at our facility over a 12-month period. The procedure involved exposure of the RA under direct visualization and without direct manipulation, using an endoscopic dissector and harmonic shears. Side branches of the RA were isolated and divided, and the vessel was removed and side branch occlusion verified. The harvested RA was then prepared for the revascularization surgery.

**Results:** The patients who underwent the procedure showed no evidence of graft spasm or occlusion in the immediate postoperative period. Patients also preferred the small endoscopic incision to the full forearm incision of the "open" technique.

**Conclusions:** Our experience indicates that endoscopic radial artery harvesting is a safe technique that achieves good short-term patency results and improved patient satisfaction. Evaluation of long-term vessel integrity is needed, and a comparison of the minimally invasive and the open technique has been initiated.

### INTRODUCTION

The radial artery (RA) was introduced as a conduit for cardiac revascularization in 1973 by Carpentier et al. [Carpentier 1973]. However, a 35% incidence of narrowing or occlusion of the RA prompted the author to abandon this approach, and use of the RA fell out of favor. Subsequently, the internal

mammary artery has demonstrated the many advantages of arterial conduits [Geha 1975], and the RA as a conduit has been reviewed critically with promising results. Acar's recommendation [Acar 1992] that the RA be used as a conduit of choice is substantiated by very good short-term patency results [Chen 1996]. The mid-term patency data now appear to approach that of the internal mammary artery and have far exceeded that of the saphenous vein for coronary bypass grafts [Bhan 1999]. Several factors may be contributing to the renewed success of the RA. These include the use of vasospastic inhibitors, such as calcium channel blockers, and harvesting of the vessel as a pedicle graft.

Coronary reoperations have become more common in recent years, and conduit options for grafting are more limited in the reoperative setting. The 10-year saphenous vein graft patency data reveal that approximately two-thirds of the grafts are occluded or severely atherosclerotic, whereas there is a 95% 10-year patency of arterial grafts used in the same fashion. This has stimulated interest in total arterial revascularization, and the RA is one of the conduits that is now commonly employed.

Encouraged by the success of minimally invasive vein harvesting techniques, we recently developed a similar minimally invasive technique for obtaining the RA from the forearm. This approach limits operative trauma and results in improved patient satisfaction.

### MATERIALS AND METHODS

Palmer arch patency of the non-dominant arm is verified noninvasively with a Doppler Allen test [Starnes 1999]. The forearm is circumferentially prepped and draped with the arm board positioned at 90 degrees from the operating room table. A 3 cm incision is made overlying the RA and beginning 3-4 cm from the wrist crease. Under direct visualization, the RA is dissected distally to the wrist crease and then proximally for several centimeters.

The Orbital Dissector (Ethicon Endo-Surgery, Inc., Cincinnati, OH), a 5 mm 30-degree endoscopic dissector, is passed above the RA in a plane above the fascia [see Movie, ©]. The Clear Glide (Ethicon Endo-Surgery, Inc., Cincinnati, OH) endoscopic dissector is placed and the fascia is transected with the use of the LCS C-5 harmonic shears instrument (Ethicon Endo-Surgery, Inc., Cincinnati, OH). The RA is unroofed proximally to the level of the recurrent radial artery, which is the proximal transection point. This exposure is accomplished without direct manipulation of the RA.

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Once the RA is fully exposed, the side branches are isolated and divided. All dissection is carried out with the use of the LCS C-5 harmonic shears instrument dividing each vessel branch. Knowledge of the anatomy of the forearm is mandatory for this procedure [Reyes 1995]. Specific attention is paid to identifying and preserving the superficial radial nerve and the lateral antebrachial cutaneous nerve. Once division of all the side branches is complete, a pigtail device is run up and down the RA to verify that none of these branches have been missed. The proximal RA is doubly clipped with a large endoclip and the vessel is transected distal to the recurrent radial artery branch. Brisk back-bleeding through the RA confirms patency of the palmar arch. In the event that the clip cannot be successfully placed endoscopically, a stab wound can be made directly over the proximal division point and either a suture or large clip applied. The RA is removed from the forearm and a vascular clamp is placed on the transected end. A suture ligature is placed on the distal vessel and the RA is transected. The RA conduit is placed in a heparinized saline bath.

The wound is irrigated with saline solution and hemostasis is verified. The incision is reapproximated with a 4-0 subcuticular monofilament suture, and an elastic bandage is placed on the forearm for 12-24 hours.

RA cannulation with gentle hydrostatic dilation using heparinized saline is carried out to verify complete side branch occlusion. The vessel is placed in a papaverine-soaked gauze (60mg/60ml saline) prior to its use for bypass grafting. Diltiazem is administered intravenously at the completion of the operation and continued until conversion to an oral intake.

## RESULTS

Endoscopic radial artery harvesting in our experience has been demonstrated to be a safe procedure that increases patient satisfaction. This technique has been used at our facility for more than 120 nonselected patients over 12 months with no evidence of graft spasm or graft occlusion in the immediate postoperative period. In one instance the brachial artery was inadvertently cut, necessitating an open repair. No major adverse clinical events were observed, although transient dysesthesia in the dorsum of the hand and radial aspect of the forearm developed in several patients. This was attributed to contusion of the superficial branch of the radial nerve and the lateral cutaneous nerve from the large instruments used for the harvesting. Smaller instruments are being developed that will simplify the operation and decrease operative trauma.

## CONCLUSION

The surgical skill required for endoscopic radial artery harvesting is slightly greater than that required for endoscopic vein harvesting. Saphenous vein harvesting, with its lower intraluminal pressure and more resilient vessel walls and branches, should be mastered prior to harvesting an RA with the minimally invasive technique. Endoscopic RA harvesting is a safe technique, improves patient comfort and cosmetic outcome, and has good short-term patency results. Further

studies are warranted to look at the microscopic differences between arteries harvested using the standard open technique and those harvested with this minimally invasive approach. Evaluation of our long-term as demonstrated by vessel integrity is presently being undertaken.

## REFERENCES

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## REVIEW AND COMMENTARY

### 1. Editorial Board Member TS513 writes:

This is a well-written and concise description of a less invasive technique demonstrating that radial arteries can technically be harvested through smaller incisions. However, there is a lack of early angiography to demonstrate the safety and efficacy of this endoscopic harvest technique. The use of radial artery grafts for CABG already has suffered one early death related to improper mechanical and/or pharmacologic handling. I would think that before this endoscopic technique could be generally recommended, angiographic evidence and perhaps physiologic and histologic data should be reported.

The authors also could comment on how much difference there is in patient satisfaction—there still will be a noticeable forearm incision.

### Authors' Response by Mark H. Genovesi, MD:

Prior to recommending minimally invasive harvesting of the RA as an accepted technique, further evaluation is warranted. To address questions regarding conduit integrity, a randomized, prospective comparison of the "open technique" and the minimally invasive technique has been initiated. Angiography, histology, and clinical outcome will be noted.

In keeping with the "revitalized technique" of radial artery harvesting, we continue to apply a minimal touch of the pedicled graft, and routinely use vasospastic inhibitors. No

patient required postoperative reintervention for clinically evident vasospasm or ischemia.

The 3-cm incision is barely noticeable at the postoperative visit and is frequently covered by a watchband. When given a choice between the full forearm incision and the minimally invasive incision, all patients opted for the latter.

## **2. Editorial Board Member KE221 writes:**

This is a solution to a nonexistent problem. Conventional harvesting is quick, easy, and accompanied by little postoperative pain or disability. This technique has to be slower and was the cause of one serious arterial injury and several minor nerve injuries.

- a) What was the average time needed to harvest the RA in this manner compared to the authors' standard technique?
- b) Who performs this procedure, surgeons or physician assistants?
- c) Is it wise to place two large clips in the antecubital fossa, where they could become uncomfortable during repetitive flexion of the arm?
- d) Why check back-bleeding only after dividing the artery? It's much safer to clamp the artery at the wrist to see if there is a strong pulse distal to the clamp before dividing the artery.

## **Authors' Response by Mark H. Genovesi, MD:**

I initially performed all endoscopic RA harvesting and soon advanced the technique while working with physician assistants (PAs). PAs who were accomplished at endoscopic saphenous vein harvesting prior to endoscopic RA harvesting now perform most of the procedures. Surgical time averaged 51 minutes for the first 25 patients, with a range of 30 to 70 minutes. Currently, harvest time averages 35 minutes compared to 45 minutes for the standard technique.

Vascular clips are placed distally to the recurrent radial artery and are not in the elbow crease. No discomfort at the proximal clip site has been noted.

Prior to arterial transection, the vessel is occluded and palpated for a pulse, as has been done for the open technique. Confirmation of palmar artery patency, notably when a pulse is not discernible, is obtained by observing pulsatile flow following proximal transection.

## **3. Editorial Board Member PB44 writes:**

Was there any sponsorship from the device suppliers?

I have found that the end under the dissector and attached parts is hard to see and can only be dissected under direct vision. Was visualization with this method a problem in the area just proximal to the wrist incision?

## **Authors' Response by Mark H. Genovesi, MD:**

Successful ERA harvesting has been achieved with instruments from other manufacturers. No sponsorship was received.

I believe that it is easier and safer to initiate dissection under direct visualization. Branches at this level appear to be more numerous and fragile than those proximally, and deserve the extra attention. The time for harvest was noticeably decreased when performed in this manner.

## **4. Editorial Board Member LO23 writes:**

The authors state that more than 120 nonselected patients underwent this approach. Were all of these consecutive patients requiring CABG surgery?

What is the cost of the instrumentation, which presumably is single-use disposable?

## **Authors' Response by Mark H. Genovesi, MD:**

Endoscopic RA harvesting was performed in the first 124 consecutive patients who were prepared for radial artery harvesting, when surgeons or PAs trained to perform the procedure were available.

The cost of instruments was as follows: standard vessel harvest kit (Ethicon): \$450; LCS C-5 harmonic shears instrument (Ethicon): \$340. When appropriate, the same instrument kit was used for harvesting both the radial artery and the saphenous vein.

## **5. Editorial Board Member DB515 writes:**

The movie is excellent and demonstrates a truly helpful method of minimizing sutical trauma. How many of these procedures have you done?

## **Authors' Response by Mark H. Genovesi, MD:**

The total number of patients operated upon to date is 196.