Consequences of Radial Artery Harvest
Results of a Prospective, Randomized, Multicenter Trial

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The Department of Veterans Affairs (VA) Cooperative Studies Program (CSP) 474 is a multicenter prospective randomized trial with a primary end point of angiographic graft patency at 1 year following coronary artery bypass grafting.1 The CSP 474 trial compares the radial artery with the saphenous vein, with the study conduit used as the graft to the best epicardial target vessel after the left anterior descending artery. Data acquisition included measurements of hand and forearm neuromuscular function, as well as leg pain, before and after surgery.

This report is a post hoc analysis of prospectively gathered data describing arm and leg neurologic outcome for the patients enrolled in CSP 474. The purpose is to quantitatively define the severity of pain and motor impairment associated with procurement of the radial artery and then compare pain and motor impairment with the unoperated-on arm. Postoperative data were obtained to measure recovery toward the preoperative baseline. Also, data describing pain in the lower extremities were collected to compare radial artery and saphenous vein procurement.

Based on a review of previously published information,2-15 the hypothesis tested in this study is that sensory and motor dysfunction associated with procurement of the radial artery largely resolves within a year of surgery and is not substantially worse than the discomfort associated with procurement of the saphenous vein. To our knowledge, no trial to date includes all attributes of CSP 474 (ie, a multicenter prospective randomized trial with quantitative assessments of pain and motor function by trained personnel that use widely accepted measurement tools at specified times before and after surgery) (details of prior literature in Table 1).
Methods

The CSP 474 trial was approved by each site’s institutional review board, and written consent was obtained from each patient before screening. Patients undergoing primary sternotomy for coronary artery bypass grafting with no concomitant valve surgery were included. Other details of the study are available in a previous publication.1

Demographic data and data describing the patients’ cardiac disease were obtained. Intraoperative variables included the quality of the conduits used for grafts, the site of harvesting for all conduits, and a description of the proximal and distal anastomotic sites.

With regard to arm and leg function, data were collected before surgery (preoperative baseline) and 3 and 12 months following surgery. The case report forms for hand and leg pain, hand strength, and hand sensory function are included in the eFigure in the Supplement. Questions with a 0 (no pain) to 10 (most intense pain imaginable) scale that describes pain at rest and during activity were included. Right and left hand strengths were measured in pounds of grip using a commercially available dynamometer.16 Three attempts were averaged for the final value. Right and left manual dexterity was measured in seconds using the 9-hole peg test.17

Patients were stratified according to the operative sites so that the following comparisons could be made: arm pain, sensation, strength, and dexterity before and after radial artery harvest; arm pain, sensation, strength, and dexterity comparing the side of radial artery harvest with the unoperated-on side; saphenous vein harvest site pain before and after vein harvest; and saphenous vein harvest site pain compared with the unoperated-on leg. Additional descriptors for hand and forearm neurologic dysfunction obtained at each time point are listed on Form 10 in the eFigure in the Supplement.

Data were gathered and then reviewed for spurious values. Study coordinators attended a national meeting every year to review data collection methods and discuss problems. All patients provided informed consent before inclusion in the study, and each site obtained approval from its local institutional review board before participation. Data analysis occurred at a core VA facility affiliated with the Palo Alto VA Medical Center. Statistical comparisons assessed for significant changes in pain score from the preoperative baseline to 3 and 12 months postoperatively using mixed regression models to account for within-patient correlation of the outcomes. The analysis adjusted for pain scores of the nonharvested extremity, age, whether the patient underwent endoscopic vein harvesting, and comorbid health conditions (smoking history, type 2 diabetes mellitus, hypertension, and heart failure). A simi-
Results

A statistical analysis was performed to assess grip strength and dexterity for patients undergoing radial artery harvest.

**Table 2. Comparisons for Radial Artery and Saphenous Vein Harvest**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Preoperative</th>
<th>Postoperative, mo 3</th>
<th>Postoperative, mo 12</th>
</tr>
</thead>
<tbody>
<tr>
<td>RA pain a</td>
<td>7.6 (1.6)</td>
<td>17.5 (2.8) b</td>
<td>13.0 (2.8) c</td>
</tr>
<tr>
<td>SV pain d</td>
<td>12.6 (1.2)</td>
<td>13.4 (1.2) b</td>
<td>15.2 (1.4) c</td>
</tr>
<tr>
<td>Grip strength, lb e</td>
<td>72.6 (3.1)</td>
<td>66.4 (4.3) b</td>
<td>65.0 (3.6) c</td>
</tr>
<tr>
<td>Peg test, s f</td>
<td>25.1 (0.6)</td>
<td>25.6 (0.8) b</td>
<td>26.9 (0.9) c</td>
</tr>
</tbody>
</table>

Abbreviations: RA, radial artery; SV, saphenous vein.

a Pain (score 1-100) at the radial artery harvest site.
b P < .001 for change in pain score from the preoperative baseline to the 3-month postoperative measurement.
c P = .07 for change in pain score from the preoperative baseline to the 12-month postoperative measurement.
d Pain (score 1-100) at the saphenous vein harvest site.
e Hand dynamometer testing of grip strength measured in pounds.
f Nine-hole peg test, a standardized test of dexterity; time to complete test is measured in seconds.

**Discussion**

In the CSP 474 multicenter trial, a primary end point was conduit patency (ie, radial artery vs saphenous vein) at 1 year after coronary artery bypass grafting. When the executive committee developed the trial’s design, it recognized the importance of measuring pain and assessing neurologic function of the operated-on extremity and then comparing arms and legs after conduit procurement. The final study design had structured examinations for pain (arm and leg) and neurologic function (sensory and motor examinations; arm only) by specially trained personnel. Pain assessment was measured using scripted questions with Likert-type scales. Scripted questions were used together with devices for rating manual dexterity (9-hole peg test) and grip strength (dynamometer).16,17
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Study concept and design: Holman, Goldman, Kelly, Fremes, Lee, Sethi.
Acquisition of data: Holman, Wang, Goldman, Lee, Wagner, Sethi.
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REFERENCES

Figure 3. Radial Artery vs Saphenous Vein Comparisons: 9-Hole Peg Test in Radial Artery Harvest Arm

Time (in seconds) required to complete a standardized 9-hole peg test using the arm ipsilateral to the radial artery harvest site. The 9-hole peg test was performed before surgery (time 0) and at 3 and 12 months after surgery.

The statistical analysis included a consideration of risk factors for pain and motor dysfunction. The study group was confined to patients with only radial artery or saphenous vein harvest so that simultaneous postincision arm and leg pain never confounded the arm and leg comparison.

The consequences of radial artery harvest with regard to pain and hand function are important. Prior investigations examined this issue as part of studies of patient survival or graft patency or as a separate entity. To our knowledge, this study is the only one that has used a prospective randomized multicenter trial design that included scripted questions and examinations by specially trained personnel. This study provides the most secure and detailed information yet to address an important question for patients considering coronary artery bypass grafting with the use of a radial artery.

In summary, analysis of data collected as part of CSP 474 found that pain after radial artery procurement was slightly greater than pain after saphenous vein harvest. However, the pain was not severe and resolved within 12 months following surgery. There was no statistically significant change in manual dexterity or grip strength at 3 or 12 months after surgery compared with the preoperative status. The 9-hole peg test and grip strength cannot discern changes in sensory or motor function for especially demanding situations (eg, the hands of a pianist) but are nevertheless reassuring regarding the outcome for most patients who undergo this procedure.