Best evidence topic - Cardiac general

Does the radial artery provide better long-term patency than the saphenous vein?

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Summary

A best evidence topic in cardiac surgery was written according to a structured protocol. The question addressed was whether the radial artery provides better long-term patency than the saphenous vein. Altogether 379 papers were found using the reported search, of which 12 presented the best evidence to answer the clinical question. The authors, journal, date and country of publication, patient group studied, study type, relevant outcomes and results of these papers are tabulated. We concluded that there is evidence that radial artery grafts have a higher rate of patency than saphenous vein grafts. Surgeons can confidently use the radial artery as a second arterial bypass graft, particularly in patients with severe native-vessel stenosis.

Keywords: Evidence-based medicine; Radial artery; Thoracic surgery; Review

1. Introduction

A best evidence topic was constructed according to a structured protocol. This protocol is fully described in the ICVTS [1].

2. Clinical scenario

You are about to perform a coronary artery bypass graft (CABG) on an obese 65-year-old man who has triple-vessel disease involving the left anterior descending (LAD) artery, the first obtuse marginal (OM) branch, and the posterior descending artery (PDA), and an akinetic inferior wall with an estimated ejection fraction of 40%. You wonder whether you should use the saphenous vein (SV) or the radial artery (RA) to graft a heavily diseased PDA or OM to achieve long-term patency.

3. Three part question

In patients undergoing [coronary artery bypass grafting] is the [radial artery or saphenous vein] the better conduit to achieve [long-term patency].

4. Search strategy

Medline 1966–Feb 2005 using OVID interface. [exp Cardiac Surgical Procedures/OR exp Coronary Artery Bypass/OR exp Myocardial Revascularization/OR exp Cardiovascular Surgi-

5. Search outcome

Three hundred and seventy-seven papers were found of which 9 were deemed relevant. Cross-checking of the reference lists revealed another three papers [2–13]. The 12 papers are presented in Table 1.

6. Comments

Several angiographic observational studies have shown that the RA has excellent short-, mid-, and long-term patency when used as a conduit for revascularization [2–10,12,13] (Table 1). However, Khot et al. [11] reported a high rate of both occlusion and severe flow-limiting disease with the use of RA grafts in patients presenting predominantly with recurrent signs or symptoms of myocardial ischemia after CABG. The RA graft results were dramatically inferior to those for internal mammary artery (IMA) bypass grafts and SV grafts. Although angiographic outcomes with the RA graft were poorer in both sexes, women had particularly high rates of occlusion. It should be noted, though, that this study had a number of limitations. The results were confounded by a selection bias, because the sample was limited to patients with symptoms or signs of recurrent ischemia. Thus, the low RA graft patency rate may have been attributable to the high-risk status of the population...
Table 1
Summary of best evidence papers

<table>
<thead>
<tr>
<th>Author, date, and country</th>
<th>Patient group</th>
<th>Study type (level of evidence)</th>
<th>Outcomes</th>
<th>Key results</th>
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<tr>
<td>Acar et al. (1992), Ann Thorac Surg, France [2]</td>
<td>104 consecutive patients underwent CABG with 122 RA grafts. The LIMA was used concomitantly as a pedicled graft in 100 cases and the RIMA in 19; a free IMA graft was used in 29 cases and a SV graft in 24</td>
<td>Cohort study (3b)</td>
<td>&lt;2 week patency</td>
<td>In the first 50 consecutive patients, RA graft patency was 100% (56/56 grafts) and SV graft patency was 88% (8/9). Six patients had localized narrowing of the RA conduit unrelated to the anastomotic lines (spasm)</td>
<td>RA may be a reasonable alternative to other types of conduits to complement the LIMA</td>
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<td>Da Costa et al. (1996), Ann Thorac Surg, Brazil [3]</td>
<td>RA grafts were used in 83 patients (mean age, 54.6 years) undergoing myocardial revascularization. 61 patients (73%) consented to undergo angiography before hospital discharge</td>
<td>Cohort study (3b)</td>
<td>Immediate patency</td>
<td>59/61 (96.7%) RA grafts were patent and 2 had diffuse spasm. On a second angiogram done in 12 patients after a mean interval of 8.7 months, all graft were patent. One patient with diffuse early spasms had recurrent symptoms, and a repeated angiogram showed further graft narrowing (string sign). 13/14 (92.8%) SV grafts were patent</td>
<td>With proper care, the RA may be used for CABG with good early results</td>
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<td>Chen et al. (1996), J Thorac Cardiovasc Surg, USA [4]</td>
<td>60 of 150 patients who underwent CABG with RA grafts had postoperative cardiac catheterization. 94 RA grafts and 26 SV grafts were reviewed</td>
<td>Cohort study (3b)</td>
<td>Immediate patency</td>
<td>RA graft patency was 90/94 (95.7%). Four grafts showed diffuse narrowing. SV graft patency was 24/26 (92.3%)</td>
<td>The short-term patency rate of RA graft is excellent</td>
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<td>Manasse et al. (1996), Ann Thorac Surg, Italy [5]</td>
<td>The RA was used for myocardial revascularization in 109 patients; in 95 (group 1), the arterial fascia was opened with gentle hydrostatic dilatation, and the graft was anastomosed to the aorta; in 14 patients (group 2), the graft was branched to another conduit</td>
<td>Prospective cohort study (2b)</td>
<td>1 year patency rate</td>
<td>Fifty-six patients (52.33%) underwent angiography at a mean interval of 334.42 days: the patency rate of the RA graft was 87.75% in group 1 and 62.5% in group 2. SV graft patency was 35/46 (76.1%) (P=0.67) in group 1. On the</td>
<td>The RA is an easily manageable conduit with very promising early patency, although longer follow-up is mandatory</td>
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<td>Possati et al. (1998), J Thorac Cardiovasc Surg, Italy [6]</td>
<td>The first 68 consecutive surviving patients in whom a RA graft was proximally anastomosed to the aorta were re-studied after 5 years (mean 59 ± 6.5 months); 48 had previously undergone early angiography</td>
<td>Prospective randomized (2b)</td>
<td>5-year patency</td>
<td>RA graft patency was 57/61 (91.9%). All RA grafts that were patent early after surgery remained patent at the midterm follow-up. Early irregularities in 7 patients disappeared after 5 years. SV graft patency was 43/58 (74.1%)</td>
<td>The midterm angiography results of RA grafts used for myocardial revascularization are excellent, and higher than those for SV grafts. The correct surgical indication is essential</td>
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<td>Amano et al. (2001), Ann Thorac Surg, Japan [7]</td>
<td>475 patients underwent RA grafting. The patients were followed to determine midterm graft patency, cardiac events, and survival</td>
<td>Cohort study (3b)</td>
<td>3-month patency 3-month patency</td>
<td>SV graft 34/38 (89.5%) RA graft 213/229 (93%) patency SV graft 71/79 (89.8%)</td>
<td>No adverse effects were with the RA grafts at midterm follow-up after CABG, and the patency of the RA graft was similar to that of other arterial grafts</td>
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<td>Buxton et al. (2003), J Thorac Cardiovasc Surg, Australia [8]</td>
<td>The RA was compared with the free RIMA in CABG in 285 patients &lt;70 years old (group 1) and with the SV in 153 patients ≥70 years old (group 2). The trial conduit was grafted to the largest available coronary artery other than the LAD. Angiography was scheduled at intervals between 0 and 10 years according to a second random assignment</td>
<td>Prospective, randomized, single center (1b)</td>
<td>5-year patency</td>
<td>Estimated graft patency rates were 0.86 in 24 RA grafts (95% CI 0.67–0.99) versus 0.95 in 22 SV grafts (95% CI 0.83–0.99) (P &lt; 0.5) in group 2. Cardiac event-free survival estimates were 0.84 (95% CI 0.64–0.99) and 0.89 (95% CI 0.762–0.99), respectively (P = 0.9)</td>
<td>The 5-year interim results do not support the hypothesis of superior patency or fewer clinical events for RA grafts than for free or SV grafts</td>
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<td>Possati et al. (2003), Circulation, Italy [9]</td>
<td>90 consecutive patients in whom the RA was used as a CABG conduit directly anastomosed to the ascending aorta were assessed</td>
<td>Prospective, randomized (1b)</td>
<td>10-year patency</td>
<td>The long-term and perfect patency rates were 77/84 (91.6%) and 74/89 (88%) for RA grafts, respectively, versus 80/82</td>
<td>Ten years after surgery, RA grafts have excellent patency and perfect patency rates. Appropriate surgical</td>
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<td>Desai et al. (2004), N Engl J Med, Canada [10]</td>
<td>In 561 patients at 13 centers, the LIMA was used to bypass the anterior circulation. The RA graft was randomly assigned to bypass the major vessel in either the inferior (RCA) or lateral (CX) territory, with the SV graft used for the opposing territory (control).</td>
<td>Prospective, randomized, multicenter (1b)</td>
<td>1 year patency</td>
<td>(97.5%) and 79/82 (96.3%) for LIMA grafts. The severity of stenosis of the target vessel clearly influenced long-term RA patency.</td>
<td>RA grafts are associated with a lower rate of graft occlusion at one year than SV grafts. Because the patency of RA grafts depends on the severity of the native-vessel stenosis, they should be used preferentially for target vessels with high-grade lesions.</td>
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<td>Khot et al. (2004), Circulation, USA [11]</td>
<td>A total of 35,536 angiographic procedures in 27,211 patients were reviewed; 310 patients had a RA graft. Patients were divided into 3 groups by graft outcome: (1) occluded, (2) severe disease (≥70% stenosis, or string sign), and (3) patent (&lt;70% stenosis)</td>
<td>Cohort study (2b)</td>
<td>Mean follow-up after CABG of 565 ± 511 days</td>
<td>The patency rate was 51.3% for RA grafts and 64.0% for SV grafts (P = 0.0016). Corresponding rates of severe stenosis were 15.1% and 5.9% (P = 0.0003). Women had a worse overall RA patency rate than men (38.9% vs. 56.1%, P = 0.025)</td>
<td>In patients presenting predominantly with signs and symptoms of myocardial ischemia after CABG, RA grafts have lower patency rates than SV grafts. Selective use of the RA is warranted, particularly in women.</td>
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rather than an intrinsic tendency of the graft itself. Furthermore, previous studies restricted RA graft placement to patients with high-grade stenosis and good distal runoff, whereas in this study, the decision to use a RA graft was made at the discretion of the individual surgeon, thereby mimicking ‘real-life’ use. As such, the results may have reflected the less stringent criteria for RA bypass.

Recently, Zacharias et al. [13] evaluated the 6-year outcome of propensity-matched patients undergoing left IMA (LIMA)-to-LAD grafting with one or more additional RA grafts or vein-only grafts (n=925 each). Perioperative outcomes, including death rate, were similar in the two groups, although cumulative survival was better in the patients with the RA graft(s). Angiographic data in restudied symptomatic patients showed a trend for greater RA graft patency. In patients who received both types of grafts, the extent of failure was significantly worse in the vein graft than the RA graft. These findings favor the use of the RA as a second arterial conduit in LIMA-LAD CABG.

Possati et al. [9], in a series of 90 consecutive patients with CABG, reported an 88% long-term (mean 105 ± 9 months) angiographic patency of RA grafts anastomosed to an OM or PDA. This rate was lower than for LIMA grafts (96.3%) but significantly higher than for SV grafts (53.4%), supporting the use of the RA as a complementary conduit for myocardial revascularization. Although these results are encouraging, there are few additional long-term randomized, controlled studies on RA graft patency in symptom-free patients.

To bridge this gap, the prospective single-center Radial Artery Patency and Clinical Outcome (RAPCO) Study [8] is conducting a 10-year comparison of angiographic patency and cardiac outcome between RA grafts and either free right IMA (RIMA) grafts (n=25, age <70 years) or SV grafts (n=153, age ≥70 years) branched to the largest available coronary artery other than the LAD. Interim analysis at 5 years showed no differences in angiographic failure rates or major clinical outcomes (namely, survival and cardiac
event-free survival) between the groups. However, these findings were based on only a small proportion of the expected angiographic results. Furthermore, the SV graft patency rates were much higher than rates in both previous reports and in the non-study SVs, perhaps because in SV grafts, atherosclerosis and dysfunction begin to increase only 5 to 10 years postoperatively. The final results at 10 years should help to clarify whether RA grafts are superior to RIMA and SV grafts in this setting.

The interim results of a second prospective multicenter trial, the Radial Artery Patency Study (RAPS) [11], were published in 2004. The investigators compared the 8- to 12-month protocol-directed angiographic patency of RA and SV grafts to the right or circumflex coronary arteries in 561 patients. Each patient served as his/her own control. Significantly higher patency rates were noted in the RA graft group (91.8% vs. 86.4%; \(P = 0.01\); graft occlusion odds ratio = 0.53; 95% confidence interval 0.31–0.85); rates of perfect graft patency (i.e., TIMI 3 flow) were similar (87.7% vs. 85.7%, \(P = 0.37\)). In the RA group, graft patency was similar in the inferior (right coronary) and lateral (circumflex) territories, and perfect patency was highly dependent on the severity of the proximal native coronary artery stenosis (70–89% coronary stenosis: 81.7% patency, \(\geq 90\%\) stenosis: 91.5% patency). The long-term (5 to 10 years) findings will be assessed in follow-up studies.

In summary, RA patency rates exceeded those of SV grafts at all time points, except in one study [5]. The tabulated studies show a 10-year patency of 50–90% for RA grafts and of 30–50% for SV grafts.

7. Clinical bottom line

The RA graft has a significantly better long-term patency than the SV graft. Although these findings are encouraging, the final results of the RAPCO and RAPS trials after 10 years of follow-up in symptom-free patients should help to clarify the long-term patency rates of RA grafts and to determine whether RA grafts yield better results than SV grafts.

References

This systematic review of the literature with weighted comparisons provides us with an excellent overview of current practice. Standard reporting techniques might help minimize some of the unexplained differences in outcomes. The late outcome from randomized controlled trial will provide the best chance of excluding bias and assessing comparisons between conduits.

References


