How does the right gastroepiploic artery compare with the saphenous vein for revascularization of the right coronary artery?

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Abstract

A best evidence topic was written according to a structured protocol. The question addressed was ‘is the saphenous vein graft or right gastroepiploic artery a better conduit for revascularization of the right coronary artery?’ One hundred and five articles were found using a designated search, of which ten articles were found to represent the best available evidence to answer the clinical question. Of these ten articles, two were reports of a randomized controlled trial and represented the highest level of evidence, whereas eight articles were retrospective observational studies. All were published between 2002 and 2012. Outcome measures varied considerably, but mostly included graft patency at varying periods of follow-up. The randomized evidence suggested that the saphenous vein had better early (6-month) and mid-term (3-year) graft patency than the right gastroepiploic artery when used for right coronary artery revascularization. The use of the saphenous vein was also found to be predictive of superior graft function using multivariate regression; however, a more recent propensity score analysis identified gastroepiploic-right coronary grafts to yield superior very long-term (>10 years) clinical outcomes. Overall, based on the best quality evidence and in view of technical limitations and flow characteristics of the right gastroepiploic artery, it appears that saphenous vein grafts may offer superior outcomes for revascularization of the right coronary artery in most cases, and should be preferentially used.

Keywords: Right coronary artery • Coronary artery bypass • Conduit patency • Gastroepiploic artery • Saphenous vein

INTRODUCTION

A best evidence topic was constructed according to a structured protocol, which is described in ICVTS [1].

CLINICAL SCENARIO

You attend the joint cardiology/cardiac surgery meeting where a 55-year old man with severe three-vessel disease is referred for coronary artery bypass graft (CABG) surgery. You suggest that you are planning to use bilateral in situ internal thoracic arteries (ITAs) for revascularization of the left coronary system and a saphenous vein graft (SVG) for the right coronary artery (RCA). The surgical resident asks whether it would be preferable to use the right gastroepiploic artery (RGEA) to graft the RCA in order to achieve total arterial revascularization with in situ anatomical grafts. Although you are confident with harvesting the RGEA, you are uncertain about its efficacy over conventional SVG grafting of the RCA. You decided to look into the relevant literature before you finalize your revascularization strategy.

THREE-PART QUESTION

In [patients undergoing CABG] does [RGEA or SVG use for RCA grafting] improve [patient outcomes]?

SEARCH STRATEGY

We searched Medline (Pubmed interface), Embase, the Cochrane Library and Google Scholar databases for studies between 1980 and April 2012 according to the following criteria: (right AND (coronary vessels [MeSH Terms] OR (coronary AND vessels) OR (coronary vessels) OR (coronary AND artery) OR (coronary artery) AND (patency OR outcomes OR events) AND (RGEA) AND (saphenous vein). Studies that did not include a direct comparison between the RGEA and SVG grafts were excluded.

RESULTS

About 105 articles were found, of which 10 represented the best evidence (Table 1).

In a retrospective study by Lev-Ran et al. [2], 234 patients undergoing bilateral ITA grafting to the left coronary system and RGEA to the RCA were compared with 127 patients with the same left-sided configuration but with SVG grafting to the RCA. The early (30-day) and mid-term survival were found to be similar between the two groups.

Hirose et al. [3] performed early (<1 year) and later (>1 year) angiographic evaluation of RGEA grafts to the RCA, and then compared patency rates with 291 patients who received the SVG
Table 1: Summary of best evidence papers

<table>
<thead>
<tr>
<th>Author (date), journal, country Study type (level of evidence*)</th>
<th>Patient group</th>
<th>Outcomes of interest</th>
<th>Key results</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lev-Ran et al. (2003), Ann Thorac Surg, Israel [2] Retrospective (level II-3)</td>
<td>361 patients underwent left coronary system revascularization with bilateral ITA of which 234 underwent RGEA grafting to the RCA, and 127 underwent SVG grafting to the RCA</td>
<td>Median follow-up: 36 months</td>
<td>30-day mortality, postoperative complications (myocardial infarction, stroke, bleeding, sternal infections), angina recurrence, mid-term survival</td>
<td>Mid-term angiographic patency in 26 patients with posterior descending artery (PDA) grafts</td>
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<td>Hirose et al. (2004), J Card Surg, Japan [3] Retrospective (level II-3)</td>
<td>1020 patients over a 11-year period undergoing revascularization of the distal RCA using the RGEA</td>
<td>Comparison with 291 patients who underwent SVG grafting to the RCA during the same period</td>
<td>Early (-1 year) and later (+1 year) angiographic patency, cardiac-related events, survival</td>
<td>Kaplan-Meier annual graft patency rates were compared: 3-year: RGEA-RCA and SVG-RGEA patencies were identical at 92.1%</td>
</tr>
<tr>
<td>Pevni et al. (2005), Ann Thorac Surg, Israel [4] Retrospective (level II-3)</td>
<td>The same patient population as in Lev-Ran et al. [2] (above) but with longer follow-up (40–78 months)</td>
<td>Additional outcome measures: 6-year Kaplan-Meier survival Angiographic patency in further 17 PDA grafts (giving a total of 18 SVG-PDA and 19 RGEA-PDA grafts followed up)</td>
<td>6-year survival rates were similar for the RGEA and SVG groups All (18/18) SVG-PDA grafts were ‘intact’ 13 of 19 RGEA-PDA grafts were ‘intact’</td>
<td>This study adds no significant findings to the previous comparison between RGEA and SVG for PDA grafting by the same group [2]</td>
</tr>
<tr>
<td>Esaki et al. (2007), Ann Thorac Surg, Japan [5] Retrospective (level II-3)</td>
<td>311 patients over a 10-year period undergoing left coronary system revascularization with bilateral ITAs In situ RGEA in 99 patients, SVG in 212</td>
<td>Early postoperative angiography (mean 12.5 days) Late outcomes: 7-year survival rate, 7-year ‘freedom from cardiac events’ rate, 7-year ‘freedom from recurrent angina’ rate</td>
<td>Early postoperative patencies were similar in the RGEA (100%) and SVG (96.6%) groups The 7-year survival was higher at 94.7% for the RGEA group compared with the SVG group (87.2%), but this was non-significant Similar freedom from reintervention (81.9 vs 85.3%) and freedom from angina (85.3 vs 88.8%) between the RGEA and SVG groups</td>
<td>No significant difference in early angiographic or late clinical outcomes between the RGEA and SVG groups</td>
</tr>
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<td>Glineur et al. (2008), Thorac Cardiovasc Surg, Belgium [6] 6-month results</td>
<td>116 patients received an SVG to the RCA, 122 received an RGEA to the RCA</td>
<td>Early (6-month) outcomes: angiographic patency/ functionality, major adverse cerebrocardiovascular events</td>
<td>Higher graft functionality (fully patent, ‘Grade 2’) in SVG grafts (97/102, 95%), than RGEA grafts (83/105, 79%) at 6 months (P = 0.001)</td>
<td>Superior graft performance for the SVG to the RCA when compared with the RGEA both at early and mid-term end points</td>
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Continued
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<td>Prospective randomized (level I)</td>
<td>Glineur et al. (2011), J Thorac Cardiovasc Surg, Belgium [7] 36-month results</td>
<td>92 RGEA and 81 SVG group patients had 3-year follow-up angiogram</td>
<td>Mid-term angiographic patency — (‘graft functionality’ defined according to a 5-point measure taking account of the competitive flow)</td>
<td>3-year patency/graft functionality: SVG–RCA patency: 86.3% RGEA–RCA patency: 66.3% P = 0.004</td>
<td>Use of SVG was a predictor of superior graft functionality according to multivariate regression analysis</td>
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<td>Follow-up study</td>
<td>Di Mauro et al. (2009), J Thorac Cardiovasc Surg, Italy [8]</td>
<td>Comparison of 643 bilateral ITA plus SVG to RCA cases with 372 bilateral ITA plus RGEA to RCA.</td>
<td>8-year freedom from all mortality, cardiac death, myocardial infarction, re-intervention</td>
<td>8-year freedom from cardiac mortality was higher with SVG (98.6%) compared with RGEA use (94.5%), P = 0.004</td>
<td>Inferior clinical outcomes for RGEA to RCA grafting</td>
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<td>Retrospective, propensity analysis (level II)</td>
<td>Suzuki et al. (2011), Ann Thorac Surg, Japan [9]</td>
<td>320 patients over 8 years: 229 underwent RGEA–RCA and 91 had SVG–RCA grafting</td>
<td>Late clinical outcomes (mean follow-up 5.1 years):</td>
<td>7-year freedom from all-cause mortality: 96% in the RGEA group and 82.2% in the SVG group (P = 0.03)</td>
<td>Better clinical outcomes for RGEA to RCA grafting</td>
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<td>Retrospective, propensity score matching (level II)</td>
<td>Glineur et al. (2012), Eur J Cardiothorac Surg, Belgium [10]</td>
<td>297 patients undergoing isolated CABG with left-sided bilateral ITA grafting between 1985 and 1995</td>
<td>Overall survival and freedom from cardiac death (mean follow-up 16.1 years)</td>
<td>10-year survival was 98.9% in the RGEA group and 87.2% in the SVG group</td>
<td>Historic data that may represent a different case mix (compared with current patient cohorts requiring revascularization) and less intense secondary prevention pharmacotherapy</td>
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</table>

Note: The RGEA was harvested as a skeletonized pedicle.
Late survival, freedom from cardiac events, angina patients. Patency rates were very good and did not differ between the two conduits (92.1% for both at 3 years; 85.7 and 79.5% at 5 years for the RGEA and SVG, respectively).

Pevni et al. [4], despite extending the follow-up period and marginally the number of cases from their previous report [2], came to the same conclusion of clinical outcome equivalence between the RGEA and SVG grafting to the RCA (Kaplan–Meier 6-year survival of 89.5 and 85%, respectively).

Esaki et al. [5] reviewed 311 cases where bilateral ITAs were used for the left coronary system of which 99 received RGEA and 212 SVG grafting to the RCA. Early postoperative angiography (within 2 weeks) took place in the majority (95%) of patients. Patency rates were very good and did not differ between the two groups (100 vs 96.6% for the RGEA and SVG, respectively). Late survival, freedom from cardiac events, angina or reintervention were also similar.

Glineur et al. reported 6-month [6] and 3-year [7] angiographic outcomes of a randomized study in which patients received RGEA or SVG grafting to the right coronary territory. Patency was classified as Grade 0 (non-apatent), Grade 1 (balanced or patent but not functioning), and Grade 2 (fully patent). At 6 months, there was functional superiority of the SVG over the RGEA conduit, with 95% (97/102) and 79% (83/105) (P = 0.001). Grade 2 patency. This observation was also apparent at 3 years with 86% (69/80) and 66% (61/92) patency rates for the SVG and RGEA grafts, respectively.

Di Mauro et al. [8] assessed the effect of either SVG (n = 643) or RGEA (n = 258) grafting of the RCA in patients with bilateral ITAs using propensity score matching. Adjusted results demonstrated 8-year freedom from cardiac death to be more favourable for the SVG (98.6%) compared with the RGEA (94.5%) (P = 0.004), and this effect was more pronounced with <80% RCA stenosis.

Suzuki et al. [9] in a similar observational study assessed 85 propensity-matched pairs of patients who received bilateral ITAs and either an RGEA or SVG graft to the RCA. In contrast to the previous study, 7-year freedom from cardiac death was significantly higher in the RGEA group (96%) compared with the SVG group (82.2%).

Glineur et al. [10] in another propensity score analysis, evaluated very long (10 and 20-year) clinical outcomes of their historic group of bilateral ITAs and the RGEA or the SVG to the RCA. They concluded that RGEA use led to superior overall and cardiac survival, which is in contrast to the findings and conclusions of their previous randomized study.

Finally, in a CT angiographic study of 121 patients (66 with RGEA and 55 with SVG grafts to the RCA), the overall patency at almost 2 years of the mean follow-up was similar between the two groups. However, Kaplan–Meier estimates of 5-year patency rates were found superior for the RGEA when the native RCA stenosis was >80%.

**CLINICAL BOTTOM LINE**

Based on the best available evidence, it appears that revascularization of the RCA is better achieved with the use of the SVG than with the RGEA, especially at early and mid-term points. The potential very long (>10 years) survival benefit conferred by RGEA grafting, as shown in an observational study [10], has to be viewed against the lack of angiographic evidence to support the clinical data and the potential for less intensive statin and aspirin treatment (which are known to influence vein graft patency) in this historic cohort.

Competitive flow is an important technical issue with the RGEA graft, which is a fourth generation branch of the aorta, when the aorto-coronary SVG routes blood directly from the aorta. This may explain a lower driving pressure of the RGEA than the SVG. For this reason, and with the support of recently published angiographic data [11], any recommendation for RGEA grafting should apply to high-grade RCA stenosis [12] and when the RGEA lumen diameter exceeds 2.6 mm [13]. This is also in line with the recent guidance for grafting of the RCA where the presence of critical native artery stenosis (>90%) is the determining factor for the use of an arterial conduit [14].

In an era when cardiac surgeons are becoming less familiar with abdominal surgery and when prolonged survival of patients undergoing CABG could also increase their lifetime possibility for future laparotomy/laparoscopy, the use of the RGEA becomes even more limited.

We have previously shown that SVG grafting of the RCA is possibly superior to the right ITA [15]; if one elects, however, to...
use the right ITA for a left-sided target along with the left ITA, then the SVG remains the graft of choice when compared with the only other pedicled arterial graft, the RGEA, and should be used preferentially.

REFERENCES


