Does the right internal thoracic artery or saphenous vein graft offer superior revascularization of the right coronary artery?

Dayal Mukherjeea, Jerry Cheriyana, Antonios Kourliourosb,* and Thanos Athanasioua

a Division of Surgery, Imperial College, London, UK
b Department of Cardiac Surgery, St Thomas’ Hospital, London, UK
* Corresponding author. Department of Cardiac Surgery, St Thomas’ Hospital, Westminster Bridge Road, London SE1 7EH, UK. Tel: +44-207-1880975; e-mail: a.kourliouros@gmail.com, akou@doctors.org.uk (A. Kourliouros).

Received 16 January 2012; received in revised form 18 March 2012; accepted 1 April 2012

Abstract

A best evidence topic was written according to a structured protocol. The question addressed was whether the right internal thoracic artery (RITA) provides a superior outcome for revascularization of the right coronary artery (RCA) compared with the saphenous vein graft (SVG). Using a designated search strategy, 226 articles were found, of which five represented the best available evidence. The authors, journal, date, country of publication, study type, patient group studied, relevant outcomes and results were tabulated. Of these five studies, one offered level I evidence (data from a randomized trial) and four were level II studies (reports of observational data). The outcome measures varied considerably, but most included graft patency at varying levels of the follow-up. The randomized data showed strong evidence favouring the SVG, mainly in terms of mid-term patency. With the exception of a large cohort study that demonstrated the superior patency of the RITA compared with the SVG in the right coronary territory, the observational studies showed better results for SVG in graft patency, reintervention and cardiovascular complication rate. Overall, and in view of the methodological limitations and the different weight of evidence among studies, it appears that the SVG may offer a superior outcome for revascularization of the RCA when compared with the RITA.

Keywords: Right internal thoracic artery • Saphenous vein graft • Right coronary artery • Patency • Graft failure

INTRODUCTION

A best evidence topic was constructed according to a structured protocol [1].

THREE-PART QUESTION

In patients [undergoing CABG] which conduit [RITA or SVG] provides [better revascularization of the RCA]? 

CLINICAL SCENARIO

You attend the joint cardiology/cardiac surgery meeting where the on-call cardiologist presents the case of a 52-year old man who was admitted to the hospital with unstable angina. The patient has a strong family history of coronary artery disease and had a stent inserted into his proximal left anterior descending artery (LAD) 3 years previously following a myocardial infarction. Repeat angiography demonstrated a critical in-stent stenosis and a de novo 80% lesion in the mid portion of the right coronary artery (RCA). The non-dominant circumflex system appeared unobstructed. He is referred to you for urgent coronary artery bypass grafting (CABG) with the suggestion of using bilateral internal thoracic artery (ITA) due to the patient’s relatively young age. You claim that your routine practice of revascularization of the RCA consists of the saphenous vein graft (SVG) but decide to look at the literature and proceed based on the best available evidence.

SEARCH STRATEGY

Medline (Pubmed interface), Embase, the Cochrane Library and Google Scholar databases were searched for all studies between 1980 and 2011 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 AND [(right internal mammary artery) OR (right internal thoracic artery [RITA]) OR (saphenous vein)]. The ‘Related articles’ feature was used and reference lists of all retrieved articles reviewed to capture relevant articles.

SEARCH OUTCOME

Two hundred and twenty-six articles were identified, of which five were found to represent the best evidence to address the question (Table 1).
Table 1: Summary of best evidence papers

<table>
<thead>
<tr>
<th>Author (date), country</th>
<th>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>Tatoulis et al. (2004), Ann Thorac Surg [2], Australia</td>
<td>Observational (level II)</td>
<td>Postoperative angiograms in patients with the recurrence of cardiac symptoms</td>
<td>Angiographic patency</td>
<td>Conduit failure: total occlusion, ‘string’ sign (diameter &lt;1 mm) or &gt;80% stenosis</td>
<td>Mean follow-up: 81.9 months for RITA, 104.9 months for SVG grafts</td>
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<tr>
<td></td>
<td></td>
<td>Two thousand one hundred and twenty-seven arterial/coronary conduits (and 3714 SVG) angiograms</td>
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<tr>
<td>Pevni et al. (2005), Ann Thorac Surg [3], Israel</td>
<td>Prospective cohort (level II)</td>
<td>One thousand consecutive patients undergoing left coronary system revascularization with bilateral internal thoracic arteries (BITA)</td>
<td>Thirty-day mortality, complications (sternal wound infection, myocardial infarction, stroke and bleeding)</td>
<td>Mid-term angiographic patency in selected patients (for chest pain or consent for elective re-study)</td>
<td>Mean follow-up: 67 months</td>
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<td></td>
<td></td>
<td>Six hundred and nineteen patients received the RCA graft</td>
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<td>No significant difference in 30-day mortality</td>
</tr>
<tr>
<td>Shah et al. (2005), Eur J Cardiothorac Surg [4], Australia</td>
<td>Retrospective (level II)</td>
<td>Review of 219 coronary angiograms of patients presented with recurrent angina after primary CABG (using at least one ITA and one radial artery graft)</td>
<td>Mid-term angiographic patency</td>
<td>Graft failure if ≥50% stenosis, string sign or occlusion</td>
<td>Mean follow-up: 3 years</td>
</tr>
<tr>
<td>Yi et al. (2010), Ann Thorac Surg [5], South Korea</td>
<td>Prospective cohort (level II)</td>
<td>Three hundred and fifty-eight off-pump patients who received either in situ RITA to RCA (n = 199) or SVG to RCA (n = 159)</td>
<td>Major adverse cardiac and cerebrovascular events</td>
<td>Angiographic patency</td>
<td>Mean follow-up: 57.6 months</td>
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<td>Sliced CT at 7 days and 1 year (at least) or coronary angiography if symptoms suggestive of ischaemia</td>
<td>Incidence of RCA reintervention</td>
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</tbody>
</table>

Continued
RESULTS

In a large cohort study published in 2004, Tatoulis et al. [2] assessed the angiographic patency of arterial conduits used for the revascularization of different coronary territories in patients with postoperative cardiac symptoms. With a mean follow-up of 81.9 months for the 254 RITA to RCA grafts, overall patency was 83.1% (this outcome was improved for free RITA compared with the \textit{in situ} graft). Although not directly compared, the SVG patency rate for RCA revascularization was in the region of 62%, which was clearly less favourable against the RITA. It is possible, however, that since this data refers to a period (1987–2001) during which intensive statin and early antiplatelet therapy were not routinely administered, such increased vein graft failure rate could be overstated with modern standards.

Pevni et al. [3] performed the free RITA to RCA grafts in 231 patients and the SVG to RCA grafts in 142; however, only six RITA grafts and 18 SVG grafts underwent postoperative angiography (mainly for recurrence of angina). Of the grafts re-studied, the RITA to RCA patency was 83.3% (5/6) and the SVG to RCA patency was 100% (18/18), with the angiographic follow-up ranging from 6 to 36 months. Similar outcomes were demonstrated for early mortality and 6-year Kaplan–Meier survival between the RITA and SVG groups. A non-significant trend for increased overall postoperative complications was noted in the RITA group.

Shah et al. [4] reviewed mid-term patency in 219 coronary angiograms, in patients who presented with angina recurrence or evidence of ischaemia, where at least one radial artery and one RITA were used as conduits. Of the eligible angiograms, the RITA to RCA patency was found to be 90.5% (19/21), while the SVG to RCA patency was 92% (23/25), a marginal trend favouring venous grafts (significance not estimated).

In a study by Yi et al. [5], 358 patients who underwent off-pump CABG were prospectively evaluated with multislice computed tomography (CT) or standard angiography for graft patency at different time points. One hundred and ninety-nine patients received \textit{in situ} RITA to RCA grafts and 159 patients received SVG to RCA grafts. The degree of native RCA stenosis (>75%) was similar between the two groups (53.3 vs.
54.1%, respectively). At the mean follow-up of 57.6 months, overall patency was 89.4% (178/199) for RITA and 93.1% (148/159) for SVG grafts. Estimated 5-year freedom from graft occlusion was found to be increased in the SVG group with an associated lower reintervention rate with the RCA. There was no difference in overall mortality or composite cardiovascular outcomes.

Glineur et al. [6] provided the highest standard of evidence included in our analysis. They assessed mid-term angiographic graft patency to the RCA (‘graft functionality’ based on a five-point scale) in 210 consecutive patients who were randomly assigned to the SVG (n = 81), RITA (n = 37) or right gastroepiploic (n = 92) to RCA grafts. The degree of native RCA stenosis was similar between the groups. At 3 years, the SVG to RCA grafts were functionally superior at 86% (70/81) when compared with the RITA graft at 68% (25/37). This pattern was more pronounced when the RCA lumen diameter was >1.1 mm (which is where arterial grafts appeared to under-perform). An important consideration in this study is that the RITA was employed in a Y-graft configuration.

**CLINICAL BOTTOM LINE**

Revascularization of the RCA with the SVG appears to ensure higher early and mid-term patency rates and improved clinical outcomes when compared with the RITA. The strongest evidence derives from the recent randomized study by Glineur et al. [6]. Although the data from observational studies still favour the use of SVG, albeit marginally, the lack of standardization and the small numbers limit the generalization of results. The larger study by
Tatoulis et al. [2], which demonstrated the better outcomes of the RITA to RCA grafting, may not need to be viewed as showing the superiority of the RITA but as showing the potentially increased venous graft failure caused by less intensive preventative pharmacotherapy during the earlier years of coronary revascularization.

The validity of these results will have to be viewed through the methodological limitations of individual studies and the technical considerations relevant to RCA grafting: the follow-up angiography in most cases was carried out ad hoc for symptomatic ischaemia, which does not always coincide with the occurrence of graft obstruction; hence the potential conflict between the Kaplan-Meier estimates and the actual graft patency rates. Concurrently, due to the lack of a long-term follow-up (>5 years) in these studies, it is debatable as to whether the patency superiority of venous grafts is maintained with time. Variable configurations of the RITA (free, pedicled and Y-graft), native RCA diameter and degree of stenosis [7], and the anatomical target of the anastomosis (main RCA vs. posterior descending artery), could also play a critical role in the flow dynamics and graft performance. In conclusion, the RITA use did not demonstrate a superior outcome and, until appropriately controlled studies with a long-term angiographic follow-up suggest otherwise, revascularization of the RCA should preferentially be performed with the SVG.

Conflict of interest: none declared.

REFERENCES