Revisiting Arterial Conduits

Mario Gaudino, MD, FEBCTS
Weill Cornell Medicine, New York City, NY, USA
Chair Coronary Artery Task Force,
European Association for Cardio-Thoracic Surgery.
2018: 50 years from Favaloro .....
Saphenous Vein Autograft Replacement of Severe Segmental Coronary Artery Occlusion

Operative Technique

Rene G. Favaloro, M.D.

Direct operation on the coronary artery has been performed in 180 patients at the Cleveland Clinic up to October, 1967. Recently, a new operative technique has been applied in 15 patients with extensive and severe obstruction of the right dominant coronary artery, specifically to overcome some of the unfavorable results that occurred when pericardial patch reconstruction was performed.
RESULTS

This operation has been performed in 15 patients, all of whom are alive. Each of them had severe segmental occlusion of the right dominant coronary artery. One patient had previously undergone a right coronary endarterectomy. Three patients also benefited by simultaneously undergoing left internal mammary artery implantation, since severe obstruction of the left coronary artery system was present. The last patient had a 95% occlusion in the upper third of the right coronary artery, starting at the ostium. The saphenous vein graft was placed in the lower portion of the ascending aorta; there, a small opening was made and a side-to-end anastomosis was accomplished. The distal anastomosis was effected with the routine end-to-end anastomosis in the middle third of the right coronary artery. Six of these patients had undergone postoperative cine-coronary angiography studies showing excellent function of the graft (Figs. 5, 6).
Double Internal Mammary-Coronary Artery Bypass

Hendrick B. Barner, MD

Double internal mammary-coronary artery bypass in 100 patients with angina was associated with 35 single-vein grafts and four double-vein grafts. Hospital mortality was 8%. Postoperative catheterization revealed patency of 80 of 84 (95%) right internal mammary artery (RIMA) grafts, 82 of 84 (97%) left internal mammary artery (LIMA) grafts, and 36 of 41 (88%) vein grafts. At one year, 22 of 23 (96%) RIMA grafts and 22 of 22 LIMA grafts remained patent. There were two late deaths, one late infarction, and three of 23 patients with angina at one year. Five of 45 IMA grafts had diffuse narrowing. The right and left IMA are hemodynamically similar, but the right will usually not reach beyond the acute margin and is smaller than the right coronary artery (RCA) one third of the time. The LIMA graft is the graft of choice for left anterior descending (LAD) reconstruction, but use of the RIMA for RCA or LAD bypass must be based on the age of the patient, the size of the coronary artery, and the distribution of atherosclerosis.

Fig 1.—Postoperative (left) and one-year (right) cineangiograms demonstrating normal left internal mammary artery initially, with continued patency but diffuse uniform narrowing at one year.
Unmeasured Confounders in Observational Studies Comparing Bilateral Versus Single Internal Thoracic Artery for Coronary Artery Bypass Grafting: A Meta-Analysis

Mario Gaudino, MD; Antonino Di Franco, MD; Mohamed Rahouma, MD; Derrick Y. Tam, MD; Mario Iannaccone, MD; Saswata Deb, MD; Fabrizio D’Ascenzo, MD; Ahmed A. Abouarab, MD; Leonard N. Girardi, MD; David P. Taggart, PhD; Stephen E. Femes, MD

Background—Observational studies suggest a survival advantage with bilateral single internal thoracic artery (BITA) versus single internal thoracic artery grafting for coronary surgery, whereas this conclusion is not supported by randomized trials. We hypothesized that this inconsistency is attributed to unmeasured confounders intrinsic to observational studies. To test our hypothesis, we performed a meta-analysis of the observational literature comparing BITA and single internal thoracic artery, deriving incident rate ratio for mortality at end of follow-up and at 1 year. We postulated that BITA would not affect 1-year survival based on the natural history of coronary artery bypass occlusion, so that a difference between groups at 1 year could not be attributed to the intervention.

Methods and Results—We searched MEDLINE and Pubmed to identify all observational studies comparing the outcome of BITA versus single internal thoracic artery. One-year and long-term mortality for BITA and single internal thoracic artery were compared in the propensity-score–matched (PSM) series, that is, the form of observational evidence less prone to confounders. Thirty-eight observational studies (174 205 total patients) were selected for final comparison. In the 12 propensity-score–matched series (34 019 patients), the mortality reduction for BITA was similar at 1 year and at the end of follow-up (incident rate ratio, 0.70; 95% confidence interval, 0.60–0.82 versus 0.77; 95% confidence interval, 0.70–0.85; P for subgroup difference=0.43).

Conclusions—Unmeasured confounders, rather than biological superiority, may explain the survival advantage of BITA in observational series. (J Am Heart Assoc. 2018;7:e008010. DOI: 10.1161/JAHA.117.008010.)
### A

**Study Name**

<table>
<thead>
<tr>
<th>Table</th>
<th>Study Name</th>
<th>Point (raw) and 95% CI</th>
<th>Point (raw) and 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### B

**Study Name**

<table>
<thead>
<tr>
<th>Table</th>
<th>Cumulative statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Point (raw) and 95% CI</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

Gaudino et al. JAHA 2018
Forest plot comparing the effect of the use of BITA vs SITA on end of follow-up (top) and 1-year (bottom) mortality

<table>
<thead>
<tr>
<th>Group by Time</th>
<th>Study name</th>
<th>Point (raw)</th>
<th>Lower limit</th>
<th>Upper limit</th>
<th>Z-Value</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>End of follow-up</td>
<td>Benedetto 2014</td>
<td>0.610</td>
<td>0.362</td>
<td>0.975</td>
<td>-2.067</td>
<td>0.039</td>
</tr>
<tr>
<td></td>
<td>Calafiore 2004</td>
<td>0.526</td>
<td>0.279</td>
<td>0.991</td>
<td>-1.988</td>
<td>0.047</td>
</tr>
<tr>
<td></td>
<td>Dalen 2014</td>
<td>1.040</td>
<td>0.776</td>
<td>1.393</td>
<td>0.263</td>
<td>0.793</td>
</tr>
<tr>
<td></td>
<td>Grau 2015</td>
<td>0.693</td>
<td>0.577</td>
<td>0.832</td>
<td>-3.925</td>
<td>0.0007</td>
</tr>
<tr>
<td></td>
<td>Joo 2012</td>
<td>0.909</td>
<td>0.728</td>
<td>1.286</td>
<td>-0.220</td>
<td>0.826</td>
</tr>
<tr>
<td></td>
<td>Kelly 2012</td>
<td>0.818</td>
<td>0.672</td>
<td>0.996</td>
<td>-2.001</td>
<td>0.045</td>
</tr>
<tr>
<td></td>
<td>Kurlansky 2010</td>
<td>0.834</td>
<td>0.767</td>
<td>0.907</td>
<td>-4.263</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>Lytle 2004</td>
<td>0.805</td>
<td>0.721</td>
<td>0.896</td>
<td>-3.882</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>Nass 2012</td>
<td>0.699</td>
<td>0.612</td>
<td>0.800</td>
<td>-5.227</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>Rosenthal 2016</td>
<td>0.743</td>
<td>0.511</td>
<td>1.389</td>
<td>0.953</td>
<td>0.341</td>
</tr>
<tr>
<td></td>
<td>Schaim 2016</td>
<td>0.658</td>
<td>0.511</td>
<td>0.848</td>
<td>-3.236</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>Stevens 2004</td>
<td>0.740</td>
<td>0.604</td>
<td>0.906</td>
<td>-2.912</td>
<td>0.004</td>
</tr>
<tr>
<td></td>
<td>Overall</td>
<td>0.752</td>
<td>0.688</td>
<td>0.821</td>
<td>-6.358</td>
<td>0.000</td>
</tr>
<tr>
<td>One year</td>
<td>Benedetto 2014</td>
<td>0.559</td>
<td>0.292</td>
<td>1.069</td>
<td>-1.760</td>
<td>0.078</td>
</tr>
<tr>
<td></td>
<td>Calafiore 2004</td>
<td>0.446</td>
<td>0.209</td>
<td>0.951</td>
<td>-2.089</td>
<td>0.037</td>
</tr>
<tr>
<td></td>
<td>Dalen 2014</td>
<td>1.407</td>
<td>0.727</td>
<td>2.724</td>
<td>1.014</td>
<td>0.311</td>
</tr>
<tr>
<td></td>
<td>Grau 2015</td>
<td>1.289</td>
<td>0.636</td>
<td>2.610</td>
<td>0.704</td>
<td>0.481</td>
</tr>
<tr>
<td></td>
<td>Joo 2012</td>
<td>1.628</td>
<td>0.728</td>
<td>3.645</td>
<td>1.196</td>
<td>0.236</td>
</tr>
<tr>
<td></td>
<td>Kelly 2012</td>
<td>0.819</td>
<td>0.582</td>
<td>1.154</td>
<td>-1.140</td>
<td>0.254</td>
</tr>
<tr>
<td></td>
<td>Kurlansky 2010</td>
<td>0.698</td>
<td>0.526</td>
<td>0.927</td>
<td>-2.487</td>
<td>0.013</td>
</tr>
<tr>
<td></td>
<td>Lytle 2004</td>
<td>0.500</td>
<td>0.247</td>
<td>1.014</td>
<td>-1.921</td>
<td>0.055</td>
</tr>
<tr>
<td></td>
<td>Nass 2012</td>
<td>0.585</td>
<td>0.463</td>
<td>0.739</td>
<td>-4.492</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>Rosenthal 2016</td>
<td>0.390</td>
<td>0.124</td>
<td>1.225</td>
<td>-1.612</td>
<td>0.107</td>
</tr>
<tr>
<td></td>
<td>Schaim 2016</td>
<td>0.294</td>
<td>0.120</td>
<td>0.673</td>
<td>-2.860</td>
<td>0.004</td>
</tr>
<tr>
<td></td>
<td>Stevens 2004</td>
<td>0.777</td>
<td>0.509</td>
<td>1.187</td>
<td>-1.196</td>
<td>0.244</td>
</tr>
<tr>
<td></td>
<td>Overall</td>
<td>0.700</td>
<td>0.599</td>
<td>0.819</td>
<td>-4.487</td>
<td>0.000</td>
</tr>
</tbody>
</table>
Radial-Artery or Saphenous-Vein Grafts in Coronary-Artery Bypass Surgery

Mario Gaudino, M.D., Umberto Benedetto, M.D., Stephen Fremes, M.D., Giuseppe Biondi-Zoccai, M.D., M.Stat., Art Sedrakyan, M.D., Ph.D., John D. Puskas, M.D., Gianni D. Angelini, M.D., Brian Buxton, M.D., Giacomo Frati, M.D., David L. Hare, M.D., Philip Hayward, M.D., Giuseppe Nasso, M.D., Neil Moat, M.D., Miodrag Peric, M.D., Kyung J. Yoo, M.D., Giuseppe Speziale, M.D., Leonard N. Girardi, M.D., and David P. Taggart, M.D., for the RADIAL Investigators*
Background and Objectives

• The RADIAL (Radial Artery Database International Alliance) started in March 2015.
• The primary aim was to overcome the limitations of individual studies in detecting differences in clinical outcomes by performing a patient-level meta-analysis of all the RCTs comparing RA vs SVG grafts for CABG.
Methods

• **Primary Outcome**
  • *Major Adverse Cardiac Events during follow-up (death, myocardial infarction and/or repeat revascularization)*

  • *Each individual component of the primary outcome was also analyzed separately*

• **Secondary Outcome**
  • Follow-up angiographic graft patency
  • *(Fitzgibbon O = occluded; A,B = patent)*
## Trials included

<table>
<thead>
<tr>
<th>Trial</th>
<th>Year (enroll)</th>
<th>Country</th>
<th>Total</th>
<th>Radial-artery graft group</th>
<th>Saphenous-vein graft group</th>
<th>Mean Age (SD)</th>
<th>% Male</th>
<th>Clinical follow-up (years)</th>
<th>Crossover</th>
<th>Follow-up angiography (N)</th>
<th>Median time to angiography (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Petrovic</td>
<td>2001-2003</td>
<td>Serbia</td>
<td>200</td>
<td>100</td>
<td>100</td>
<td>56.4(6.1)</td>
<td>72.5%</td>
<td>8</td>
<td>0.0%</td>
<td>47</td>
<td>6</td>
</tr>
<tr>
<td>RAPCO</td>
<td>1997-2004</td>
<td>Australia</td>
<td>225</td>
<td>113</td>
<td>112</td>
<td>72.8(4.7)</td>
<td>80.9%</td>
<td>5</td>
<td>3.6%</td>
<td>84</td>
<td>5</td>
</tr>
<tr>
<td>RAPS*</td>
<td>1996-2001</td>
<td>Canada, New Zealand</td>
<td>269</td>
<td>269</td>
<td>269</td>
<td>60.4(8.0)</td>
<td>84.8%</td>
<td>8.4</td>
<td>2.6%</td>
<td>269</td>
<td>7.7±1.5</td>
</tr>
<tr>
<td>RSVP</td>
<td>1998-2000</td>
<td>United Kingdom</td>
<td>142</td>
<td>82</td>
<td>60</td>
<td>58.5(6.7)</td>
<td>96.5%</td>
<td>5.5</td>
<td>0.0%</td>
<td>122</td>
<td>5.5</td>
</tr>
<tr>
<td>Stand-in-Y</td>
<td>2003-2006</td>
<td>Italy</td>
<td>409</td>
<td>204</td>
<td>205</td>
<td>70.3(7.7)</td>
<td>57.0%</td>
<td>3.3</td>
<td>4.2%</td>
<td>405</td>
<td>3.5</td>
</tr>
<tr>
<td>Yoo</td>
<td>2008-2009</td>
<td>Korea</td>
<td>60</td>
<td>35</td>
<td>25</td>
<td>75.7(5.4)</td>
<td>50.0%</td>
<td>5.8</td>
<td>0.0%</td>
<td>41</td>
<td>0.7</td>
</tr>
</tbody>
</table>

5Petrovic trial is not included in the analyses of graft occlusion

*RAPS trial is not included in the analysis of clinical outcomes and in the main analysis of graft occlusion
Hazard ratio 0.67 (95% CI 0.49-0.90)
Hazard ratio 0.44 (95% CI 0.28-0.70)
Hazard ratio 0.90 (95% CI 0.59-1.41)

Hazard ratio 0.50 (95% CI 0.40-0.63)
# Subgroup analysis

<table>
<thead>
<tr>
<th>Subgroup</th>
<th>total n</th>
<th>RA events/tot, n(%)</th>
<th>SVG events/tot, n(%)</th>
<th>Hazard Ratio</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>1036</td>
<td>67/534 (12.5)</td>
<td>94/502 (18.7)</td>
<td>0.67 (0.49–0.9)</td>
<td>0.008</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;75</td>
<td>864</td>
<td>50/454 (11.0)</td>
<td>77/410 (18.8)</td>
<td>0.61 (0.42–0.87)</td>
<td>0.008</td>
</tr>
<tr>
<td>&gt;75</td>
<td>172</td>
<td>17/80 (21.2)</td>
<td>17/92 (18.5)</td>
<td>1.0 (0.48–2.08)</td>
<td>0.008</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>309</td>
<td>10/158 (6.3)</td>
<td>29/151 (19.2)</td>
<td>0.23 (0.09–0.56)</td>
<td>0.01</td>
</tr>
<tr>
<td>Male</td>
<td>727</td>
<td>57/376 (15.2)</td>
<td>65/351 (18.5)</td>
<td>0.83 (0.57–1.2)</td>
<td>0.01</td>
</tr>
<tr>
<td>Diabetes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.35</td>
</tr>
<tr>
<td>Yes</td>
<td>358</td>
<td>26/181 (14.4)</td>
<td>31/177 (17.5)</td>
<td>0.79 (0.45–1.43)</td>
<td>0.35</td>
</tr>
<tr>
<td>No</td>
<td>678</td>
<td>41/353 (11.6)</td>
<td>63/325 (19.4)</td>
<td>0.58 (0.38–0.88)</td>
<td>0.35</td>
</tr>
<tr>
<td>Renal Insufficiency</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>91</td>
<td>9/45 (20.0)</td>
<td>6/46 (13.0)</td>
<td>2.44 (0.78–7.69)</td>
<td>0.016</td>
</tr>
<tr>
<td>No</td>
<td>945</td>
<td>58/489 (11.9)</td>
<td>88/456 (19.3)</td>
<td>0.57 (0.4–0.81)</td>
<td>0.016</td>
</tr>
<tr>
<td>LVEF</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;35%</td>
<td>57</td>
<td>7/25 (28.0)</td>
<td>8/32 (25.0)</td>
<td>0.83 (0.26–2.7)</td>
<td>0.37</td>
</tr>
<tr>
<td>&gt;35%</td>
<td>979</td>
<td>60/509 (11.8)</td>
<td>86/470 (18.3)</td>
<td>0.63 (0.44–0.89)</td>
<td>0.37</td>
</tr>
<tr>
<td>Prior MI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>324</td>
<td>23/164 (14.0)</td>
<td>39/160 (24.4)</td>
<td>0.51 (0.28–0.91)</td>
<td>0.45</td>
</tr>
<tr>
<td>No</td>
<td>712</td>
<td>44/370 (11.9)</td>
<td>55/342 (16.1)</td>
<td>0.71 (0.47–1.09)</td>
<td>0.45</td>
</tr>
<tr>
<td>Target Vessel</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LCX</td>
<td>784</td>
<td>54/415 (13.0)</td>
<td>75/369 (20.3)</td>
<td>0.61 (0.41–0.88)</td>
<td>0.42</td>
</tr>
<tr>
<td>RCA</td>
<td>252</td>
<td>13/119 (10.9)</td>
<td>19/133 (14.3)</td>
<td>0.87 (0.41–1.85)</td>
<td>0.42</td>
</tr>
</tbody>
</table>
Arterial Revascularization Trial (ART)
Randomized comparison of single versus bilateral internal thoracic artery grafts in 3102 CABG patients:
Major cardiovascular outcomes at ten years of follow up

David P Taggart MD (Hons), PhD, FRCS, FESC
Professor of Cardiovascular Surgery
University of Oxford, United Kingdom

for the Arterial Revascularization Trial Investigators
(No conflicts declared)

ESC 2018
Largest cardiac surgery trials
(sample size is adjusted by the length of the follow-up)
Analysis of Results at 10 Years:

98.4% of Patients With Vital Status

- **Intention To Treat (ITT):**

- **(As Treated (AT):** Non-Randomized

- 36% of Patients Received A ‘Different’ Treatment Strategy

- 14% of Bilateral ITA crossed to Single ITA

- 22% of Single ITA received a 2\textsuperscript{nd} Arterial Graft (Radial Artery)
Mortality at 10 years (Intention to treat)

\[ HR \ (95\% \ CI) = 0.96 \ (0.82, \ 1.12) \]
\[ p = 0.62 \]

<table>
<thead>
<tr>
<th>No. at risk</th>
<th>0</th>
<th>2</th>
<th>4</th>
<th>6</th>
<th>8</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bilateral graft</td>
<td>1548</td>
<td>1481</td>
<td>1417</td>
<td>1359</td>
<td>1283</td>
<td>882</td>
</tr>
<tr>
<td>Single graft</td>
<td>1554</td>
<td>1484</td>
<td>1432</td>
<td>1370</td>
<td>1283</td>
<td>894</td>
</tr>
</tbody>
</table>
Death/MI/Stroke 10 years (Intention to treat)

HR (95% CI) = 0.90 (0.78, 1.03)

p = 0.12

No. at risk
Bilateral graft 1548  1435  1362  1299  1214  830
Single graft 1554  1427  1366  1296  1194  821
Mortality at 10 years (As treated)

HR (95% CI) = 0.81 (0.68, 0.95)

No. at risk
MAG  1690  1632  1567  1510  1430  998
SAG  1330  1270  1222  1163  1081  750
Death/MI/Stroke 10 years (as treated)

HR (95% CI) = 0.80 (0.69, 0.93)

No. at risk
MAG 1690 1591 1510 1442 1353 934
SAG 1330 1212 1162 1101 1006 692
Why No Difference in Bilateral vs Single ITA Grafts at 10 years (Intention To Treat)?

① **Genuinely NO Difference:**
   (Concept of Complete vs Incomplete Revascularization?)

② **Guideline Based Medical Therapy:**
   in > 80% (slows vein graft failure?)

③ **Radial Artery Use:**
   22% of Single ITA: (superior 5yr patency and clinical outcomes)

④ **Differential X-over:**
   14% of Bilateral ITA ➔ Single ITA; 4% Single ITA ➔ Bilateral ITA

⑤ **Surgeon Experience:**
   Individual Surgeon X-over for Bilateral ITA to Single ITA : 0%-100%
Effect of surgeon volume in ART

<table>
<thead>
<tr>
<th>Subgroup</th>
<th>Bilateral Graft</th>
<th>Single Graft</th>
<th>Hazard Ratio (95% CI)</th>
<th>P value for Interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 50 operations</td>
<td>172/829 (20.8)</td>
<td>151/846 (17.9)</td>
<td>1.17 (0.94, 1.46)</td>
<td>0.015</td>
</tr>
<tr>
<td>≥ 50 operations</td>
<td>127/637 (19.9)</td>
<td>159/634 (25.1)</td>
<td>0.79 (0.62, 0.99)</td>
<td></td>
</tr>
<tr>
<td>Composite – Death/MI/Stroke</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 50 operations</td>
<td>210/829 (25.3)</td>
<td>207/846 (24.5)</td>
<td>1.03 (0.85, 1.25)</td>
<td>0.058</td>
</tr>
<tr>
<td>≥ 50 operations</td>
<td>156/637 (24.5)</td>
<td>195/634 (30.8)</td>
<td>0.78 (0.63, 0.96)</td>
<td></td>
</tr>
</tbody>
</table>

Favors bilateral graft  | Favors single graft

0.5  | 0.67  | 1     | 1.5   | 2
10-Year mortality for highest volume surgeon in ART: 1.2% crossover from BITA to SITA

HR (95% CI) = 0.69 (0.46, 1.03)

<table>
<thead>
<tr>
<th></th>
<th>No. at risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bilateral graft</td>
<td>211</td>
</tr>
<tr>
<td></td>
<td>202</td>
</tr>
<tr>
<td></td>
<td>195</td>
</tr>
<tr>
<td></td>
<td>188</td>
</tr>
<tr>
<td></td>
<td>175</td>
</tr>
<tr>
<td></td>
<td>175</td>
</tr>
<tr>
<td></td>
<td>122</td>
</tr>
<tr>
<td>Single graft</td>
<td>205</td>
</tr>
<tr>
<td></td>
<td>196</td>
</tr>
<tr>
<td></td>
<td>188</td>
</tr>
<tr>
<td></td>
<td>175</td>
</tr>
<tr>
<td></td>
<td>161</td>
</tr>
<tr>
<td></td>
<td>114</td>
</tr>
</tbody>
</table>
Use Rate and Outcome in Bilateral Internal Thoracic Artery Grafting: Insights From a Systematic Review and Meta-Analysis

Mario Gaudino, MD; Faisal Bakaen, MD; Umberto Benedetto, PhD; Mohamed Rahouma, MD; Antonino Di Franco, MD; Derrick Y. Tam, MD; Mario Iannaccone, MD; Thomas A. Schwann, MD; Robert Habib, MD; Marc Ruel, MD; John D. Puskas, MD; Joseph Sabik, MD; Leonard N. Girardi, MD; David P. Taggart, MD; Stephen E. Freames, MD

**Background**—This meta-analysis was designed to assess whether center experience affects the short- and long-term results and the relative benefits of bilateral internal thoracic artery grafting (BITA) for coronary artery bypass grafting.

**Methods and Results**—MEDLINE and EMBASE were searched to identify all articles reporting the outcome of BITA in patients undergoing coronary artery bypass grafting. The BITA center experience was gauged according to the percentage use of BITA in the institutional overall coronary artery bypass grafting population (%BITA). The primary outcome was long-term all-cause mortality. Secondary outcomes were operative mortality, perioperative myocardial infarction, perioperative stroke, deep sternal wound infections (DSWIs), and major postoperative adverse event. The rates of the primary and secondary outcomes were calculated after adjusting for %BITA. Primary and secondary outcomes were also compared between the BITA and the single internal thoracic artery arms in the adjusted studies. Meta-regression was used to evaluate the effect of %BITA on the primary and secondary outcomes. Thirty-four studies (27,894 patients undergoing BITA) were included. In the pooled analysis, the incidence rate for long-term mortality was 2.83% (95% confidence interval, 2.21%–3.61%). %BITA was significantly and inversely associated with long-term mortality and the rate of DSWI. In the pairwise comparison, %BITA was significantly and inversely associated with the risk of long-term mortality and DSWI in the group undergoing BITA.

**Conclusions**—BITA series with higher %BITA report significantly lower long-term mortality and DSWI rate as well as higher long-term survival advantage and lower relative risk of DSWI in their BITA cohort. These findings suggest that a specific volume-outcome relationship exists for BITA grafting. (*J Am Heart Assoc.* 2018;7:e009361. DOI: 10.1161/JAHA.118.009361.)
Randomized comparison of the clinical
Outcome of single versus Multiple
Arterial grafts: the ROMA trial
How ROMA addresses ART limitations?

- **ROMA**: SS is event driven RCT; **ART**: underpowered, 10 years death rate 20% vs 25% expected
- **ROMA**: The primary outcome is MACCE; **ART**: all-cause mortality
- **ROMA**: SAG group is LITA + SVGs; **ART**: > 20% RA in SITA group
- **ROMA**: MAG second arterial graft (second ITA or RA) according to surgeon decision, and additional arterial grafts allowed; **ART**: BITA
- **ROMA**: Pilot phase to assess protocol adherence; **ART**: crossover rate > 15%
ROMA trial – Pilot phase projected recruitment
Progress

• Canadian CIHR grant for the pilot phase
• Pilot phase opened January 8, 2018
• First patient randomized in Innsbruck (Austria) January 8th, 2018
• Pilot phase enrollment completed September 5, 2018
• 22 centers open, 20 centers recruited at least 1 patient
ROMA trial – *Pilot phase actual and expected enrollment*
RCTs in CABG

<table>
<thead>
<tr>
<th>RCT</th>
<th>#of subjects</th>
</tr>
</thead>
<tbody>
<tr>
<td>CORONARY</td>
<td>4752</td>
</tr>
<tr>
<td>ROMA</td>
<td>4300</td>
</tr>
<tr>
<td>ART</td>
<td>3102</td>
</tr>
<tr>
<td>PREVENT IV</td>
<td>3014</td>
</tr>
<tr>
<td>ROOBY</td>
<td>2203</td>
</tr>
<tr>
<td>EXCEL</td>
<td>1905</td>
</tr>
<tr>
<td>FREEDOM</td>
<td>1900</td>
</tr>
<tr>
<td>SYNTAX</td>
<td>1800</td>
</tr>
<tr>
<td>NOBLE</td>
<td>1201</td>
</tr>
</tbody>
</table>
State of knowledge on arterial conduits - 2018

- Retrospective studies inadequate to provide solid answer to the arterial graft controversy.
- Strong signal in favor of the use of the RA and supporting the importance of surgeons’ experience.
- ROMA will probably provide the answer to the 40-year-old debate.
- A great time to be a coronary surgeon!!
Thank You