The Diabetes Epidemic and its Effect on Cardiac Surgery Practice: Operative Strategies to Maximize Long-Term Survival after CABG

Faisal Bakaeen, MD
Diabetes Epidemic

• The diabetes epidemic is one of the most challenging public health issues of the 21st century

• Responsible for 4.9 million deaths worldwide in 2014—one every 7 seconds

Diabetes Epidemic

• According to the World Health Organization, excess body weight and physical inactivity are the 2 main culprits leading to diabetes, which is now developing at younger ages.

• With diabetes comes development of CAD, which is not only common in diabetic patients, but also their major cause of death

www.who.int/mediacentre/factsheets/fs312/en/.
• The proportion of patients presenting for CABG who have diabetes is on the rise.

*Coronary artery bypass grafting in diabetics: A growing health care cost crisis*

Sajjad Raza, MD, Joseph F. Sabik III, MD, Ponnuthurai Ainkaran, MS, and Eugene H. Blackstone, MD

*Cleveland Clinic*
The Society of Thoracic Surgeons 2008 Cardiac Surgery Risk Models: Part 1—Coronary Artery Bypass Grafting Surgery

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Predictors of Long-Term Survival After Coronary Artery Bypass Grafting Surgery

Results From the Society of Thoracic Surgeons Adult Cardiac Surgery Database (The ASCERT Study)

David M. Shahian, MD; Sean M. O’Brien, PhD; Shubin Sheng, PhD; Frederick L. Grover, MD; John E. Mayer, MD; Jeffrey P. Jacobs, MD; Jocelyn M. Weiss, PhD, MPH; Elizabeth R. DeLong, PhD; Eric D. Peterson, MD, MPH; William S. Weintraub, MD; Maria V. Grau-Sepulveda, MD, MPH; Lloyd W. Klein, MD; Richard E. Shaw, PhD; Kirk N. Garratt, MD; Issam D. Moussa, MD; Cynthia M. Shewan, PhD; George D. Dangas, MD; Fred H. Edwards, MD

Table 2. Cox Model Hazard Ratios

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>0–30 d (No. of Deaths=11 062)</th>
<th>31–180 d (No. of Deaths=11 075)</th>
<th>181 d to 2 y (No. of Deaths=10 155)</th>
<th>≥2 y (No. of Deaths=28 164)</th>
</tr>
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<tbody>
<tr>
<td>Diabetes mellitus, insulin-dependent</td>
<td>1.21 (1.15–1.28)</td>
<td>1.59 (1.50–1.68)</td>
<td>1.61 (1.53–1.69)</td>
<td>1.77 (1.71–1.84)</td>
</tr>
<tr>
<td>Diabetes mellitus, non-insulin-dependent</td>
<td>0.96 (0.91–1.00)</td>
<td>1.25 (1.20–1.31)</td>
<td>1.21 (1.17–1.26)</td>
<td>1.30 (1.27–1.34)</td>
</tr>
</tbody>
</table>
Higher Atherosclerotic Burden
SYNTAX = Synergy between PCI with Taxus and Cardiac Surgery

Serruys et al. NEJM 2009;360:961
SYNTAX Investigators
Coronary artery bypass graft surgery versus percutaneous coronary intervention in patients with three-vessel disease and left main coronary disease: 5-year follow-up of the randomised, clinical SYNTAX trial

Friedrich W Mahr, Marie-Claude Monic, A Pieter Kappetein, Ted E Feldman, Elisabeth Stähle, Antonio Colombo, Michael J Mack, David R Holmes Jr, Marie-angèle Morel, Nic Van Dyck, Vicki M Houle, Keith D Dawkins, Patrick W Serruys

"CABG should remain the standard of care for patients with complex lesions (high or intermediate SYNTAX scores)."
Figure 3. Kaplan-Meier cumulative event curves for MACCE by baseline SYNTAX score tertile.
Treatment of complex coronary artery disease in patients with diabetes: 5-year results comparing outcomes of bypass surgery and percutaneous coronary intervention in the SYNTAX trial

Arie Pieter Kappetein*, Stuart J. Head*, Marie-Claude Morice*, Adrian P. Banning*, Patrick W. Serruys*, Friedrich-Wilhelm Mohr*, Keith D. Dawkins* and Michael J. Mack* on behalf of the SYNTAX Investigators

Diabetic

Non-Diabetic
Cost

OVERALL

MATCHED

Anesthesia
Surgical
Cardiology
Respiratory therapy
Professional
Imaging
Nursing
Pharmacy
Laboratory
Miscellaneous
Grand total

Cost Ratio (in log scale)
Arterial vs. Venous grafts
Graft Patency Saphenous Vein

- **Angiographic patency:**
  - 6-8% loss at 7-10 days
  - 9% loss at 1 year
  - 15% loss at 3 year
  - 10 year patency 50-70%
Internal Mammary Artery
Saphenous Vein vs. Mammary

Landmark paper by Loop et al from the Cleveland Clinic, NEJM 1986
A Video Speaks A Million Words
Diabetic Living on a Mammary
Single vs. Bilateral Mammary
Randomized Trial of Bilateral versus Single Internal-Thoracic-Artery Grafts

David P. Taggart, M.D., Ph.D., Douglas G. Altman, D.Sc., Alastair M. Gray, Ph.D.,

ART Trial Outcome of Death from Any Cause, Myocardial Infarction, or Stroke.

Rate of sternal wound complication was 3.5% in the bilateral-graft group versus 1.9% in the single-graft group (P=0.005)

Rate of sternal reconstruction was 1.9% versus 0.6% (P=0.002).

The Effect of Bilateral Internal Thoracic Artery Grafting on Survival During 20 Postoperative Years

Bruce W. Lytle, MD, Eugene H. Blackstone, MD, Joseph F. Sabik, MD, Penny Houghtaling, MS, Floyd D. Loop, MD, and Delos M. Cosgrove, MD

Departments of Thoracic and Cardiovascular Surgery, and Biostatistics and Epidemiology, The Cleveland Clinic Foundation, Cleveland, Ohio

Background. To compare survival of patients receiving bilateral internal thoracic artery grafts and single internal thoracic artery grafts more than 20 postoperative years, assess magnitude of benefit, and identify predictors of benefit.

Methods. From cohorts of 8123 patients receiving single internal thoracic artery grafts and 2001 receiving bilateral internal thoracic artery grafts during primary isolated bypass operations for multivessel coronary disease between 1971 and 1989, we identified 1152 propensity-matched pairs. Mean follow-up of survivors was 16.5 years, with 31 patients followed for 20 years or more. Hazard function methodology was used to identify risk factors for mortality, compare survival, and assess magnitude of benefit.

Results. Comparison of the matched pairs showed survival of the bilateral internal thoracic artery and single internal thoracic artery groups at 7, 10, 15, and 20 years was 89% versus 87%, 81% versus 78%, 67% versus 58%, and 50% versus 37%, respectively ($p < 0.0001$).

Divergence of bilateral internal thoracic artery and single internal thoracic artery hazard function curves continued to widen through 20 postoperative years. At 20 years, bilateral internal thoracic artery grafting was predicted to produce worse survival in 2.8% of patients, a survival advantage of less than 5% in 12.9%, greater than 10% in 32%, and greater than 15% in 7.6%. Combinations of cardiac and noncardiac descriptors were used to define higher and lower risk patient subsets. Advanced age, abnormal left ventricular function and noncardiac risk factors decreased overall survival but the incremental benefit of bilateral internal thoracic artery grafting persisted.

Conclusions. Bilateral internal thoracic artery grafting produces improved survival compared with single internal thoracic artery grafting during the second postoperative decade, and the magnitude of that benefit increases through 20 postoperative years.


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Lytle BW, Ann Thorac Surg 2004
Surgical revascularization techniques that minimize surgical risk and maximize late survival after coronary artery bypass grafting in patients with diabetes mellitus

Sajjad Raza, MD, Joseph F. Sabik III, MD, Khalil Masabni, MD, Ponnuthurai Ainkaran, MS, Bruce W. Lytle, MD, and Eugene H. Blackstone, MD

Objective: To identify surgical revascularization techniques that minimize surgical risk and maximize late survival in patients with diabetes undergoing coronary artery bypass grafting (CABG).


BITA grafting should be used in all patients with diabetes whose risk of DSWI is low.

Conclusions: BITA grafting with complete revascularization maximizes long-term survival and is recommended for patients with diabetes undergoing CABG. BITA grafting should be used in all patients with diabetes whose risk of DSWI is low. It might be best avoided in obese diabetic women with diffuse atherosclerotic burden—those at greatest risk of developing these infections. (J Thorac Cardiovasc Surg 2014;148:1257-66)
BITA grafting be best avoided in obese diabetic women with diffuse atherosclerotic burden-those at greatest risk of developing DSWI
Despite the potential survival benefit, only 4% of CABG cases incorporate BITA

- Risk of sternal complications reduced by
  - Strict preoperative and perioperative glucose control
  - Meticulous surgical technique.
BIMA in Diabetic
Arterial Grafting Strategy

• Patient Selection
• Meticulous Technique
• Conduit Selection and Configuration
• Target Selection
  — Target vessel stenosis
  — Importance of target vessel
• Intraoperative Quality Control
Radial Artery vs. SVG
The long-term impact of diabetes on graft patency after coronary artery bypass grafting surgery: A substudy of the multicenter Radial Artery Patency Study

Sawwata Deb, MD, Steve K. Singh, MD, Fuad Moussa, MD, Hideki Tsubota, MD, Dai Une, MD, Alex Kiss, PhD, George Tomlinson, PhD, Mehdi Afshar, BSc, Ryan Sless, BSc, Eric A. Cohen, MD, Sam Radhakrishnan, MD, James Dubbin, MD, Leonard Schwartz, MD, and Stephen E. Frennes, MD, on behalf of the Radial Artery Patency Study Investigators

The use of the radial artery should be strongly considered in diabetic patients undergoing coronary bypass surgery, especially with high-grade target vessel stenosis.
RITA vs. Radial Artery
The present network meta-analysis consistently demonstrated an angiographic superiority of RIMA and RA over SVG. The RIMA is expected to achieve a better patency rate than the RA, but further studies are needed.
The Society of Thoracic Surgeons Clinical Practice Guidelines on Arterial Conduits for Coronary Artery Bypass Grafting

Gabriel S. Aldea, MD, Faisal G. Bakaeeen, MD, Jay Pal, MD, PhD, Stephen Fremen, MD, Stuart J. Head, MD, PhD, Joseph Sabik, MD, Todd Rosengart, MD, A. Pieter Kappetein, MD, PhD, Vinod H. Thourani, MD, Scott Firestone, MS, and John D. Mitchell, MD

Division of Cardiothoracic Surgery, University of Washington School of Medicine, Seattle, Washington; Department of Cardiovascular Surgery, Texas Heart Institute, Houston, Texas; Schulich Heart Centre, Sunnybrook Health Sciences Centre, and Institute of Health Policy Management and Evaluation, University of Toronto, Toronto, Ontario, Canada; Department of Cardiothoracic Surgery, Erasmus Medical Center, Rotterdam, Netherlands; Center of Heart Valve Disease, Heart and Vascular Institute, Cleveland Clinic, Cleveland, Ohio; Department of Surgery, Emory University School of Medicine, Atlanta, Georgia; The Society of Thoracic Surgeons, Chicago, Illinois; and Department of Surgery, Division of Cardiothoracic Surgery, University of Colorado Denver, Anschutz Medical Campus, Aurora, Colorado

Consideration of more arterial grafting

- The ITA should be used to bypass the LAD artery when bypass of the LAD is indicated (COR I, LOE B).
- As an adjunct to LITA, a second arterial graft (right internal thoracic artery or radial artery [RAI]) should be considered in appropriate patients (COR IIa, LOE B).
- Use of BITAs should be considered in patients who do not have an excessive risk of sternal complications (COR IIa, LOE B).

- The RGEA may be considered in patients with poor conduit options or as an adjunct to more complete arterial revascularization (COR IIb, LOE B).
At CCF there is NO place for that:
Team Concept

– The Heart Team concept
– Tailor the procedure to the patient, not the patient to the procedure
CABG Strategy in Diabetics

• Complete Revascularization
• Meticulous Technique
• 2+ Arterial Conduit When Possible/Appropriate
• Optimal Metabolic Management
• Team Approach
Thank You