“Direct from the CVOR to the Cath Lab”

Immediate post-op coronary angiography and ad hoc PCI for perioperative myocardial ischemia or infarction after aorto-coronary bypass surgery

COAST Conference: 2008
Anaheim, California

Effect of Perioperative Myocardial Infarction on Late Survival in Patients Undergoing Coronary Artery Bypass Surgery

DAVID L. NAMAY, M.D., K. E. HAMMERMEISTER, M.D., MAY S. ZIA, M.S., TIMOTHY A. DEROUEN, M.D., HAROLD T. DODGE, M.D., AND KEVAN NAMAY, M.D.

SUMMARY From the Seattle Heart Watch angiography registry, the baseline characteristics and late survival of 77 patients who sustained operative infarction (new Q waves) with myocardial revascularization were compared with 1790 patients who underwent coronary artery bypass without perioperative infarction. With the exception of coronary collateral vessels, which were less frequently seen in the patients with perioperative infarction, no baseline or operative characteristic distinguished between the two groups. Late survival was clearly adversely affected by perioperative infarction. Five-year survival was 76% in patients with perioperative infarction, compared with 90% in those with no perioperative infarction.

Peri-op MI rate (new Q-waves) = 4.1%
“Operative Mortality” with MI = 10.4%
without MI = 5%

Circulation 1982;65;1066-1071
### California CABG Outcomes Reporting Program (CCORP)

- Largest public reporting program for CABG
- 34 variables in a logistic regression risk model for operative mortality

<table>
<thead>
<tr>
<th>Year</th>
<th>Hospitals</th>
<th>Isolated CABG</th>
<th>Operative Mortality %</th>
<th>Average Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td></td>
<td></td>
<td>2.91</td>
<td></td>
</tr>
<tr>
<td>2004</td>
<td></td>
<td></td>
<td>3.29</td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>120</td>
<td>16,939</td>
<td>3.08</td>
<td>141</td>
</tr>
<tr>
<td>2006</td>
<td>121</td>
<td>15,647</td>
<td>2.22</td>
<td>129</td>
</tr>
</tbody>
</table>
The Society of Thoracic Surgeons: 30-Day Operative Mortality and Morbidity Risk Models

Rationale: Complications occur more frequently than death, therefore major morbidity may differentially impact quality of care

Goal: To identify preoperative risk factors associated with major complications or 30-day mortality, or both

Setting: STS National Cardiac Database of 503,478 CABG-only patients from 495 sites in the US

Dependent variables:
• 30-day operative death
• permanent stroke
• renal dysfunction or failure requiring dialysis
• any reoperation
• prolonged ventilation
• deep sternal wound infection
• composite of any major morbidity or 30-day mortality

Results: 30-day death and major morbidity rates for CABG procedures of 3.05% and 13.40%, respectively.

Only a slight correlation was found between major morbidity and mortality risk indicators.

Perioperative MI not included due to too much variation in reporting, “…indicating a problem with definition…or uniformity of tests.”
To determine the odds of dying of complications from AC-bypass:

189 surgeons at 33 hospitals, NY State CABG Reporting System; 51,750 pts, 1997-1999, 5361 with complications (9%)

- Average 523 CABG cases per year
- Mortality in-hospital = 2.2% overall
- Mortality after no complication = 0.77%
- Mortality with complications = 16.1% (x20, p< .001)
- Adjusted odds ratios (all p< .001)
  - Myocardial infarction OR= 7.90
  - Respiratory failure OR = 6.02
  - Renal failure OR = 7.15
  - Stroke OR = 4.09

San Francisco Medical Center

Effect of complications on mortality after coronary artery bypass grafting surgery: Evidence from New York State
Glance, Osler, Mukamel, Dick; The Journal of Thoracic and Cardiovascular Surgery, July 2007

Circulation

Health Services and Outcomes Research

Relationship Between Preventability of Death After Coronary Artery Bypass Graft Surgery and All-Cause Risk-Adjusted Mortality Rates

Veena Guru, MD; Jack V. Tu, MD, PhD; Edward Etchells, MD, MSc; Geoffrey M. Anderson, MD, PhD; C. David Naylor, MD, DPhil; Richard J. Novick, MD, MSc; Christopher M. Feindel, MD, MSc; Fraser D. Rubens, MD, MSc; Kevin Teoh, MD, MSc; Avdesh Mathur, MD; Andrew Hamilton, MD; Daniel Bonneau, MD; Charles Cutrara, MD; Peter C. Austin, PhD; Stephen E. Femes, MD, MSc

To determine the relationship between all-cause, risk-adjusted, in-hospital mortality after coronary artery bypass graft surgery and the proportion of preventable in-hospital deaths as a measure of quality of care.

Rationale: Compared with a handful of outliers, the total number of preventable deaths may actually be much higher if cumulated across the non-outlier hospitals.

Setting: Ontario, Canada, population 12 million, 1998 to 2003

- 347 randomly selected in-hospital deaths after isolated CABG at 9 institutions
- Risk adjusted mortality rates are low, ~2%
- Institutional volumes are high, ≥400 / yr
- Regionalized health care system

Findings:

- 111 of 347 deaths (32%) were judged preventable despite low mortality rates (1.3% to 3.1%) at all hospitals
- No significant correlation was found between mortality rates and the proportion of preventable deaths
- Preventable deaths were related to problems in the operating room (86%) and intensive care unit (61%)
- Preventable deaths were more likely to occur in patients with a lower predicted operative risk
**Relationship Between Preventability of Death After Coronary Artery Bypass Graft Surgery and All-Cause Risk-Adjusted Mortality Rates**


Top 5 causes of 347 deaths after CABG surgery

<table>
<thead>
<tr>
<th>Condition</th>
<th>% Cause of Death</th>
<th>“Preventable”</th>
<th>Potential Lives Saved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ventricular arrhythmia</td>
<td>28%</td>
<td>35%</td>
<td>34</td>
</tr>
<tr>
<td>MI / Ischemia, LV failure</td>
<td>20%</td>
<td>43%</td>
<td>30</td>
</tr>
<tr>
<td>Multiorgan failure</td>
<td>21%</td>
<td>24%</td>
<td>17</td>
</tr>
<tr>
<td>Stroke / Coma</td>
<td>11%</td>
<td>31%</td>
<td>12</td>
</tr>
<tr>
<td>Respiratory failure</td>
<td>7%</td>
<td>22%</td>
<td>5</td>
</tr>
</tbody>
</table>

Figure 3. Percentage of deaths judged preventable and/or inappropriate for surgery on primary surgeon review vs patient’s estimated risk of in-hospital death.
Criteria for Diagnosis of Acute Myocardial Infarction

Thygesen, et al. J. Am. Coll. Cardiol. 2007;50;2173-2195

Laboratory evidence of myocardial necrosis with clinical myocardial ischemia. Any one of the following criteria meets the diagnosis for myocardial infarction:

• Detection of rise and/or fall of biomarkers (preferably troponin) with at least one value above the 99th percentile of the upper reference limit (URL) together with myocardial ischemia with at least one of the following:
  • Symptoms of ischemia;
  • New ischemic ST-T changes or new LBBB;
  • New pathological Q waves;
  • New loss of viable myocardium or new regional wall motion abnormality.

• Sudden unexpected death from cardiac arrest.

• For PCI patients, new elevations of biomarkers greater than 3x 99th percentile URL. A subtype related to stent thrombosis is recognized.

• For CABG patients, new elevations of biomarkers greater than 5x 99th percentile URL plus new pathological Q waves or new LBBB, or angiographically documented new graft or native coronary artery occlusion, or imaging of new loss of viable myocardium.

Cardiac Biomarkers in STEMI

Increased creatine kinase MB level predicts postoperative mortality after cardiac surgery independent of new Q waves

- A prospective, randomized trial of the anti-C5 complement antibody pexelizumab (…it doesn’t help) in patients undergoing CABG
- Electrocardiography and CK-MB were examined for association with death or severe LV dysfunction
- Peak CK-MB within 36 Hr after on-pump elective CABG 1999-2000, 65 centers, n=800
- 55% peak CM-MB > x5 ULN (ULN=5 ng/ml)
- CK-MB peaked by 4 hr in 55%, 8 hr in 19%, 16 hr in 12%, 20 hr in 6%
- The strongest predictor of the combined outcome of death or severe LV dysfunction was a peak CK-MB level of ≥100 ng/mL
- New Q-wave myocardial infarction did not significantly predict the combined outcome

55% peak CM-MB > x5 ULN;
Peak reached by 4 hrs in 55%, 8 hrs in 19%, 16 hrs in 12%, 20 hrs in 6%
Increased creatine kinase MB level predicts postoperative mortality after cardiac surgery independent of new Q waves


TABLE 2. Incidence of clinical adverse outcomes and Q-wave myocardial infarction according to peak postoperative CK-MB level

<table>
<thead>
<tr>
<th>N (%) for Peak postoperative CK-MB (ng/mL)</th>
<th>0-24</th>
<th>25-49</th>
<th>50-99</th>
<th>&gt;100</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Death</td>
<td>3/345 (1%)</td>
<td>2/278 (1%)</td>
<td>1/112 (1%)</td>
<td>3/50 (6%)</td>
<td>.04</td>
</tr>
<tr>
<td>LVD</td>
<td>3/343 (1%)</td>
<td>11/277 (4%)</td>
<td>5/112 (5%)</td>
<td>8/50 (16%)</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Death or LVD</td>
<td>6/345 (2%)</td>
<td>13/278 (5%)</td>
<td>6/112 (5%)</td>
<td>9/50 (18%)</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Q-wave MI*</td>
<td>13/335 (4%)</td>
<td>10/270 (4%)</td>
<td>10/108 (9%)</td>
<td>15/49 (31%)</td>
<td>&lt;.01</td>
</tr>
</tbody>
</table>

Data are presented as proportion of patients with outcome (%). CK-MB, Creatine kinase MB; LVD, left ventricular dysfunction; MI, myocardial infarction.

*Twenty-three patients had electrocardiogram data that were incomplete or not interpretable.
Impact of Perioperative Myocardial Infarction on Angiographic and Clinical Outcomes Following Coronary Artery Bypass Grafting (from PRoject of Ex-vivo Vein graft ENgineering via Transfection [PREVENT] IV)

Yau, Alexander, MD, Hafley, et al., for the PREVENT IV Investigators; Am J Cardiol 2008;102:546-551

Phase III trial of edifoligide to prevent SVG failure (…it doesn’t help)

• First isolated CABG, 3014 pts in 107 centers, 8-2002 thru 10-2003

• Angiographic follow-up by 1.5 yrs in 1829 patients (clinically driven= 65)

• Peri-op MI if CK-MB ≥ x10 ULN, or x5 with new Q-waves within 24 hrs

• MI in 294 (9.8%): longer OR times, more on-pump, worse target vessels

• Increased mortality only with CK-MB ≥ x15 ULN

Efficacy and Safety of Edifoligide, an E2F Transcription Factor Decoy, for Prevention of Vein Graft Failure Following Coronary Artery Bypass Graft Surgery

PREVENT IV: A Randomized Controlled Trial

PREVENT IV Investigators; JAMA. 2005;294(19):2446-2454

Angiographic Results for 1920 patients

<table>
<thead>
<tr>
<th>Graft Status</th>
<th>Occlusion</th>
<th>Failure*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vein Graft Per patient (n=1920)</td>
<td>42%</td>
<td>46%</td>
</tr>
<tr>
<td>Per vein graft (n=4507)</td>
<td>26%</td>
<td>29%</td>
</tr>
<tr>
<td>LIMA graft (n=1593)</td>
<td>NR</td>
<td>8%</td>
</tr>
</tbody>
</table>

* Graft failure = ≥75% stenosis + occlusion
### PREVENT IV (continued): 30 Day Outcomes

Yau, et al., for the PREVENT IV Investigators; Am J Cardiol 2008;102:546-551

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Yes (n = 294)</th>
<th>No (n = 2,720)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median intensive care length of stay (h)</td>
<td>29 (23.57)</td>
<td>26 (22.47)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Median postoperative hospital length of stay (d)</td>
<td>7 (5, 8)</td>
<td>6 (5, 8)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Median duration of mechanical ventilation (h)</td>
<td>8.8 (5.3, 16.5)</td>
<td>7.0 (4.5, 13.0)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Death</td>
<td>6 (2.0%)</td>
<td>59 (1.1%)</td>
<td>0.15</td>
</tr>
<tr>
<td>Stroke</td>
<td>8 (2.7%)</td>
<td>58 (1.3%)</td>
<td>0.08</td>
</tr>
<tr>
<td>Bleeding requiring reoperation</td>
<td>6 (2.0%)</td>
<td>70 (2.6%)</td>
<td>0.47</td>
</tr>
<tr>
<td>Atrial fibrillation</td>
<td>82 (27.9%)</td>
<td>699 (25.7%)</td>
<td>0.42</td>
</tr>
<tr>
<td>Renal failure</td>
<td>9 (3.1%)</td>
<td>90 (3.3%)</td>
<td>0.82</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>6 (2.0%)</td>
<td>64 (2.4%)</td>
<td>0.74</td>
</tr>
<tr>
<td>Adult respiratory distress syndrome</td>
<td>3 (1.0%)</td>
<td>23 (0.8%)</td>
<td>0.74</td>
</tr>
<tr>
<td>Mediastinitis</td>
<td>4 (1.4%)</td>
<td>17 (0.6%)</td>
<td>0.14</td>
</tr>
<tr>
<td>Pulmonary embolism</td>
<td>4 (0.3%)</td>
<td>16 (0.6%)</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Values expressed as median (25th, 75th percentiles or number (percent)).

### PREVENT IV (continued): 2 Yr Mortality by Day 1 CK-MB

Yau, et al., for the PREVENT IV Investigators; Am J Cardiol 2008;102:546-551

![Figure 2. Two-year mortality according to day 1 CK-MB as a multiple of the ULN.](image)

Figure 2. Two-year mortality according to day 1 CK-MB as a multiple of the ULN.
Increased risk of heart failure as a consequence of perioperative myocardial injury after coronary artery bypass grafting
Steuer, Granath, de Faire, Ekbom, Ståhle; Heart 2005;91;754-758


- 228 (3.0%) deaths in hospital, 7493 were discharged alive
- 691 (9%) pts had peri-operative MI
- 576 (7.7%) pts re-hospitalized for CHF
  - 20% of those had peri-operative MI (HR 2.3, CI 1.8-2.2)
- Peri-operative MI imposed increased late mortality
  - HR 1.4, CI 1.1-1.8, without CHF
  - Late mortality was increased in pts with CHF

San Francisco Medical Center

Significance and management of early graft failure after coronary artery bypass grafting: feasibility and results of acute angiography and re-re-vascularization

- 2003 pts between 1990-1995, 71 (3.5%) suspected of acute graft failure
- 12 pts immediate re-operation without angiography
  - Graft occlusion in 11 pts (92%)
  - 30 day mortality was 6 (50%)
- 59 pts studied by angiography (diagnostic only, no PCI option)
  - Graft failure or incomplete revascularization in 43 pts (73%)
    - Occluded vein grafts in 19 (32%), poor runoff in 10 (17%)
    - IMA anastomotic stenosis in 4 (7%) or occlusion in 3 (5%)
    - L subclavian steal in 2 (3%)
- 27 pts re-operated after angiography
  - 18 pts (67%) evolved MI
  - 2 pts (3%) suffered CVA “related to angiography”
  - 30 day mortality was 3 (7%)
“...we pursue a policy of early postoperative angiography, followed by re-operation if necessary, in patients showing criteria of myocardial infarction..."

Jan-Dec 1999, 2052 isolated AC Bypass surgeries, 131 pts met criteria, overall in-hospital mortality n=19 (0.9%),

Criteria for ischemia or infarction, n=131 (6.4%), confirmed MI, n=93 (4.5%)
- Increased biomarkers for myocardial injury, n=71 (66%)
- Dynamic ST-segment changes, n=72 (67%)
- Ventricular arrhythmias, n=31 (29%)
- Hemodynamic deterioration and LV failure, n=20 (19%)
- New BBB, n=9 (8%)
- New Q-waves, n=7 (6.5%)
- Angina, n=6 (5.5%)

Median time OR to CCL 19.8 Hrs (1-48 Hrs)

Group A: 108 pts, to the Cath Lab
- Ischemia not explained = 45 (42%)
- No further intervention = 65 (60%)
- Pathology on angio = 63 (58%)
  - Graft thrombosis = 41
  - Anastamotic stenosis = 29
  - Graft stenosis = 14
  - Graft spasm = 6
  - Misplaced graft = 6
  - Incomplete revasc = 5
  - Poor run off = 2
- Immediate Re-op = 34 (31%)
- Angioplasty = 9 (8%)
- Med Rx with pathology = 20 (19%)
- Mortality =10 (9%)

Group B: 23 pts, CPR to the CVOR
- Ischemia not explained = 4 (17%)
- Pathology on re-do = 19 (83%)
  - Graft thrombosis = 10
  - Anastamotic stenosis = 5
  - Graft stenosis = 1
  - Graft spasm = 1
  - Misplaced graft = 1
  - Bleeding = 1
- Mortality = 9 (39%)
Emergency re-revascularization with percutaneous coronary intervention, reoperation, or conservative treatment in patients with acute perioperative graft failure following coronary artery bypass surgery

Thielmann, Massoudy, Jaeger, et al., Thoracic and Cardiovascular Surgery, University of Essen, Germany


- 118 peri-op MIs (2.17%) from 5427 consecutive isolated AC-Bypass patients over 7 years (1999-2005, ave.=775/yr) studied with coronary angiography within 24 hrs
- Early graft failure in 67 of 118 pts (57%) and 84 of 214 grafts (39%)
- PCI deemed appropriate in 25/118 pts (21%)
  - Trop-I peak 81 ±18 ng/ml
  - In hospital deaths 12%
  - 1 yr deaths 20%
- Re-op AC-Bypass in 15/118 pts (13%)
  - Trop-I peak 178 ±62 ng/ml
  - In hospital deaths 20%
  - 1 yr deaths 27%
- Medical management in 27/118 pts (23%)
  - In hospital deaths 14.8%
  - 1 yr deaths 18.5%
- Conclusion: PCI better than re-op for MI due to graft failure
  Only a minority require re-op

Rescue Percutaneous Coronary Intervention Early After Coronary Artery Bypass Grafting in the Drug-Eluting Stent Era

Price, Housman, Teirstein; Am J Cardiol 2006;97:789 –791

Departments of Cardiovascular Diseases and Cardiovascular Surgery, Scripps Clinic, La Jolla, California

All CABG surgeries 6-2003 -> 6-2005, n=321 (~3 / week )

Repeat CCL before DC n =14 (4.3% of 321)
  Medical Rx n = 4 (29% of 14)
  “Rescue” PCI n = 10 (71% of 14)
  Re-do in CVOR n = 0

CVOR -> CCL median time = 4.9 Hrs (1.25 Hrs to 13 Days)
  Less than 24 Hrs, n = 6
  Venous graft occlusion = 2
  Venous graft anastamotic stenosis = 4
  LIMA graft anastamotic stenosis = 2
  Incomplete revascularization = 2
  Poor distal runoff = 1
Rescue Percutaneous Coronary Intervention Early After Coronary Artery Bypass Grafting in the Drug-Eluting Stent Era

Price, Housman, Teirstein; Am J Cardiol 2006;97:789 –791
Departments of Cardiovascular Diseases and Cardiovascular Surgery, Scripps Clinic, La Jolla, California

Angiographic success in 13 of 15 lesions (87%)
Perforations in 3, Rx 1 covered stent & 2 long balloon inflations
Death in 2 patients, both cardiogenic shock before and after PCI
Major bleeding 4 patients: tamponade in 2, GI in 1, chest tube 1
One subacute-ST after GI bleed and DC of ASA & Plavix

Case 1: SM 54 y Cauc male with DM, hyperlipidemia, chronic renal insufficiency and no CAD history, hospitalized with acute pulmonary edema requiring emergency hemodialysis. He was transferred to SF Kaiser for further evaluation and Rx.

Coronary angiography was performed 8-25-2006 revealing severe multivessel CAD and LVEF of 50%. The patient was referred for surgical revascularization, performed 8-30-2006.

Two hours post-op while in CV-ICU patient developed anterior ST-segment elevations and severe hypotension requiring high-dose vasopressor support to maintain BP 70/ mmHg.

CK-MB Fract = 219 ng/ml
Coronary-Artery Spasm Immediately After Myocardial Revascularization
Recognition and Management

Alfred E. Buxton, M.D., Sheldon Goldberg, M.D., Alden Haren, M.D., John Hirshfeld, Jr., M.D., and John A. Kastor, M.D.

Abstract We investigated coronary-artery spasm in six patients who had had unexpected hemodynamic collapse within two hours after cardiopulmonary bypass for myocardial revascularization. All six had profound hypotension and recurrent ST-segment elevation in electrocardiographic Leads II, III, and aVF. All had either normal or noncritical luminal irregularities of dominant right coronary arteries and more than 75 per cent occlusions in the left coronary circulation. Right-coronary-artery spasm, which was reversed after intracoronary nitroglycerin, was demonstrated angiographically in one patient; a patent right coronary artery was found at autopsy in another patient. Three patients died despite large intravenous doses of nitroglycerin. Two patients who had been unresponsive to intravenous nitroglycerin recovered after direct infusion of nitroglycerin into the right coronary artery. Coronary-artery spasm immediately after myocardial revascularization may cause circulatory collapse and death; although the spasm may be refractory to usual therapy, it may respond to intracoronary nitroglycerin. (N Engl J Med. 1981; 304:1249-53)
Depending on the center in which the surgery takes place, positive inotropic drugs (PIDs) may be administered to as few as 5% or to as many as 100% of patients undergoing elective coronary artery bypass surgery. … … a critical and testable hypothesis must be that patients who can be appropriately managed without PIDs will have a worse outcome if they receive PIDs. Fellahi et al.(6) used a propensity scoring technique to approach this hypothesis. … … Their conclusion was that, all other things being the same, patients had worse outcome when they received PIDs.
Case 2: RS 79 y South Asian female with known CAD requiring balloon angioplasty x3, most recently 5-31-1991, hospitalized with non-STEMI, transferred to SF Kaiser for coronary angiography and further management.

Coronary angiography performed 6-22-2007 revealed severe multivessel CAD and preserved LV systolic function, LVEF = 60%.

Triple vessel AC-bypass was performed 6-27-2007. After chest closure while in the CVOR hyperacute inferolateral ST segment elevations were observed. Emergency coronary angiography was requested.

CK-MB Fract = 124 ng/ml
### Five Case Series (Entire World Literature ?) Compiled:

<table>
<thead>
<tr>
<th>Year</th>
<th>CABG Cases</th>
<th>All Isolated</th>
<th>Peri-op MI</th>
<th>Direct to CVOR</th>
<th>To CCL</th>
<th>Time CVOR to CCL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rasmussen</td>
<td>1997</td>
<td>2003</td>
<td>Isol.</td>
<td>71 (3.5%)</td>
<td>12/71 (17%)</td>
<td>59/71 (83%)</td>
</tr>
<tr>
<td>Copenhagen</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fabricius</td>
<td>2000</td>
<td>2052</td>
<td>Isol.</td>
<td>131 (6.4%)</td>
<td>23/131 (18%)</td>
<td>106/131 (82%)</td>
</tr>
<tr>
<td>Leipzig</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Alter</td>
<td>2005</td>
<td>1000</td>
<td>Isol.</td>
<td>40 (4%)</td>
<td>NR</td>
<td>40 (100%)</td>
</tr>
<tr>
<td>Marberg</td>
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<tr>
<td>Thielmann</td>
<td>2005</td>
<td>5427</td>
<td>Isol.</td>
<td>118 (2.2%)</td>
<td>NR</td>
<td>118 (100%)</td>
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<tr>
<td>Price</td>
<td>2006</td>
<td>321</td>
<td>All</td>
<td>14 (4.3%)</td>
<td>NR</td>
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<tr>
<td>La Jolla</td>
<td></td>
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</tr>
</tbody>
</table>

**Five case series combined:**

- **CABG Cases:** 10803
- **All Isolated:** 574 (3.5%)
- **To CCL:** 539 (91%)
Take Home Lessons:

- Peri-operative MI is the most frequent (~3.5%) and most serious (mortality OR=7.9) CABG complication
- Peri-op MI is not good for the patient, the facility, or the surgeon
- Peri-op mortality may be preventable (est. 32%)
- Low risk patients present greater opportunity for death prevention
- CVOR, CV anesthetic and ICU treatments account for the majority of preventable deaths, not case selection
- Diagnosis of peri-op MI is problematic

Take Home Lessons (continued):

- Coronary angiography and PCI are rarely employed in peri-op MI evaluation and management
- Peri-op ischemia / infarction is often not anatomically explained (~42%)
- "Blind re-op" is associated with high mortality, necessitated in ~10% peri-op MI cases for hemodynamic rescue with CP-bypass
- SVG occlusion is the most common anatomic explanation for peri-op MI, LIMA-G failure is typically anastamotic stenosis
- Re-op after angiography is required in a minority of patients (~26%)
- Mortality with angiography guided Rx is ~8%, rather than expected 16%
- Benefit of prompt angiography is likely time dependent ("Time is muscle.")
Issues for the Interventionalist and CV Surgeon:

• Who is in charge?
• How much myocardium is at risk?
• How amenable is the native coronary anatomy for PCI?
• Which access route?
• Bare metal or drug-eluting stents?
• What anticoagulation and antiplatelet regimen?
• What level of inotropic and vasopressor support is needed?
• Can we improve outcomes?

Impact of Perioperative Myocardial Infarction on Angiographic and Clinical Outcomes Following Coronary Artery Bypass Grafting (from PRoject of Ex-vivo Vein graft ENgineering via Transfection [PREVENT] IV)

Yau, Alexander, Hafley, et al., for the PREVENT IV Investigators; Am J Cardiol 2008;102:546-551

“In PREVENT IV, patients with a perioperative MI were seldom treated differently than patients without a perioperative MI. Rates of early angiography and percutaneous coronary intervention were low. In addition, there was limited use of proven evidence-based medications after perioperative MI, and their use was not significantly different from that in patients without perioperative MI. More research is needed to determine whether more aggressive revascularization or therapy with cardioprotective drugs will benefit patients with a perioperative MI.”