Assessment of Coronary Artery Disease Risk in 5,463 Patients Undergoing Cardiac Surgery

When is Preoperative Coronary Angiography Necessary?

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## Disclosure Mayo Clinic Divisions of Cardiovascular Surgery and Cardiovascular Diseases

<table>
<thead>
<tr>
<th>Research Funding</th>
<th>Consultant/Advisory Board</th>
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<tbody>
<tr>
<td>Edwards Lifesciences</td>
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<td>Cleveland Clinic</td>
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<td>Sorin Group</td>
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<tr>
<td>Patent Application</td>
<td>Principal Investigator</td>
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<tr>
<td>Sorin Group</td>
<td>FDA Perceval Trial – Sorin Group</td>
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</table>
Class I: Coronary angiography should be performed before valve surgery in men ≥ 35 yr, premenopausal women ≥ 35 yr who have coronary risk factors, and postmenopausal women. (Level of Evidence: C)

1. Coronary angiography is indicated before valve surgery (including infective endocarditis) or mitral balloon commissurotomy in patients with chest pain, other objective evidence of ischemia, decreased LV systolic function, history of CAD, or coronary risk factors (including age). Patients undergoing mitral balloon valvulotomy need not undergo coronary angiography solely on the basis of coronary risk factors. (Level of Evidence: C)

2. Coronary angiography is indicated in patients with apparently mild to moderate valvular heart disease but with progressive angina (Canadian Heart Anesthesia Functional Class III or greater), objective evidence of ischemia, decreased LV systolic function, or overt coronary heart failure. (Level of Evidence: C)

3. Coronary angiography should be performed before valve surgery in men aged 55 years or older, premenopausal women aged 35 years or older who have coronary risk factors, and postmenopausal women. (Level of Evidence: C)

Bonow et al: J Am Coll Cardiol 48:1, 2006
“Slightly more than 1/3 of patients who underwent elective cardiac catheterization had obstructive CAD”
Objectives

• To evaluate CAD risk prior to noncoronary cardiac surgery

• To develop a simple bedside model to determine the likelihood of significant coexistent CAD
Inclusion

- Aortic valve surgery
- Mitral valve surgery
- Septal myectomy
- ± CABG
- Jan 1, 2001 – Dec 31, 2010
Exclusions

- <18 yr of age
- Prior sternotomy
- Active endocarditis
- Concomitant major operation
- Ischemic valve pathology
5,463
Aortic, Mitral, Myectomy

4,711 angiography
752 no angiography
5,463 Aortic, Mitral, Myectomy

1,692 Angina, prior MI/PCI
4,711 angiography

3,019 No Angina, prior MI/PCI
752 no angiography

CAD 34% / No CAD 66%

CAD 34% / No CAD 66%

CAD 45% / No CAD 55%
## Multivariate Predictors of Significant CAD* (C=0.76)

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Odds Ratio</th>
<th>95% CI</th>
<th>P</th>
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</thead>
<tbody>
<tr>
<td>Age (per 5 yr)</td>
<td>1.40</td>
<td>1.34–1.47</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Male sex</td>
<td>1.85</td>
<td>1.54–2.23</td>
<td>0.002</td>
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<td>Diabetes mellitus</td>
<td>2.01</td>
<td>1.61–2.53</td>
<td>&lt; 0.001</td>
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<tr>
<td>Family history CAD</td>
<td>1.98</td>
<td>1.47–2.65</td>
<td>&lt; 0.001</td>
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<td>Hypercholesterolemia</td>
<td>1.49</td>
<td>1.23–1.80</td>
<td>&lt; 0.001</td>
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<tr>
<td>Hypertension</td>
<td>1.36</td>
<td>1.13–1.63</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>PVD</td>
<td>2.49</td>
<td>1.72–3.62</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Smoking history</td>
<td>1.30</td>
<td>1.10–1.55</td>
<td>0.003</td>
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* ≥50% stenosis of major epicardial vessels or side branches
## Four-variable Model Predicting CAD* (C = 0.74)

<table>
<thead>
<tr>
<th></th>
<th>Odds Ratio</th>
<th>95% CI</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (per 5 yr)</td>
<td>1.4</td>
<td>1.3 – 1.5</td>
<td>&lt; 0.001</td>
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<tr>
<td>Male sex</td>
<td>1.9</td>
<td>1.6 – 2.2</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>2.3</td>
<td>1.8 – 2.8</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>PVD</td>
<td>2.7</td>
<td>1.9 – 4.0</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>

* ≥50% stenosis of major epicardial vessels or side branches
3,019 No Angina, prior MI/PCI

552 Diabetes or PVD
- 99.5% with > 10% predicted probability CAD

2,467 no Diabetes or PVD

CAD: 55%
No CAD: 45%
All Patients Without Diabetes or PVD

n = 2,467

Probability CAD

Age

Male
Female
Aortic Valve Surgery Without Diabetes or PVD

n = 1,248

Probability CAD

Age

Male
Female

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

0 20 40 60 80 100
Mitral Valve Surgery Without Diabetes or PVD

Probability CAD

n = 969

Age

Male

Female

Probability CAD

0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%

10%
20%
30%
40%
50%
60%
70%
80%
90%
100%

20 30 40 50 60 70 80 90 100

51
57
Myectomy Without Diabetes or PVD

\[ n = 250 \]

Probability CAD

<table>
<thead>
<tr>
<th>Age</th>
<th>Probability</th>
<th>Male</th>
<th>Female</th>
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<tbody>
<tr>
<td>20</td>
<td>10%</td>
<td>54</td>
<td>69</td>
</tr>
<tr>
<td>30</td>
<td>10%</td>
<td></td>
<td></td>
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<tr>
<td>40</td>
<td>10%</td>
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<tr>
<td>50</td>
<td>10%</td>
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<td>60</td>
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<tr>
<td>90</td>
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</tr>
<tr>
<td>100</td>
<td>10%</td>
<td></td>
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## Age Thresholds for Low Probability* of CAD

<table>
<thead>
<tr>
<th></th>
<th>Men (♂)</th>
<th>Women (♀)</th>
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<tbody>
<tr>
<td>Aortic Valve Surgery (yr)</td>
<td>33</td>
<td>46</td>
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<tr>
<td>Mitral Valve Surgery (yr)</td>
<td>51</td>
<td>57</td>
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<tr>
<td>Myectomy (yr)</td>
<td>54</td>
<td>69</td>
</tr>
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</table>

* Low probability defined as a ≤ 10% probability of significant CAD
Conclusions

- Approximately **90%** of patients coming to myectomy, aortic valve or mitral valve surgery are assessed by invasive angiography.

- In the absence of angina, prior MI or PCI, angiography identifies CAD in only **one third** of patients.

- Risk prediction models may facilitate identification of patients at **low risk of CAD**; external validation is recommended prior to widespread clinical use.
Clinical Implications

• This strategy may minimize procedure-related morbidity while offering significant cost savings

• Risk prediction models are not a substitute for sound clinical judgment

• Scope for increased consistency by which CAD risk is assessed prior to noncoronary cardiac surgery
Divisions of Cardiovascular Surgery and Cardiovascular Diseases