When to Revascularize in Chronic Coronary Disease

BRUCE KLUGHERZ, MD, FACC
ABINGTON JEFFERSON HEALTH
APRIL 8, 2016
Therapeutic Targets of FDA-Approved Agents for Myocardial Ischemia

Development of Ischemia
- Increased oxygen demand
- Tachycardia
- Hypertension
- Preload
- Contractility
- Decreased oxygen supply

Consequences of Ischemia
- $\text{Ca}^{2+}$ overload
- Electrical instability
- Myocardial dysfunction (decreased systolic function/increased diastolic stiffness)

Ranolazine
(reduces late $\text{Na}^+$ current)

β-blockers
Nitrates
Calcium Channel Blockers
CABG vs. Medical Therapy

- VA Cooperative Study
- European Coronary Surgery Study
- CASS
- Medicine, Angioplasty, or Surgery Study II (MASS II)
PCI vs. Medical Therapy

- PCI reduces the incidence of angina
- PCI has not been demonstrated to improve survival in stable patients
- PCI may increase the short-term risk of MI
- PCI does not lower the long-term risk of MI
COURAGE Trial: Optimal Medical Therapy + PCI for Stable Coronary Disease

Patients (n=2287)
AHA/ACC Class I/II indications for PCI
Suitable coronary artery anatomy
≥70% stenosis in ≥1 proximal epicardial vessel
Objective evidence of ischemia
(or ≥80% stenosis + CCS class III angina without provocation testing)

Follow-Up: 2.5 to 7 Years

Randomization 1:1

Optimal Medical Therapy + PCI (n=1149)

Optimal Medical Therapy (n=1138)

Primary Outcome:
All-cause mortality, non-fatal MI

Secondary Outcomes:
Death, MI, stroke, ACS hospitalization

Median follow-up: 4.6 years

COURAGE Study:
All-Cause Mortality/Non-Fatal MI

Death From Any Cause and Non-Fatal MI

Survival Free of Primary Outcome

Follow-Up (years)

OMT + PCI
OMT

Unadjusted Hazard Ratio
1.05 (95% CI 0.87-1.27)
P=0.62

OMT: optimal medical therapy.
CABG vs. PCI
(22 randomized trials)

• Survival is similar at 1 year and 5 years
• Incidence of MI is similar at 5 years
• Periprocedural stroke is more common with CABG
• Anginal relief is more effective with CABG
• Repeat revascularization is more common during the first year following PCI
Single vessel CAD

Non-Proximal LAD

PCI

Proximal LAD

PCI or CABG
Double vessel CAD

- Non-Proximal LAD: PCI or CABG
- Proximal LAD: PCI or CABG

- For patients with CKD: PCI preferred if surgical risk is high
- For patients with DM: PCI reasonable if SYNTAX score low
Synergy Between Percutaneous Coronary Intervention With Taxus and Cardiac Surgery:

The “SYNTAX” score

- Validated angiographic score that correlates with PCI risk
- Each coronary segment weighted according to jeopardized myocardium
- Each significant lesion assigned a point score based on various measures of complexity
- Point values are added to derive the final score
  - Low risk = 22 or less
  - Intermediate risk = 23-32
  - High risk = 32-83
Triple vessel CAD

- For patients with CKD: PCI preferred if surgical risk is high
- For patients with DM: PCI reasonable if SYNTAX score low
Left main CAD

SYNTAX low or intermediate → PCI or CABG

SYNTAX high → CABG
Revascularizing the Heart Failure Patient – what’s the objective?

- Alleviate angina
- Alleviate heart failure
- Improve myocardial function
- Reduce mortality
Definitions

“Ischemic Cardiomyopathy”
- EF < 35-40%
- H/O MI or Evidence of Ischemia
- Severe CAD on angiogram

“Viable dysfunctional myocardium”: Any myocardial region where contractile function improves after revascularization

“Myocardial stunning”: Persistent post-ischemic contractile dysfunction

“Myocardial hibernation”: A condition of chronic hypocontractile tissue due to persistently underperfusion, with the potential to improve function after flow restoration
“Domains” of myocardial viability and corresponding imaging modality

- Perfusion: SPECT
- Membrane Integrity: SPECT
- Metabolism: PET-FDG
- Contractility: Dobutamine ECHO or MRI
Viability studies predict improvement in LVEF after revasc.

- 29 studies, 758 patients
- Mean increase in LVEF 8% if viability present, no change in absence of viability

Patients With Hibernating Myocardium Show Altered Left Ventricular Volumes and Shape, Which Revert After Revascularization

Percent changes in left ventricular volumes and geometry at follow-up according to presence of viability (Viab+) or absence of viability (Viab−) during dobutamine echocardiography before revascularization. EDVI = end-diastolic volume index; ESVI = end-systolic volume index; SI = sphericity index.

Myocardial Viability Testing and Impact of Revascularization on Prognosis in Patients With Coronary Artery Disease and Left Ventricular Dysfunction: A Meta-Analysis

- 24 studies
- 3088 patients
- Medial f/u 25 months

STICH trial

Randomized trial of medical therapy with or without CABG among patients with CAD and LV dysfunction
STICH trial – inclusion criteria

- CAD suitable for revascularization
- EF <= 35%
STICH trial: 1° Endpoint measure

Hazard ratio, 0.86 (95% CI, 0.72–1.04)
P=0.12
STICH trial: CV death (2° endpoint)
STICH trial: Death or hospitalization for CV causes (2nd endpoint)
STICH trial: Overall mortality as a function of treatment assignment and viability

$p$ value for interaction = 0.53
<table>
<thead>
<tr>
<th>Recommendations</th>
<th>COR</th>
<th>LOE</th>
<th>References</th>
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<tbody>
<tr>
<td>CABG or percutaneous intervention is indicated for HF patients on GDMT with</td>
<td>I</td>
<td>C</td>
<td>10,12,14,848</td>
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<td>angina and suitable coronary anatomy, especially significant left main stenosis</td>
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<td>or left main equivalent</td>
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<td>CABG to improve survival is reasonable in patients with mild to moderate LV</td>
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<td>B</td>
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<td>systolic dysfunction and significant multivessel CAD or proximal LAD stenosis</td>
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<td>when viable myocardium is present</td>
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<td>CABG or medical therapy is reasonable to improve morbidity and mortality for</td>
<td>IIA</td>
<td>B</td>
<td>309,851</td>
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<td>patients with severe LV dysfunction (EF &lt;35%), HF, and significant CAD</td>
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<td>Surgical aortic valve replacement is reasonable for patients with critical</td>
<td>IIA</td>
<td>B</td>
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<td>aortic stenosis and a predicted surgical mortality of no greater than 10%</td>
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<td>Transcatheter aortic valve replacement is reasonable for patients with critical</td>
<td>IIA</td>
<td>B</td>
<td>853</td>
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<td>aortic stenosis who are deemed inoperable</td>
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<td>CABG may be considered in patients with ischemic heart disease, severe LV</td>
<td>IIb</td>
<td>B</td>
<td>307–309</td>
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<td>systolic dysfunction, and operable coronary anatomy whether or not viable</td>
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<td>myocardium is present</td>
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<td>Transcatheter mitral valve repair or mitral valve surgery for functional</td>
<td>IIb</td>
<td>B</td>
<td>854–857</td>
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<td>mitral insufficiency is of uncertain benefit</td>
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<td>Surgical reverse remodeling or LV aneurysmectomy may be considered in HFrEF</td>
<td>IIb</td>
<td>B</td>
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<td>for specific indications, including intractable HF and ventricular arrhythmias</td>
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CABG indicates coronary artery bypass graft; CAD, coronary artery disease; COR, Class of Recommendation; EF, ejection fraction; GDMT, guideline-directed medical therapy; HF, heart failure; HFrEF, heart failure with reduced ejection fraction; LAD, left anterior descending; LOE, Level of Evidence; and LV, left ventricular.
How about percutaneous revascularization?

- CAD in CHF tends to be multivessel, often occlusive disease
- Not rigorously studied
- Techniques are evolving
Successful Recanalization of Native Coronary Chronic Total Occlusion Is Not Associated With Improved Long-Term Survival

- 1173 pts underwent PCI for CTO
- 85% success
- 4.6 year median f/u

Conclusions (1):

1) Revascularization is a reasonable alternative for patients on guideline directed medical therapy with ongoing angina.

2) Mode of revascularization is dependent on anatomical factors

3) Revascularization improves indices of ventricular performance in patients with ischemic cardiomyopathy
Conclusions (2):

1) CABG has **NOT** been shown to improve overall survival in heart failure patients, even when the subjects with myocardial **VIABILITY** are selectively analyzed, but CABG does reduce likelihood of cardiovascular death and heart failure hospitalization.