Invasive Management of Stable Coronary Artery Disease

Juan A. Pastor-Cervantes, M.D FACC, FSCAI
Director Cardiac Catheterization Laboratory
Cardiac and Vascular Institute
Memorial Regional Hospital
Hollywood, Fl
Goals of Therapy

- Prevention of death, MI & stroke
- Relief of angina / ischemia

The intensity of therapy is predicated on the magnitude of risk and the severity of symptoms or signs of ischemia.
Revascularization in SIHD

CAD

SIHD

ACS

UA, NSTEMI

STEMI

GD-sizing GDMT

COURAGE, FAME, SYNTAX FREEDOM
Primary and Secondary Prevention

Cholesterol (lipid) control
Smoking cessation
Blood pressure control
Diabetic management
Weight control & diet
Exercise
Stress management
Alcohol use
Follow-up

Treatments
Aspirin
Beta blockers
ACE inhibitors
Statins
Nitrates
Fish oils
Fibrates
Niacin
Soy stanol esters
Vitamins

Memorial Cardiac and Vascular Institute
Memorial Regional Hospital | Memorial Hospital West
Therapies from 4S: Effects on Coronary Events

- Placebo: 28.9%
- Statin only: 18.6%
- Statin + ASA: 11.2%
- Statin + ASA + BB: 8.6%

Coronary Event Rate (%)

Kjekshus, J. Am J of CD. 1995, 76:64C-68C.
Logical Treatment of LDLc

- COURAGE Trial
- PROVE IT
- ASTEROID
- Elephant Horse
- Costal people (Japan China)
- NCEP 2001 ATP3
- Average American

LDLc (mg/dL)

- New born baby: 30
- Heart disease does not exist
- Framingham data, Castelli

CVD events

- 2000

- 50 60 70 100 130 177
Candidates for Very Low LDL-C
Goal of < 70 mg/dL

• Very high risk patients
  – Established atherosclerotic CVD
  + multiple risk factors (esp. diabetes)
  + severe and poorly controlled risk factors (e.g. cigarette smoking)
  + metabolic syndrome (high TG, low HDL)
  + acute coronary syndromes (PROVE-IT)

Enrollment

35,539 Patients assessed

32,468 patients were excluded
- 8,677 Did not meet inclusion criteria
- 5,155 Had undocumented ischemia
- 3,961 Did not meet protocol for vessels
- 6,554 Were excluded for logistic reasons
- 18,360 Had one or more exclusions
  - 4,513 Had undergone recent (<6 mo) revascularization
  - 4,939 Had an inadequate ejection fraction
  - 2,987 Had a contraindication to PCI
  - 2,542 Had a serious coexisting illness
  - 1,285 Had concomitant valvular disease
  - 1,203 Had class IV angina
  - 1,071 Had a failure of medical therapy
    - 947 Had left main stenosis >50%
    - 722 Had only PCI restenosis (no new lesions)
    - 528 Had complications after MI

3,071 (8.6%) met eligibility criteria
The Problem with Randomizing after Cath

WHAT HAS BEEN SEEN
Cannot be unseen.

Memorial Cardiac and Vascular Institute
## Table 1. Baseline Clinical and Angiographic Characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>PCI Group (N = 1149)</th>
<th>Medical-Therapy Group (N = 1138)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demographic</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age — yr</td>
<td>61.5±10.1</td>
<td>61.8±9.7</td>
<td>0.54</td>
</tr>
<tr>
<td>Sex — no. (%)</td>
<td></td>
<td></td>
<td>0.95</td>
</tr>
<tr>
<td>Male</td>
<td>979 (85)</td>
<td>968 (85)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>169 (15)</td>
<td>169 (15)</td>
<td></td>
</tr>
<tr>
<td>Race or ethnic group — no. (%)</td>
<td></td>
<td></td>
<td>0.64</td>
</tr>
<tr>
<td>White</td>
<td>988 (86)</td>
<td>975 (86)</td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>57 (5)</td>
<td>57 (5)</td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>68 (6)</td>
<td>58 (5)</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>35 (3)</td>
<td>47 (4)</td>
<td></td>
</tr>
<tr>
<td><strong>Clinical</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Angina (CCS class) — no. (%)</td>
<td></td>
<td></td>
<td>0.24</td>
</tr>
<tr>
<td>0</td>
<td>135 (12)</td>
<td>148 (13)</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>340 (30)</td>
<td>341 (30)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>409 (36)</td>
<td>425 (37)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>261 (23)</td>
<td>221 (19)</td>
<td></td>
</tr>
<tr>
<td>Missing data</td>
<td>3 (+1)</td>
<td>2 (&lt;1)</td>
<td></td>
</tr>
</tbody>
</table>

Vast majority white males

80% had no or mild symptoms
PCI in Stable CAD: COURAGE
Median FU 4.6 years (n=2,287)

- Optimal Medical Therapy (OMT)
- PCI + OMT
- 33% PCI Most in year 1
- Death/MI at 4.6 yrs: 19.0% 18.5%

Hazard ratio: 1.05
95% CI (0.87-1.27)
P = 0.62

Number at Risk
OMT: 1138, 1017, 959, 834, 638, 408, 192, 30
PCI: 1149, 1013, 952, 833, 637, 417, 200, 35

Years
0 1 2 3 4 5 6 7
Freedom from Death or MI (%)
Despite 32% XO to PCI in the OMT group

PCI + OMT compared to OMT resulted in:

- Significantly less use of nitrates at:
  - 1 year (53% vs. 67%)
  - 3 years (47% vs. 61%)
  - 5 years (40% vs. 57%)

- Significantly less use of Ca$^{+2}$ channel blockers at:
  - 1 year (40% vs. 49%)
  - 3 years (43% vs. 50%)
  - 5 years (42% vs. 52%)

Boden WE et al. NEJM 2007;356:1503-16
Design Limitations of COURAGE and BARI-2D

- Low risk patients included
- Referral bias by randomizing after cath
- Revascularization procedures not optimal (little DES, no FFR, no CABG in COURAGE)
Proportion of PCI Patients on OMT

Low Rates of OMT pre- and post-PCI

Adapted from: Borden WB et al. JAMA 2011;305:1882-1889
GLAGOV TRIAL

Background

• Prior intravascular ultrasound (IVUS) trials have shown that statins slow progression or induce regression of coronary disease in proportion to the magnitude of LDL-C reduction.

• No other LDL-lowering therapy has shown regression in an IVUS trial.

• The lowest LDL-C achieved in prior trials was approximately 60 mg/dL. Effects of lower levels remain unknown.

• PCSK9 inhibitors incrementally lower LDL-C when added to statins, allowing achievement of very low LDL-C levels, however, no data exist describing effects on progression.
IVUS Imaging with Preserved LCSA due to Positive Remodeling
GLAGOV TRIAL

968 patients at 197 global centers with symptomatic CAD and other high risk features. Coronary angiography showing 20-50% stenosis in a target vessel

Stable, optimized statin dose for 4 weeks with LDL-C >80 mg/dL or 60-80 mg with additional high risk features

Intravascular ultrasound via motorized pullback at 0.5 mm/sec through >40 mm segment

Statin monotherapy

18 months treatment

Statin plus monthly SC evolocumab 420 mg

61 patients did not complete

61 patients did not complete

423 statin completers

423 evolocumab completers

Follow-up IVUS of originally imaged “target” vessel (n=846)
Change in LDL-Cholesterol During Treatment

- Mean LDL-C 93.0 mg/dL
- Change from baseline 3.9%
- 90 mg/dL

- Mean LDL-C 36.6 mg/dL
- Change from baseline -59.8%
- 29 mg/dL
GLAGOV TRIAL

Exploratory Subgroup: Baseline LDL-C <70 mg/dL

Percent Atheroma Volume

- Change in PAV (%)
  - Statin monotherapy
  - Statin-evolocumab

- Percent Atheroma Volume
  - Statin monotherapy: -0.35 (P = NS)
  - Statin-evolocumab: -1.97 (P < 0.0001)

Fraction Showing Regression

- Percentage Regressing (%)
  - Statin monotherapy: 48.0%
  - Statin-evolocumab: 81.2%
Are All Angiographic Lesions $>50\%$ stenosis need to be stented?
Angiographic vs. Functional Severity of Coronary Stenosis

Of 509 pts with angiographically-defined MVD, 46% had “functional MVD”
FAME: Optimizing Complete Revascularization

1005 pts with MVD undergoing PCI with DES were randomized to FFR-guided vs. angio-guided intervention.

Absolute difference in MACE-free survival

- **FFR-guided (n=509)**
- **Angio-guided (n=496)**

- **30 days**
  - FFR: 2.9%
  - Angio: 3.8%
  - Difference: 0.9%

- **90 days**
  - FFR: 3.8%
  - Angio: 4.9%
  - Difference: 1.1%

- **180 days**
  - FFR: 4.9%
  - Angio: 5.3%
  - Difference: 0.4%

- **360 days**
  - FFR: 5.3%
  - Angio: 6.6%
  - Difference: 1.3%

**MACE 13.3% vs. 18.2%**

**P=0.02**
FAME 2 Symptoms

Baseline
- PCI+MT
- MT alone
- Registry

30 Days
- PCI+MT
- MT alone
- Registry

6 Months
- PCI+MT
- MT alone
- Registry

12 Months
- PCI+MT
- MT alone
- Registry

24 Months
- PCI+MT
- MT alone
- Registry

Patients with CCS II to IV (%)

De Bruyne et al, ESC 2014
ORBITA: Trial design

230 pts with stable angina (mean duration ~9 months)
Single vessel angiographic stenosis suitable for PCI
Enrolled at 5 UK sites over 3.5 yrs; 200 pts randomized

- 6 weeks
- Blinded procedure
- PCI
- Placebo
- 6 weeks

Enrolment assessment
CCS SAQ EQ-5D-5L
Pre-randomization assessment
CCS SAQ EQ-5D-5L
Research angiogram: iFR, FFR Sedation
Follow-up Assessment
CCS SAQ EQ-5D-5L
Exercise test Stress echo

Al Lamee et al, Lancet 2017
32% of patients meeting the inclusion criteria were not included because patient or physician declined.

- At the end of the 6 week blinded treatment phase of the trial, 85% of Placebo Patients elected to cross over to the PCI.

This diminishes broad applicability of the results.
ORBITA: Primary endpoint result

Change in total exercise time

Baseline in PCI: 8:48 smoothed Bruce w/VO2max ~25 (calculated)
Baseline in Placebo: 8:10 smoothed Bruce w/VO2 max ~24 (calculated)

+20.7 sec adjusted for baseline
(-4.0 to 45.5)

Error bars are standard errors of the mean

Al Lamee et al, Lancet 2017 and Circulation 2018
The implications of ORBITA are profound and far-reaching. First and foremost, the results of ORBITA show unequivocally that there are no benefits for PCI compared with medical therapy for stable angina, even when angina is refractory to medical therapy.

Based upon these data, all cardiology guidelines should be revised to downgrade the recommendation for PCI in patients with angina despite medical therapy.”
Early (4-6 Week) Angina-free Status

Results are consistent across eras, devices, drugs & trial design

- **VA ACME (PTCA, open-label)**: 50% PCI, 24% OMT
- **COURAGE (BMS, open-label)**: 42% PCI, 33% OMT
- **ORBITA (DES, sham-controlled)**: 50% PCI, 32% OMT

References:
- Weintraub WS et al. NEJM 2008;359:677-87
### Anti-Anginal Agents: An Alternate Perspective

A point rarely discussed: For most patients, GDMT with the ability to affect “hard endpoints” is limited to only aspirin, statins, and lifestyle modification.

<table>
<thead>
<tr>
<th>Agent</th>
<th>Issues for Patients</th>
<th>“Hard Outcomes” in SIHD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beta-blockers</td>
<td>Sluggishness, fatigue</td>
<td>No benefit unless post-MI or low EF</td>
</tr>
<tr>
<td>Nitrates</td>
<td>Really need to push for effect</td>
<td>No benefit</td>
</tr>
<tr>
<td>Ca++ Channel Blockers</td>
<td>Reasonably tolerated</td>
<td>No benefit</td>
</tr>
<tr>
<td>Ranolazine</td>
<td>Cost</td>
<td>No benefit</td>
</tr>
</tbody>
</table>

Non-Adherence Polypharmacy Side-Effects Cost
“Intensive medical therapy not realistic”

- ~3 anti-anginals per patient pre-randomization
- Achieved by 2-3 telephone consultations weekly with consultant cardiologist
- May not be achievable or sustainable in long term
- Most patients would prefer up front procedure to long term medical therapy
What is the Take Home Message of ORBITA?

- If I am about to leave on vacation and I am referred a patient with this lesion:

  After ORBITA, maybe I don’t have to delay my travel plans. Maybe, I can go on vacation and stent it when I get back to town.
The NIH-Sponsored ISCHEMIA Trial

5,179 pts* with moderate to severe ischemia by non-invasive testing

Blinded CT scan to rule out LM ds or normal coronaries

Optimal Medical Therapy (OMT - cath reserved for refractory ischemia)

Invasive Strategy (OMT + cath, followed by PCI [2\textsuperscript{nd} gen DES] or CABG as appropriate)

Primary endpoint: CV death, MI, cardiac arrest, hospitalization for unstable angina or heart failure. Major secondary endpoints: CV death or MI; QOL

*777 additional pts randomized in ISCHEMIA-CKD
Who Were the Enrolled Patients?

Exclusion of Patients with Severe Symptoms

**Exclusion:** Participant-reported unacceptable level of angina despite maximal medical therapy

- Ask the question "Over the past 4 weeks, on average, how many times have you had chest pain, chest tightness, or angina?"

- Potential responses:
  - 4 or more times per day
  - 1-3 times per day
  - 3 or more times per week but not every day
  - 1-2 times per week
  - Less than once a week
  - None over the past 4 weeks

*At least daily angina without ability to further titrate medical or anti-anginal therapy excludes the participant.*
ISCHEMIA was originally designed with hard endpoints that are "bias-resistant" because the trial isn’t blinded. Soft endpoints (e.g. hospitalizations for unstable angina or heart failure) may drive outcomes.

Responses:
- Pre-cath randomization
- Depends on WHO WAS ENROLLED (symptom status)
- Still look at "hard" endpoints (which may not be so hard)
- Adjudication / protocol processes
- Problems with an underpowered trial
Appropriateness of Revascularization and Outcomes in the UK

“Studies using [the RAND] method have shown that overuse of invasive techniques in the management of coronary disease is uncommon, and attention has turned to the issue of underuse”

### Appropriate Analysis

<table>
<thead>
<tr>
<th>Category</th>
<th>Angina at Follow-up</th>
<th>Odds Ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Medical Treatment</td>
<td>Revascularization</td>
</tr>
<tr>
<td>PTCA</td>
<td>Inappropriate</td>
<td>56/110 9/14</td>
</tr>
<tr>
<td></td>
<td>Uncertain</td>
<td>172/317 67/142</td>
</tr>
<tr>
<td></td>
<td>Appropriate</td>
<td>143/205 114/210</td>
</tr>
<tr>
<td>CABG</td>
<td>Inappropriate</td>
<td>49/70 6/8</td>
</tr>
<tr>
<td></td>
<td>Uncertain</td>
<td>189/348 60/136</td>
</tr>
<tr>
<td></td>
<td>Appropriate</td>
<td>137/208 213/547</td>
</tr>
</tbody>
</table>
## CAD Prognostic Index

<table>
<thead>
<tr>
<th>Extent of CAD</th>
<th>Prognostic Weight (0–100)</th>
<th>5-Year Survival Rate (%)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-vessel disease, 75%</td>
<td>23</td>
<td>93</td>
</tr>
<tr>
<td>1-vessel disease, 50% to 74%</td>
<td>23</td>
<td>93</td>
</tr>
<tr>
<td>1-vessel disease, ≥95%</td>
<td>32</td>
<td>91</td>
</tr>
<tr>
<td>2-vessel disease</td>
<td>37</td>
<td>88</td>
</tr>
<tr>
<td>2-vessel disease, both ≥95%</td>
<td>42</td>
<td>86</td>
</tr>
<tr>
<td>1-vessel disease, ≥95% proximal LAD artery</td>
<td>48</td>
<td>83</td>
</tr>
<tr>
<td>2-vessel disease, ≥95% LAD artery</td>
<td>48</td>
<td>83</td>
</tr>
<tr>
<td>2-vessel disease, ≥95% proximal LAD artery</td>
<td>56</td>
<td>79</td>
</tr>
<tr>
<td>3-vessel disease</td>
<td>56</td>
<td>79</td>
</tr>
<tr>
<td>3-vessel disease, ≥95% in ≥1 vessel</td>
<td>63</td>
<td>73</td>
</tr>
<tr>
<td>3-vessel disease, 75% proximal LAD artery</td>
<td>67</td>
<td>67</td>
</tr>
<tr>
<td>3-vessel disease, ≥95% proximal LAD artery</td>
<td>74</td>
<td>59</td>
</tr>
</tbody>
</table>

*Assuming medical treatment only.
CABG vs PCI for Chronic Stable CAD Revascularization

Two Very Different Procedures…
CABG vs. no CABG

CABG Surgery Trialists Collaboration; 10-year outcome

**VA study**
- P = 0.12 5 yrs
- P = 0.45 10 yrs
- n = 354
- n = 332

**European study**
- P < 0.001 5 yrs
- P = 0.02 10 yrs
- n = 373
- n = 394

**CASS study**
- P = 0.25 10 yrs
- n = 390
- n = 390

**All studies**
- P < 0.001 5 yrs
- P = 0.03 10 yrs
- n = 1,325
- n = 1,324

**Cumulative mortality rate**

**Time (years)**
Surgical Revascularization
Arterial Conduits

LAD
- Internal mammary artery (left)

RCA
- Saphenous vein
- Saphenous vein for 70-90% diameter stenosis
- Radial artery for ≥90% diameter stenosis

LGx
- Second internal mammary artery (BIMA)
- Saphenous vein, if internal mammary artery is not indicated*
- Second internal mammary artery (BIMA)
- Radial artery, if internal mammary artery is not indicated*

* Depending on clinical situation

# Mortality Results at 5 Years

<table>
<thead>
<tr>
<th>Subgroup</th>
<th>Odds ratio (95% CI)</th>
<th>P for CABG surgery vs medical Tx</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vessel disease</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 vessel</td>
<td>0.54 (0.22-1.33)</td>
<td>0.18</td>
</tr>
<tr>
<td>2 vessel</td>
<td>0.84 (0.54-1.32)</td>
<td>0.45</td>
</tr>
<tr>
<td>3 vessel</td>
<td>0.58 (0.42-0.80)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Left main artery</td>
<td>0.32 (0.15-0.70)</td>
<td>0.004</td>
</tr>
<tr>
<td><strong>LAD disease present</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 or 2 vessels</td>
<td>0.58 (0.34-1.01)</td>
<td>0.05</td>
</tr>
<tr>
<td>3 vessels</td>
<td>0.61 (0.42-0.88)</td>
<td>0.009</td>
</tr>
<tr>
<td>Left main artery</td>
<td>0.30 (0.11-0.84)</td>
<td>0.02</td>
</tr>
<tr>
<td>Overall</td>
<td>0.58 (0.43-0.77)</td>
<td>0.001</td>
</tr>
</tbody>
</table>
SIHD: CABG vs. PCI
SYNTAX 5 Year Results

MVD in Diabetes
FREEDOM Trial

Farkouh ME et al. NEJM 2012; 367:2375-84
SYNTAX Trial II
Inclusion: All-Comers, angiographic, de-novo 3-vessel disease without left main involvement (visual % diameter stenosis ≥50%)

Screening according to SYNTAX Score I

Screening according to SYNTAX Score II

SYNTAX Score II Favours PCI

SYNTAX Score II Offers equipoise for PCI and CABG

SYNTAX Score II Favours CABG

Heart Team Discussion:
Confirm SYNTAX Score II calculation, and that recruitment of patients for PCI is based on safety (long term mortality comparisons between CABG and PCI).
Can ‘equivalent’ anatomical revascularisation be achieved*?
*Surgeon and interventional cardiologist in agreement

CABG Registry

Consensus Heart Team for performing PCI

Patient ‘Signed Off’ by Heart Team for PCI

Informed Consent Procedure

Patient is included in the study
Patient “Signed-off” by the Heart Team for PCI

iFR in all intended to treat vessels

iFR < 0.86*

iFR 0.86 – 0.93

iFR > 0.93

Implantation of SYNERGY™ stent(s)

Optimization by IVUS guidance (modified MUSIC Criteria)

Optimal medical therapy with strict LDL control (≤ 1.8mmol/L)

FFR ≤ 0.80

FFR > 0.80

No stent implantation in lesion

* Consider FFR pullback with sequential lesions
Anatomic lesions intended to be treated before functional assessment

n=1553 lesions – 3.5 lesions/patient

Treated lesions (n=1169 lesions) – (2.6 lesions/patient)

- Treated (n=1169)
- iFR/FFR negative (n=351)
- Failed/Not attempted CTO (n=16)
- Diffuse disease/small vessel (n=8)
- Failed PCI (non-CTO) (n=4)
- Other (n=5)

*Investigator reported
SYNTAX II: MACCE

SYNTAX II Score guidance for Heart Team, Physiology (75%), IVUS (84%), CTO Success 87%, Newer generation BP-DES (Synergy)

HR 0.58 (95% CI 0.39-0.85), p=0.006

Escaned J et al, ESC 2017
A Heart Team approach to revascularization is recommended in patients with unprotected left main or complex CAD.

Calculation of the STS and SYNTAX scores is reasonable in patients with unprotected left main and complex CAD.
# Revascularization

**ESC 2014**

<table>
<thead>
<tr>
<th>Extent of CAD (anatomical and/or functional)</th>
<th>Class&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Level&lt;sup&gt;c&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>For prognosis</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Left main disease with stenosis &gt;50%&lt;sup&gt;a&lt;/sup&gt;</td>
<td>I</td>
<td>A</td>
</tr>
<tr>
<td>Any proximal LAD stenosis &gt;50%&lt;sup&gt;a&lt;/sup&gt;</td>
<td>I</td>
<td>A</td>
</tr>
<tr>
<td>Two-vessel or three-vessel disease with stenosis &gt; 50%&lt;sup&gt;a&lt;/sup&gt; with impaired LV function (LVEF&lt;40%)&lt;sup&gt;a&lt;/sup&gt;</td>
<td>I</td>
<td>A</td>
</tr>
<tr>
<td>Large area of ischaemia (&gt;10% LV)</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>Single remaining patent coronary artery with stenosis &gt;50%&lt;sup&gt;a&lt;/sup&gt;</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td><strong>For symptoms</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any coronary stenosis &gt;50%&lt;sup&gt;a&lt;/sup&gt; in the presence of limiting angina or angina equivalent, unresponsive to medical therapy</td>
<td>I</td>
<td>A</td>
</tr>
</tbody>
</table>

<sup>a</sup> Coronary artery stenosis or diameter reduction

<sup>b</sup> Class

<sup>c</sup> Level
<table>
<thead>
<tr>
<th>Recommendations according to extent of CAD</th>
<th>CABG</th>
<th>PCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>One or two-vessel disease without proximal LAD stenosis.</td>
<td>IIb</td>
<td>I</td>
</tr>
<tr>
<td>One-vessel disease with proximal LAD stenosis.</td>
<td>I</td>
<td>A</td>
</tr>
<tr>
<td>Two-vessel disease with proximal LAD stenosis.</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>Left main disease with a SYNTAX score ≤ 22.</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>Left main disease with a SYNTAX score 23–32.</td>
<td>I</td>
<td>IIa</td>
</tr>
<tr>
<td>Left main disease with a SYNTAX score &gt;32.</td>
<td>I</td>
<td>III</td>
</tr>
<tr>
<td>Three-vessel disease with a SYNTAX score ≤ 22.</td>
<td>I</td>
<td>A</td>
</tr>
<tr>
<td>Three-vessel disease with a SYNTAX score 23–32.</td>
<td>I</td>
<td>A</td>
</tr>
<tr>
<td>Three-vessel disease with a SYNTAX score &gt;32.</td>
<td>I</td>
<td>A</td>
</tr>
</tbody>
</table>
Courage, Orbita, Ischemia, Syntax II like Patient

- 68 yo Physician
- PMHx of HTN, Hyperlipidemia, Spinal Stenosis
- Prior Calcium Score 293 in the LAD/2016
- Unable to tolerate Statin due to Myalgias
- Aggressive Diet/Vegetarian Last Total Cholesterol 171, LDL 109, HDL 38, Trig 122
- Progressive DOE CCSC III
- CTA Borderline Stenosis of the Proximal LAD
Initial Angiographic Evaluation of the LAD demonstrating Borderline Stenosis of the Proximal Mid Segment and Proximal 1st Diagonal with an IFR of 0.77 and concomitant Severe Distal LAD Stenosis
RAO Caudal View of the LAD
IVUS image demonstrating unexpanded stent, in need of optimization
Complete Revascularization of the LAD with IVUS optimization
I cannot thank you enough for what you did for me today .. you LITERALLY saved my life .. I know that only God really saves lives, but you are His instrument and I know NO ONE else would have given me the time and expert attention that you did.. I am forever in your debt .. Larry
New Generation DES

<table>
<thead>
<tr>
<th>Revascularisation technique</th>
<th>All-cause mortality</th>
<th>Rate ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surgery</td>
<td></td>
<td>0.80 (0.70-0.91)</td>
</tr>
<tr>
<td>CABG</td>
<td></td>
<td>0.85 (0.68-1.04)</td>
</tr>
<tr>
<td>Early PCI techniques</td>
<td></td>
<td>0.92 (0.79-1.05)</td>
</tr>
<tr>
<td>BA</td>
<td></td>
<td>0.92 (0.75-1.12)</td>
</tr>
<tr>
<td>BMS</td>
<td></td>
<td>0.91 (0.75-1.10)</td>
</tr>
<tr>
<td>Early-generation drug-eluting stents</td>
<td></td>
<td>0.88 (0.69-1.10)</td>
</tr>
<tr>
<td>PES</td>
<td></td>
<td>0.65 (0.42-1.00)</td>
</tr>
<tr>
<td>SES</td>
<td></td>
<td>0.75 (0.59-0.96)</td>
</tr>
<tr>
<td>New-generation drug-eluting stents</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R-ZES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EES</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Favours revascularisation  Favours medical treatment

56 yo Physician, Known Asymptomatic CAD

- CASHD
  - Calcium score 706
  - Asymptomatic – very active, runs and spins regularly
  - He wants a screening stress test.

- HTN
- Dyslipidemia
- Childhood Asthma
56 yo Physician, Known Asymptomatic CAD

- Medications:
  - Atorvastatin 20 mg daily (LDL = 82, HDL = 70, Trig = 83)
  - Atenolol 50 mg daily
  - Lisinopril 20 mg daily
  - ASA 81 mg daily
  - Ubiquinone (coenzyme Q10) 200 mg daily
  - Vit D3 1,000 units daily

- 110/70 HR = 60 BMI = 23.1
56 yo Physician, Known Asymptomatic CAD

- **CASHD**
  - Calcium score 266, 10 years ago
  - Asymptomatic – very active, runs and spins regularly
  - Screening Stress Nuclear
    - 14 minutes 31 seconds of Bruce protocol
    - Stopped from fatigue. No CP
    - 89% age predicted maximal heart rate. Normal BP response.
    - 4 mm horizontal ST depression V5, V6; 2 mm horizontal ST depression II, III, aVF
    - Nuclear = Severe Anterior and inferolateral ischemia, extend of perfusion abnormality 18%
Observational study: Revascularization was associated with lower risk of cardiac death only in those with >10% ischemia on perfusion imaging.

- *p < 0.001
- N = 10,627
- 146 Cardiac deaths
- 492 ACS

Graph showing the log hazard ratio vs. % total myocardium ischemic with significant differences indicated by asterisks.
Diffuse Moderate Mid LAD Stenosis
Diffuse Moderate Mid LAD Stenosis

\[
FFR = \frac{\text{Distal Coronary Pressure (Pd)}}{\text{Proximal Coronary Pressure (Pa)}}
\]

(During Maximum Hyperemia)
Total Occlusion of Circumflex Coronary Artery
95% Proximal RCA Stenosis
56 yo Physician, Known Asymptomatic CAD Follow Up

Syntax I Score 17 Low Risk (0-22)

- DES of LAD, DES of RCA, DES to LCx
- On 80 mg atorvastatin: LDL = 49, HDL = 75, Trig = 80
- Stress Nuclear
  - 17 minutes Bruce protocol!
  - No ECG ST changes
  - Nuclear = normal
## GDMT vs. Revasc for Stable Ischemic Heart Disease

<table>
<thead>
<tr>
<th>Factors favoring GDMT</th>
<th>Factors favoring Revasc + GDMT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Symptoms:</strong></td>
<td>None to mild</td>
</tr>
<tr>
<td><strong>Exercise capacity:</strong></td>
<td>Normal</td>
</tr>
<tr>
<td><strong>Ischemia/Risk:</strong></td>
<td>None to mild</td>
</tr>
<tr>
<td><strong>Anti-anginal drug tolerance:</strong></td>
<td>Good</td>
</tr>
<tr>
<td><strong>Revasc. risk (pt factors, cor anat):</strong></td>
<td>High</td>
</tr>
<tr>
<td><strong>DAPT compliance:</strong></td>
<td>Poor</td>
</tr>
</tbody>
</table>

Adapted from G. Stone
Conclusions

- First and Foremost Establish Aggressive Guideline Directed Medical Therapy
- Revascularization should be deferred for symptomatic patients or patients with moderate or large areas of ischemia by non invasive testing
- Functional Assessment of Coronary Artery Stenosis in the Cardiac Catheterization Laboratory is essential for correct management of patients with Chronic Stable CAD
- Consider Surgical Revascularization in Diabetic Patients
- The large gap in outcomes, especially repeat revascularizations, between CABG and PCI with POBA and BMS has been drastically reduced following the introduction of 2nd generation DES
Thank You