PCI vs CABG for Multivessel Disease: Calculation of Risk and Long Term Outcome

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Strategy

- Local Heart team (surgeon & interventional cardiologist) assessed each patient in regards to:
  - Patient’s operative risk (EuroSCORE & Parsonnet score, Cleveland score)
    - Operative risk scores predict perioperative and in-hospital surgical risk of death or severe complications
  - Coronary lesion complexity (SYNTAX score)
    - SYNTAX score provides guidance on optimal revascularization strategies for patients with high-risk lesions based on results of SYNTAX Study
  - PCI risk score: risk of technical failure and hemodynamic collapse
  - Prediction of long term outcome (1-5-10 years) after PCI and CABG
Assessment of extent of coronary artery disease

- **SYNTAX Score:** [www.syntaxscore.com](http://www.syntaxscore.com)

[Image: SYNTAX score diagram with categories such as Dominate, Number & location of lesions, Calcification, Thrombus, Bifurcation, Tortuosity, Total Occlusion, Left Main, 3 Vessel, and EuroInterv 2005;1:219–227]
Syntax score vs 12/12 outcome

MACCE to 12 Months by SYNTAX Score Tertile Low Scores (0–22)

- 3VD subset
  - Mean baseline SYNTAX Score
    - CABG: 17.3 ± 3.8
    - TAXUS: 17.3 ± 3.8
  - P = 0.66*

- LM subset
  - Mean baseline SYNTAX Score
    - CABG: 15.3 ± 4.3
    - TAXUS: 15.7 ± 4.4
  - P = 0.19*

MACCE to 12 Months by SYNTAX Score Tertile Intermediate Scores (23–32)

- 3VD subset
  - Mean baseline SYNTAX Score
    - CABG: 27.5 ± 2.7
    - TAXUS: 27.8 ± 2.9
  - P = 0.02*

- LM subset
  - Mean baseline SYNTAX Score
    - CABG: 27.9 ± 3.0
    - TAXUS: 27.9 ± 2.7
  - P = 0.54*

MACCE to 12 Months by SYNTAX Score Tertile High Scores (33+)

- 3VD subset
  - Mean baseline SYNTAX Score
    - CABG: 49.8 ± 5.1
    - TAXUS: 49.2 ± 5.9

- LM subset

MACCE% by SYNTAX Score Tertile

- Scores 0–22
  - Diabetes: 18.3%
- Scores 23–32
  - Diabetes: 20.3%
- Scores ≥33
  - Diabetes: 32.4%

Event rate: 1.5 S/5, Fisher exact test
Calculated by core laboratory; ITT population
Logistic EuroScore

1. **Age** (per 5 years or part thereof over 60 years)  
   - 1
2. **Sex**  
   - female
3. **Chronic pulmonary disease**  
   - long-term use of bronchodilators or steroids for lung disease  
   - 1
4. **Extracardiac arteriopathy**  
   - any one or more of the following: claudication, carotid occlusion or >50% stenosis, previous or planned intervention on the abdominal aorta, limb arteries or carotids  
   - 2
5. **Neurological dysfunction disease**  
   - severely affecting ambulation or day-to-day functioning  
   - 2
6. **Previous cardiac surgery**  
   - requiring opening of the pericardium  
   - 3
7. **Serum creatinine**  
   - >200 micromol/L preoperatively  
   - 2
8. **Active endocarditis**  
   - patient still under antibiotic treatment for endocarditis at the time of surgery  
   - 3
9. **Critical preoperative state**  
   - any one or more of the following: ventricular tachycardia or fibrillation or aborted sudden death, preoperative cardiac massage, preoperative ventilation before arrival in the anaesthetic room, preoperative inotropic support, intraaortic balloon counterpulsation or preoperative acute renal failure (anuria or oliguria <10 ml/hour)  
   - 3
10. **Cardiac-related factors**  
    - **Score**
    - **Unstable angina**  
      - rest angina requiring iv nitrates until arrival in the anaesthetic room  
      - 2
    - **LV dysfunction**  
      - moderate or LVEF 30-50%  
      - 1
      - poor or LVEF <30  
      - 3
    - **Recent myocardial infarct**  
      - (<90 days)  
      - 2
    - **Pulmonary hypertension**  
      - Systolic PA pressure >60 mmHg  
      - 2
11. **Operation-related factors**  
    - **Score**
    - **Emergency**  
      - carried out on referral before the beginning of the next working day  
      - 2
    - **Other than isolated CABG**  
      - major cardiac procedure other than or in addition to CABG  
      - 2
# EuroScore – calculator: additive and logistic

<table>
<thead>
<tr>
<th>Patient-related factors</th>
<th>Cardiac-related factors</th>
<th>Operation-related factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>65</td>
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<tr>
<td>Gender</td>
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<td>No</td>
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<td>No</td>
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<tr>
<td>Neurological dysfunction</td>
<td>No</td>
<td>No</td>
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<tr>
<td>Previous Cardiac Surgery</td>
<td>No</td>
<td>Emergency</td>
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<tr>
<td>Creatinine &gt; 200 μmol/L</td>
<td>No</td>
<td>No</td>
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<tr>
<td>Active endocarditis</td>
<td>No</td>
<td>No</td>
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<tr>
<td>Critical preoperative state</td>
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</tbody>
</table>

**EuroSCORE**

Logistic 3.81%

Note: Logistic is now default calculator

[Calculate] [Clear]
<table>
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<tr>
<th>Patient-related factors</th>
<th>Cardiac-related factors</th>
<th>Operation-related factors</th>
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</thead>
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<td>0</td>
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<td>Creatinine &gt; 200 µmol/L</td>
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<td>Active endocarditis</td>
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<td>Unstable angina</td>
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<tr>
<td>LV function</td>
<td>Poor</td>
<td></td>
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<tr>
<td>Recent MI</td>
<td>No</td>
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<tr>
<td>Pulmonary hypertension</td>
<td>No</td>
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</tr>
<tr>
<td>Emergency</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Other than isolated CABG</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Surgery on thoracic aorta</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Post infarct septal rupture</td>
<td>No</td>
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</tbody>
</table>

**EuroSCORE**

53.82 %

Note: Logistic is now default calculator
## SYNTAX TRIAL: Predictors of 12 month MACCE: Pre-procedure

<table>
<thead>
<tr>
<th>Variable</th>
<th>Odds Ratio [95% CI]</th>
<th>(P) value(^{†})</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CABG</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COPD</td>
<td>2.45 [1.25, 4.80]</td>
<td>0.009</td>
</tr>
<tr>
<td>Unstable Angina</td>
<td>1.88 [1.14, 3.09]</td>
<td>0.01</td>
</tr>
<tr>
<td>Moderate or Poor LVEF</td>
<td>1.98 [1.13, 3.47]</td>
<td>0.02</td>
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<tr>
<td>SYNTAX Score</td>
<td>0.97 [0.95, 1.00]</td>
<td>0.02</td>
</tr>
<tr>
<td>Race</td>
<td>0.33 [0.14, 0.82]</td>
<td>0.02</td>
</tr>
<tr>
<td>Emergent Revasc.</td>
<td>2.78 [1.08, 7.17]</td>
<td>0.03</td>
</tr>
<tr>
<td>Prior MI</td>
<td>0.57 [0.33, 0.99]</td>
<td>0.045</td>
</tr>
<tr>
<td>Age</td>
<td>1.03 [1.00, 1.05]</td>
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<tr>
<td><strong>TAXUS</strong></td>
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<td></td>
</tr>
<tr>
<td>Medically Treated Diabetes</td>
<td>2.07 [1.40, 3.05]</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>SYNTAX Score</td>
<td>1.02 [1.00, 1.04]</td>
<td>0.02</td>
</tr>
<tr>
<td>Age</td>
<td>1.02 [1.00, 1.04]</td>
<td>0.03</td>
</tr>
</tbody>
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## Syntax Trial

<table>
<thead>
<tr>
<th></th>
<th>Euroscore additive</th>
<th>Syntax Score</th>
<th>1 year mortality</th>
<th>1 year MACE</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCI RCT</td>
<td>3,8</td>
<td>28,4</td>
<td>4,3</td>
<td>17,8</td>
</tr>
<tr>
<td>CABG RCT</td>
<td>3,8</td>
<td>29,1</td>
<td>3,5</td>
<td>12,1</td>
</tr>
<tr>
<td>PCI Reg.</td>
<td>5,8</td>
<td>31,6</td>
<td>7,4</td>
<td>20,5</td>
</tr>
<tr>
<td>CABG Reg</td>
<td>3,8</td>
<td>35,5</td>
<td>2,5</td>
<td>8,8</td>
</tr>
</tbody>
</table>
Decision diagram

EuroScore

High Risk

5

Low Risk

0-22 22-33 >33

PCI PCI CABG

PCI or CABG: LM = PCI 3vd and DM = CABG

PCI or Rx?

Syntax Score

5
High risk population

- Acute coronary syndrome patients
- LMCA disease
- Depressed LV function
- Diabetes, Renal Failure etc.
LE MANS Registry (n = 252)

**Figure 1. The LE MANS Study Algorithm**

The LE MANS algorithm is from Buscemi et al. (20) but is based on new data. DAV = directional atherectomy; CABG = coronary artery bypass grafting; PCI = percutaneous coronary intervention; STEMI = ST-segment elevation myocardial infarction.

**Figure 2. Survival and Major Adverse Cardiovascular Events**

(A) Kaplan-Meier survival curves for the overall study group (B) survival in 8 subgroups with isolated LM (LM) and LM plus LAD (LM + LAD) and LM plus LAD and LCX (LM + LAD + LCX).
Results:
uni and multivariate analysis with Odds Ratio for long term follow-up

Age >60 y.o.  
LVEF <50%  
Stent diam. <3,8mm  
DES  
Euroscore >9

The Cox multivariate analysis for independent risk factors showed that EF <50% decreased survival rate, while DES implantation decreased and stent diameter <3,8mm increased the risk of MACCE.
ACS Registry

PL-ACS (150 000 pts in Poland)

Substudy: revascularization for MVD in 3787 pts (Years 2003-2009)
Results – 30 day mortality

P = 0.1
PCI better than CABG for MVCAD and NST-ACS?

Two years cumulative survival: PCI vs. CABG

- PCI
- CABG

Time (days)
Single and independent risk factors influencing long term mortality in ACS + MVCAD

- CABG*
- Male
- Unstable Angina
- NSTEMI
- Cardiogenic shock *
- Tobacco
- Hypertension
- Dyslipidemia
- Diabetes
- Obesity
- Prior MI
- Prior CABG
- Prior PCI

* Independent risk factor
DES for ACS subanalysis of all comers studies

AHP Registry 2006-2009
Single risk / benefit factors influencing 2 year mortality

Age > 65
Male
Unstable angina
NSTEMI
STEMI
Killip > 1
**Euroscore < 7**
BMI > 27
Hypertension
**DM**
Obesity
Tobacco
Hyperlipidemia
Family History
Creatinine > 0.9
COPD
prior MI
prior PCI
prior CABG
Single risk / benefit factors influencing 2 year mortality

- LVEF < 50%
- MVD
- LM disease
- 2nd gen DES
  - Cypher
  - Biomatrix
  - Endeavor
  - Xience
- Stent diam. < 3.0
- Restenotic lesion
- CTO
- Predilatation
- Complete revasc
- GPI
Cumulative survival: DES 1st gen vs DES 2nd gen

F-Cox p = 0.07
PCI scoring system to predict early and long term outcome

- Clinical risk factors:
  - SA/UA/NSTEMI/STEMI
  - Killip class
  - LV function
  - Biomarkers
  - Risk of bleeding
  - Antiplatelet pre-treatment, bedside platelet reactivity
  - Diabetes Mellitus, Renal Failure, PAD
  - Hyperlipidemia and pre-treatment with statins
PCI scoring system to predict early and long term outcome

- **Angiographic risk**
  - 1-2-3 vessel CAD
  - LMCA disease
  - **Syntax score!**

- **Peri- and post PCI risk (residual risk)**
  - DES vs BMS
  - No of stents
  - Overlapping stents
  - Apposition and strut expansion, residual stenosis (IVUS!)
  - adge dissection
  - Prox/dist lesions, TIMI flow post PCI
  - Complete revascularization
  - Bleeding, MI
Algorhythm to predict outcome after PCI or CABG

- Based on data from the large registries and randomized trials (PCI, CABG) a risk calculator should be designed to predict the late outcome after PCI or CABG in a particular case!
Previous experience

- **Patient Specific Predictions and Comparisons for Patients with Coronary Artery Disease.**
  DC Naftel, EH Blackstone, JW Kirklin
  - Software ver. 1.0, Summit Medical Systems

  *JACC 1991;17:543-89*  *Circulation 1991;83:1125-1173*

  (data including ca 6000 CABG and 300 PCI pts)
The Cardiologist as a gatekeeper

- Is recascularization necessary?
  Yes, if prognostic or symptomatic indications

- Can we perform PCI?
  - Yes, if technically feasible at low periprocedural risk

- Can we do it as good as the surgeons? Long term results?
  - SYNTAX score, EUROSCORE, PCI/CABG calculator?

- Should I do it?
  - Only if the experience in multivessel, complex
SYNTAX Score: guiding selection of revascularization
Syntax Score Examples

- Left Main Randomized Score 25
- LM & 3VD Randomized Score 39
- LM & 3VD Registry Score 50
## Euroscore - calculator

![Image of the Euroscore calculator interface](https://example.com/euroscore_calculator.png)

### Euroscore Components

**Patient related factors**
- **Age (years):** 75
- **Gender:** Male
- **Chronic pulmonary disease:** Yes
- **Extracardiac arteriopathy:** No
- **Neurological dysfunction:** No
- **Previous Cardiac Surgery:** No
- **Creatinine > 200 µmol/L:** No
- **Active endocarditis:** No
- **Critical preoperative state:** No

**Cardiac related factors**
- **Unstable angina:** Yes
- **LV function:** Poor
- **Recent MI:** No
- **Pulmonary hypertension:** No

**Operation related factors**
- **Emergency:** No
- **Other than isolated CABG:** No
- **Surgery on thoracic aorta:** No
- **Post infarct septal rupture:** No

### Euroscore Calculation

**Euroscore:** 18.22%

*Note: Logistic is now default calculator*
Euroscore > 7 vs <7

F-Cox \( p = 0.01 \)
DM vs. no DM

F-Cox \( p = 0.02 \)
MACCE at 12 Months by SYNTAX Score Tercile

All Terciles PCI Registry

Cumulative Event Rate (%)

Months Since Allocation

Kaplan-Meier rates
Per-protocol population

Low (0–22) 16.1%
Intermediate (23–32) 16.1%
High (≥33) 26.9%
Overall MACCE to 12 Months
*TAXUS RCT and PCI Registry

- **Cumulative Event Rate (%)**
- **Event Rate ± 1.5 SE**
- **Months Since Allocation**
- **TAXUS RCT* (n=903)**
- **PCI Reg (n=192)**

For descriptive purposes only; no statistical comparisons done

Per-protocol population

Event Rate ± 1.5 SE
Kaplan-Meier rates