Prediction of Death or Revascularization Using the SYNTAX Score in Unprotected Left Main Coronary Revascularization
Application to MAIN-COMpare Registry

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The Syntax score was proposed to take into account the heterogeneity in the lesion anatomy and complexity.

**The SYNTAX score algorithm**
1. Dominance
2. Number of lesions
3. Segments involved per lesion

*Lesion Characteristics*
4. Total occlusion
   i. Number of segments involved
   ii. Age of the total occlusion (>3 months)
   iii. Blunt Stump
   iv. Bridging collaterals
   v. First segment beyond the occlusion visible by antegrade or retrograde filling
   vi. Side branch involvement
5. Trifurcation
   i. Number of segments diseased
6. Bifurcation
   i. Type
   ii. Angulation between the distal main vessel and the side branch <70°
7. Aorto-ostial lesion
8. Severe tortuosity
9. Length >20mm
10. Heavy calcification
11. Thrombus
12. Diffuse disease/small vessels
   i. Number of segments with diffuse disease/small vessels

Prediction of MACCE
SYNTAX Score

Serruys PW. TCT 2008
SYNTAX Score

- No consideration of clinical parameters
- Not based on the multivariate analysis of true database
- Inhomogeneous risk factors between PCI versus CABG
- Inconsistent weigh on the anatomical complexity between PCI versus CABG
Predictability of SYNTAX Score for 320 CABG Patients

Event Free Survival Probability (%)

Log-rank $p=0.763$

Angiographic Analysis Cohort from MAIN-COMPARE Registry

Wave I
- LMCA disease
  - BMS (N=174)
  - CABG (N=260)

Wave II
- LMCA disease
  - DES (N=627)
  - CABG (N=471)
  - PCI (N=801)
  - CABG (N=731)

1532 (68.3%)* from all 2242 patients

* Patients in whom angiograms were successfully retrieved for analysis
Statistics

- Outcomes of interest were death (all cause) and target vessel revascularization (TVR)
- Patients were stratified into 3 groups with the SYNTAX score defined as a low score as $\leq 22$, an intermediate score as 23 to 32, and a high score as $\geq 33$ (NEJM 2009;360:961)
- Chi square and ANOVA for 3-group comparison
- Log-rank test to compare survival curves
- Multivariate Cox model to identify predictors of death or TVR
- C-statistic for predictability accuracy
- Creation of propensity score for all angiographic cohort
- Multivariate Cox model to adjust the selection bias of two treatments, using the covariates of propensity-score, Euro-Score, and SYNTAX-Score
Angiographic Analysis in Core Lab of CVRF

Creation of SYNTAX Calculator for both Core-lab analyzer and on-site operators
Distribution of SYNTAX Score
Non-normal distribution

Mean 30.8 ± 14.8
Median 30.0
IQR 18, 41
Tertiles 22, 36
K-S test p < 0.001
Distribution of SYNTAX Score
Comparison between PCI vs. CABG

<table>
<thead>
<tr>
<th></th>
<th>PCI (N=801)</th>
<th>CABG (N=731)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median</td>
<td>22.0</td>
<td>38.0</td>
</tr>
<tr>
<td>IQR</td>
<td>14, 31</td>
<td>29, 49</td>
</tr>
<tr>
<td>Tertiles</td>
<td>16, 27</td>
<td>32, 44</td>
</tr>
<tr>
<td>K-S p</td>
<td>&lt;0.001</td>
<td>0.197</td>
</tr>
</tbody>
</table>

*p < 0.001 between PCI vs. CABG* by t or Mann-Whitney test
Distribution of SYNTAX Score
Overall 1532 patients

- Low (≤ 22): 518 (33.8%)
- Intermediate (23-32): 352 (23.0%)
- High (≥ 33): 662 (43.2%)

Mean 15.1, Median 14, IQR 12-19
Mean 27.5, Median 27, IQR 25-30
Mean 44.8, Median 42.5, IQR 37-51
SYNTAX Score between CABG vs PCI

CABG (N=731)
- Low: 97 (13.3%)
- Intermediate: 150 (20.5%)
- High: 484 (66.2%)

PCI (N=801)
- Low: 202 (25.2%)
- Intermediate: 178 (22.2%)
- High: 421 (52.6%)

P<0.001
SYNTAX Score between BMS vs DES

BMS (N=174)
- Low: 108 (62.1%)
- Intermediate: 35 (20.1%)
- High: 31 (17.8%)

DES (N=627)
- Low: 313 (49.9%)
- Intermediate: 167 (26.6%)
- High: 147 (23.4%)

P = 0.018
## Baseline Demographics

<table>
<thead>
<tr>
<th></th>
<th>Low (N=518)</th>
<th>Intermediate (N=352)</th>
<th>High (N=662)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yrs)</td>
<td>58.5 ± 11.5</td>
<td>63.0 ± 10.0</td>
<td>64.5 ± 9.4</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Male gender</td>
<td>347 (67.0)</td>
<td>253 (71.9)</td>
<td>493 (74.5)</td>
<td>0.018</td>
</tr>
<tr>
<td>Hypertension</td>
<td>217 (41.9)</td>
<td>183 (52.0)</td>
<td>363 (54.8)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>121 (23.4)</td>
<td>111 (31.5)</td>
<td>254 (38.4)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>(Insulin-treated)</td>
<td>20 (3.9)</td>
<td>28 (8.0)</td>
<td>39 (5.9)</td>
<td>0.036</td>
</tr>
<tr>
<td>Hypercholesterolemia</td>
<td>154 (29.7)</td>
<td>122 (34.7)</td>
<td>264 (39.9)</td>
<td>0.003</td>
</tr>
<tr>
<td>Current smoking</td>
<td>143 (27.6)</td>
<td>102 (29.0)</td>
<td>161 (24.3)</td>
<td>0.218</td>
</tr>
</tbody>
</table>
# Baseline Demographics

<table>
<thead>
<tr>
<th></th>
<th>Low (N=518)</th>
<th>Intermediate (N=352)</th>
<th>High (N=662)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Previous MI</td>
<td>27 (19.1)</td>
<td>38 (27.0)</td>
<td>76 (53.9)</td>
<td>0.001</td>
</tr>
<tr>
<td>Previous CHF</td>
<td>10 (1.9)</td>
<td>6 (1.7)</td>
<td>24 (3.6)</td>
<td>0.093</td>
</tr>
<tr>
<td>History of CVA</td>
<td>27 (5.2)</td>
<td>26 (7.4)</td>
<td>63 (9.5)</td>
<td>0.021</td>
</tr>
<tr>
<td>Peripheral disease</td>
<td>11 (2.1)</td>
<td>10 (2.8)</td>
<td>36 (5.4)</td>
<td>0.007</td>
</tr>
<tr>
<td>Chronic lung disease</td>
<td>10 (1.9)</td>
<td>7 (2.0)</td>
<td>15 (2.3)</td>
<td>0.913</td>
</tr>
<tr>
<td>CRF (Cr &gt; 2.0 mg/dl)</td>
<td>9 (1.7)</td>
<td>9 (2.6)</td>
<td>29 (4.4)</td>
<td>0.027</td>
</tr>
<tr>
<td>Euro Score</td>
<td>3.6 ± 2.2</td>
<td>4.1 ± 2.3</td>
<td>4.6 ± 2.3</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>LV Ejection Fraction (%)</td>
<td>61.5 ± 9.6</td>
<td>59.4 ± 11.7</td>
<td>56.6 ± 11.8</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>
## Clinical Presentation & Involved Vessels
(Site Reported)

<table>
<thead>
<tr>
<th>Presentation</th>
<th>Low (N=518)</th>
<th>Intermediate (N=352)</th>
<th>High (N=662)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silent ischemia</td>
<td>16 (3.1)</td>
<td>11 (3.1)</td>
<td>15 (2.3)</td>
<td>0.048</td>
</tr>
<tr>
<td>Stable angina</td>
<td>159 (30.7)</td>
<td>102 (29.0)</td>
<td>150 (22.7)</td>
<td></td>
</tr>
<tr>
<td>Unstable angina</td>
<td>295 (56.9)</td>
<td>209 (59.4)</td>
<td>428 (64.7)</td>
<td></td>
</tr>
<tr>
<td>MI</td>
<td>48 (9.3)</td>
<td>30 (8.5)</td>
<td>69 (10.4)</td>
<td></td>
</tr>
<tr>
<td>Vessel diseased</td>
<td></td>
<td></td>
<td></td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>(site reported)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LM only</td>
<td>200 (38.6)</td>
<td>22 (6.3)</td>
<td>12 (1.8)</td>
<td></td>
</tr>
<tr>
<td>LM + 1VD</td>
<td>137 (26.4)</td>
<td>69 (19.6)</td>
<td>47 (7.1)</td>
<td></td>
</tr>
<tr>
<td>LM + 2VD</td>
<td>110 (21.2)</td>
<td>130 (36.9)</td>
<td>163 (24.6)</td>
<td></td>
</tr>
<tr>
<td>LM + 3VD</td>
<td>71 (13.7)</td>
<td>131 (37.2)</td>
<td>440 (66.5)</td>
<td></td>
</tr>
</tbody>
</table>
Outcomes
According to SYNTAX Score
Mortality by SYNTAX Score
Overall Patients

- ≤ 22 (518)
- 23-32 (352)
- ≥ 33 (662)

P=0.016
TVR by SYNTAX Score

Overall Patients

P=0.001

- $\leq 22$ (518)
- 23-32 (352)
- $\geq 33$ (662)

%
Mortality by SYNTAX Score
PCI Patients

- ≤ 22 (421)
- 23-32 (202)
- ≥ 33 (178)

P=0.002

% vs months

0 40
10 30
20 20
30 10
40 0

0 360 720 1080 (months)
TVR by SYNTAX Score
PCI Patients

≤ 22 (421)
23-32 (202)
≥ 33 (178)

P=0.876
Mortality by SYNTAX Score
CABG Patients

P=0.454

%  

- ≤ 22 (N=97)
- 23-32 (N=150)
- ≥ 33 (N=484)

0 360 720 1080 (months)

9.9 8.7 5.5
TVR by SYNTAX Score
CABG Patients

$P=0.456$
Predictability of Death

AUC, area under the curve

<table>
<thead>
<tr>
<th>Score</th>
<th>AUC</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Euro-Score</td>
<td>0.675</td>
<td>0.622 – 0.729</td>
</tr>
<tr>
<td>SYNTAX-Score</td>
<td>0.581</td>
<td>0.529 – 0.633</td>
</tr>
</tbody>
</table>
Predictability of TVR

- **Euro-Score**: AUC = 0.445, 95% CI = 0.388 – 0.502
- **SYNTAX-Score**: AUC = 0.383, 95% CI = 0.333 – 0.433

AUC, area under the curve
Outcomes
Between PCI vs. CABG
Stratified by SYNTAX Score
Mortality
Between PCI vs. CABG
stratified by SYNTAX Score
Mortality between PCI vs. CABG In Low SYNTAX Score

$P=0.154$
Mortality between PCI vs. CABG
In Intermediate SYNTAX Score

%  
40  
30  
20  
10  
0  

PCI (N=202)
CABG (N=150)

P=0.392

0  360  720  1080 (months)
Mortality between PCI vs. CABG
In High SYNTAX Score

PCI (N=178)
CABG (N=484)

% of mortality over time:
- PCI: 13.7%
- CABG: 9.9%

P = 0.148
TVR Between PCI vs. CABG Stratified by SYNTAX Score
TVR between PCI vs. CABG
In Low SYNTAX Score

PCI (N=421)
CABG (N=97)

$P=0.013$
TVR between PCI vs. CABG in Intermediate SYNTAX Score

- PCI (N=202)
- CABG (N=150)

P=0.008
TVR between PCI vs. CABG
In High SYNTAX Score

PCI (N=178)
CABG (N=484)

P<0.001

(months)
**Multivariate Predictors by Cox Model**

For Overall Patients

SYNTAX Score was not an independent predictor.

<table>
<thead>
<tr>
<th>Predictors</th>
<th>Mortality</th>
<th>P value</th>
<th>TVR</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HR (95% CI)</td>
<td></td>
<td>HR (95% CI)</td>
<td></td>
</tr>
<tr>
<td><strong>Euro-SCORE</strong></td>
<td>1.31 (1.21 – 1.41)</td>
<td>&lt; 0.001</td>
<td><strong>PCI (vs. CABG)</strong></td>
<td>5.04 (2.90 – 8.78)</td>
</tr>
<tr>
<td><strong>CRF</strong></td>
<td>2.30 (1.23 – 4.32)</td>
<td>0.009</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


## Multivariate Predictors by Cox Model
### For PCI Patients

<table>
<thead>
<tr>
<th>Predictor</th>
<th>HR (95% CI)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mortality</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EuroSCORE</td>
<td>1.23 (1.10 – 1.38)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>CHF</td>
<td>3.25 (1.31 – 8.04)</td>
<td>0.011</td>
</tr>
<tr>
<td>CRF</td>
<td>3.81 (1.65 – 8.80)</td>
<td>0.002</td>
</tr>
<tr>
<td>Ostial LCX stenosis</td>
<td>2.13 (1.22 – 3.72)</td>
<td>0.008</td>
</tr>
<tr>
<td>BMS (vs. DES)</td>
<td>1.81 (0.99 – 3.30)</td>
<td>0.051</td>
</tr>
<tr>
<td><strong>TVR</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMS (vs. DES)</td>
<td>1.79 (1.12 – 2.89)</td>
<td>0.016</td>
</tr>
</tbody>
</table>
## Multivariate Predictors by Cox Model for CABG Patients

<table>
<thead>
<tr>
<th>Predictor</th>
<th>HR</th>
<th>P value</th>
<th>HR</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mortality</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Euro-SCORE</td>
<td>1.30</td>
<td>&lt; 0.001</td>
<td>4.60</td>
<td>0.005</td>
</tr>
<tr>
<td>(1.17 – 1.45)</td>
<td></td>
<td></td>
<td>(1.57 – 13.44)</td>
<td></td>
</tr>
<tr>
<td>Lung ds</td>
<td>2.53</td>
<td>0.053</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(0.99 – 6.49)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ostial LCX stenosis</td>
<td>1.85</td>
<td>0.034</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1.05 – 3.27)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TVR</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prior PCI</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

HR: Hazard Ratio, CI: Confidence Interval
Conclusion

• The SYNTAX score is a useful representative of coronary angiographic complexity.
• Predictably, the patients having high SYNTAX score were more likely to be older, had multiple coronary risk factors and received bypass surgery as compared with those with low SYNTAX score.
• In our ‘MAIN-COMPARE’ registry enrolling unprotected LMCA stenosis, the SYNTAX score did not confer an additional predictive power of adverse outcomes in either PCI or CABG patients.
Conclusion

• In contrast, traditional risk factors, such as Euro-Score or other comorbidities, still remain important predictors of adverse outcomes.
• The comparative effectiveness of PCI with reference to CABG, shown in the previous literature, was not changed with the angiographic adjustment using SYNTAX score.
• A new risk score model integrating clinical and angiographic parameters is warranted to better predict prognosis of revascularization for unprotected LMCA stenosis.
Thank You !!

summitMD.com
# Hazards of PCI compared with CABG

Adjusted by Cox Model using Propensity Score, Euro SCORE, SYNTAX Score

<table>
<thead>
<tr>
<th></th>
<th>Death</th>
<th>TVR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HR (95% CI)</td>
<td>p</td>
</tr>
<tr>
<td>Crude</td>
<td>0.88 (0.61 – 1.27)</td>
<td>0.491</td>
</tr>
<tr>
<td>Covariates of</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Propensity-Score</td>
<td>1.19 (0.79 – 1.80)</td>
<td>0.414</td>
</tr>
<tr>
<td>Euro-Score</td>
<td>1.07 (0.74 – 1.54)</td>
<td>0.737</td>
</tr>
<tr>
<td>SYNTAX-Score</td>
<td>1.18 (0.78 – 1.80)</td>
<td>0.435</td>
</tr>
<tr>
<td>All three scores</td>
<td>1.31 (0.85 – 2.02)</td>
<td>0.215</td>
</tr>
</tbody>
</table>