SYNTAX score before decision making!

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Within the past 12 months, I or my spouse/partner have had a financial interest/arrangement or affiliation with the organization(s) listed below

Consulting fees/honoraria: Medtronic, Abbott Vascular, Boston Scientific, Stentys, Celonova
Integrating the Synergy between percutaneous coronary intervention with Taxus and Cardiac Surgery (SYNTAX) score into practice: Use, pitfalls, and new directions

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Risk stratification is key in optimizing care of patients undergoing percutaneous coronary intervention (PCI). Score algorithms, in particular, are useful prognostic tools to select the most appropriate strategy of treatment and help patients and their families to get a better understanding of issues relevant to treatment strategies and subsequent risks. Most scores tested in the setting of PCI focus on clinical variables. The SYNTAX score is a semiquantitative angiographic score developed to prospectively characterize the disease complexity of the coronary vasculature. This scoring system has recently been assessed in numerous cohorts of patients undergoing coronary revascularization by PCI or bypass surgery. When using the SYNTAX score, however, physicians are still challenged with a labor-intensive calculation and conflicting results from validation studies. Understanding how the SYNTAX score works, for which patients it works best, and whether it predicts accurately enough for its purpose is of paramount importance to get the maximum benefit from its application. The present article provides an overview of the background and the currently available evidences on the use of the SYNTAX score in patients undergoing coronary revascularization along with its limitations. (Am Heart J 2011;161:462-70.)
Why do we need risk stratification in complex coronary artery disease?

- **Diagnostic and prognostic models:**
  - Drive informed clinical decisions because they allow the selection of the most appropriate strategy of treatment based on the patient's individual characteristics
  - Help patients and their families to get a better understanding of issues relevant to treatment strategies and subsequent risks as part of the process to obtain informed consent
  - Assist quality-of-care monitoring and facilitate a fair comparison of procedures performed in different clinical scenarios
  - Are valuable aids for stratifying patients by disease severity in clinical trials

*Capodanno, Tamburino. Am Heart J 2011;161:462-70*
Currently used Clinical and Angiographic Scores in Left Main Disease

<table>
<thead>
<tr>
<th>Score</th>
<th>Calculation</th>
<th>Number of variables used to calculate risk</th>
<th>Validated outcomes</th>
<th>Class(^a)Class(^b)</th>
<th>Ref.(^c)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EuroSCORE</td>
<td><a href="http://www.euroscore.org/calc.html">www.euroscore.org/calc.html</a></td>
<td>17</td>
<td>Short- and long-term mortality</td>
<td>IIb B</td>
<td>2, 3, 6</td>
</tr>
<tr>
<td>SYNTAX score</td>
<td><a href="http://www.syntaxscore.com">www.syntaxscore.com</a></td>
<td>0, 1 (per lesion)</td>
<td>Quantify coronary artery disease complexity</td>
<td>IIa B</td>
<td>4</td>
</tr>
<tr>
<td>Mayo Clinic Risk Score</td>
<td>(7, 8)</td>
<td>7</td>
<td>MACE and procedural death</td>
<td>IIb C</td>
<td>III C</td>
</tr>
<tr>
<td>NCDR.CathPCI</td>
<td>(5)</td>
<td>8</td>
<td>In-hospital mortality</td>
<td>IIb B</td>
<td>5</td>
</tr>
<tr>
<td>Parsonnet score</td>
<td>(9)</td>
<td>16</td>
<td>30-day mortality</td>
<td>—</td>
<td>III B</td>
</tr>
<tr>
<td>STS score</td>
<td><a href="http://209.220.160.181/STSWEBRiskCalc261/">http://209.220.160.181/STSWEBRiskCalc261/</a></td>
<td>40</td>
<td>Operative mortality, stroke, renal failure, prolonged ventilation, deep sternal infection, re-operation, morbidity, length of stay &lt;6 or &gt;14 days</td>
<td>—</td>
<td>10</td>
</tr>
<tr>
<td>ACEF score</td>
<td>[Age/ejection fraction (%)] + 1 (if creatinine &gt;2 mg/dL) (11)</td>
<td>2, 0</td>
<td>Mortality in elective CABG</td>
<td>—</td>
<td>IIb C</td>
</tr>
</tbody>
</table>

\(^a\) Class: I: prospective validation in >1000 patients, II: prospective validation in <1000 patients, III: retrospective validation in >1000 patients, IV: retrospective validation in <1000 patients

\(^b\) Level: A: high risk of death or heart failure, B: high risk of non-fatal events, C: low risk of death or heart failure

\(^c\) Ref.: 1. ESC guidelines 2010
            2. Tamburino TCT Asia Pacific–Seoul, 27 April 2011
            3. Ferrarotto Hospital University of Catania
            10. STS Guidelines 2009

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ESC guidelines 2010
The SYNTAX score usefully discriminates MACE and MACCE between patients at low risk and those at high risk in patients undergoing left main PCI.

- **1-year MACCE**
  - **LOW**: 8%
  - **HIGH**: 25%
  - ΔHIGH-LOW: +17%

- **1-year MACE**
  - **LOW**: 7%
  - **HIGH**: 20%
  - ΔHIGH-LOW: +10%

- **32-month MACE**
  - **LOW**: 22%
  - **HIGH**: 43%
  - ΔHIGH-LOW: +21%

- **3-year MACCE**
  - **LOW**: 15%
  - **HIGH**: 20%
  - ΔHIGH-LOW: +5%

**References**
- SYNTAX: Circulation 2010
- Capodanno et al.: Circ Card Interv 2009
- Brito et al.: EuroPCR 2010
- MAIN COMPARE: JACC Interv 2010
Unadjusted 2-Year incidence of mortality stratified by SYNTAX score

**CUSTOMIZE Registry (n = 819)**

**SYNTAX score ≤ 34**

- **PCI, n = 257**
- **CABG, n = 273**

\[ P = 0.461 \]

**SYNTAX score > 34**

- **PCI, n = 85**
- **CABG, n = 204**

\[ P < 0.001 \]

*p for interaction between SYNTAX score >34 and treatment < 0.001; adjusted HR for SYNTAX score > 34 2.54 (95% CI 1.09-5.92), p = 0.031*
Differences of complete revascularization rates per revascularization treatment *

* when forced into the Cox multivariable proportional hazard regression model, complete revascularization was found to be an independent predictor of lower mortality (HR 0.55, 95% CIs 0.31-0.98, p = 0.041), but this finding did not affect the prognostic significance of a SYNTAX score. Conversely, treatment type was no longer a significant predictor of mortality.
Indications for CABG vs PCI in stable patients with lesions suitable for both procedures and low predicted surgical mortality

<table>
<thead>
<tr>
<th>Subset of CAD by anatomy</th>
<th>Favours CABG</th>
<th>Favours PCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1VD or 2VD – non-proximal LAD</td>
<td>I b C</td>
<td>I C</td>
</tr>
<tr>
<td>1VD or 2VD – proximal LAD</td>
<td>I A</td>
<td>I B</td>
</tr>
<tr>
<td>3VD simple lesions, 1 functional revascularization</td>
<td>I A</td>
<td>II B</td>
</tr>
<tr>
<td>Left main + 2VD or 3VD, SYNTAX score ≤ 22</td>
<td>I A</td>
<td>III B</td>
</tr>
<tr>
<td>Left main isolated or 1VD, ostium/shift</td>
<td>I A</td>
<td>III B</td>
</tr>
<tr>
<td>Left main – 2VD, SYNTAX score ≤ 22</td>
<td>I A</td>
<td>III B</td>
</tr>
<tr>
<td>Left main – 2VD, SYNTAX score &gt; 22</td>
<td>I A</td>
<td>III B</td>
</tr>
</tbody>
</table>
Pitfalls and issues relevant to SYNTAX score application in clinical practice

- **Does not include any subset of lesions** (i.e., in-stent restenosis, stenotic bypass grafts, coronary anomalies, muscular bridges, aneurysms)

- **Time-consuming**

- **Interobserver and intraobserver variability**

- **Does not account for clinical or procedural variables** that are known for impacting the outcomes during and after PCI

Capodanno, Tamburino. Am Heart J 2011;161:462-70
Why do we need both clinical and angiographic variables?

Clinical and angiographic scores summarize very different information in 255 patients with unprotected LM.

Low Spearman rank correlation coefficient between SYNTAX score and EuroSCORE ($R_s=0.204$, $p = 0.001$)

The frequency of patients for each cross-tabulation cell is shown within a rectangle that is proportional in size to the frequency.

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The Global Risk Classification (GRC)

**SYNTAX score**

<table>
<thead>
<tr>
<th>SYNTAX score</th>
<th>&lt; 19</th>
<th>19-27</th>
<th>&gt; 27</th>
</tr>
</thead>
<tbody>
<tr>
<td>EuroSCORE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-2</td>
<td>L</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>3-6</td>
<td>L</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>&gt; 6</td>
<td>I</td>
<td>I</td>
<td>H</td>
</tr>
</tbody>
</table>

**Cardiac death free survival (%)**

- **LOW**: 96.1%
- **MIDDLE**: 94.6%
- **HIGH**: 78.1%

**Time (months)**: 0 12 24

- **SYNTAX score**
  - **LOW**: 98.4%
  - **MIDDLE**: 84.0%
  - **HIGH**: 68.6%

- **Time (months)**: 0 12 24

* log rank test; n = 255 LM patients undergoing PCI

Improved calibration

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Capodanno, et al.
*Am Heart J* 2010:159:103-9
3-year Death Stratified by SXscore and GRC in the SYNTAX LM Cohort

- **GRC\textsubscript{HIGH}**
  - With GRC: 30.0%
  - With SXscore alone: 13.4%
  - \(\Delta\text{HIGH} = +16.6\%\)

- **GRC\textsubscript{MID}**
  - With GRC: 13.1%
  - With SXscore alone: 4.9%
  - \(\Delta\text{MID} = +8.2\%\)

- **GRC\textsubscript{LOW}**
  - With GRC: 2.7%
  - With SXscore alone: 2.6%
  - \(\Delta\text{LOW} = +0.1\%\)
Prediction accuracy of different risk models

- PCI
- CABG

Hosmer-Lemeshow

C-statistic

Discrimination better

Calibration better

| SYNTAX score 0-22 | 0.348 | 0.084 | 1.445 | 0.146 |
| SYNTAX score 23-32 | 0.582 | 0.177 | 1.910 | 0.372 |
| SYNTAX score > 32 | 2.323 | 1.091 | 4.945 | 0.029 |
| EuroSCORE 0-2 | 0.293 | 0.025 | 3.482 | 0.331 |
| EuroSCORE 3-6 | 1.753 | 0.709 | 4.339 | 0.224 |
| EuroSCORE > 6 | 1.091 | 0.452 | 2.638 | 0.846 |
| ACEF 0-1.2 | 1.431 | 0.115 | 17.804 | 0.781 |
| ACEF 1.2-1.4 | 1.511 | 0.552 | 4.134 | 0.421 |
| ACEF > 1.4 | 1.107 | 0.521 | 2.352 | 0.793 |
| LOW GRC | 0.557 | 0.129 | 2.407 | 0.434 |
| MID GRC | 1.174 | 0.475 | 2.904 | 0.728 |
| HIGH GRC | 1.760 | 0.648 | 4.779 | 0.267 |
| LOW CSS | 0.467 | 0.103 | 2.122 | 0.324 |
| MID CSS | 0.929 | 0.268 | 3.218 | 0.908 |
| HIGH CSS | 1.711 | 0.810 | 3.615 | 0.159 |

* adjusted by propensity score; HR indicates hazard ratio; LCL indicates lower confidence limit; UCL indicates upper confidence limit
Why does it happen? An egg of Columbus

Good risk stratification both in PCI and CABG

Example #1
Good risk stratification in PCI and BAD risk stratification in CABG

Example #2

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Closing remarks

- Standardized risk stratification is of paramount importance in complex PCI. Eyeball risk stratification is ok if you have Antonio Colombo in your cath lab. Otherwise, use stand-alone and combined scores.

- Adding clinical variables requires more time, but improves the discrimination and calibration ability of the SYNTAX score alone for prognostic purposes. Risk redistribution may be useful especially in low and intermediate risk patients.

- Conversely, the good predictive ability in the PCI scenario along with the poor predictive ability in the CABG scenario make the SYNTAX score the preferable tool to guide decision-making in LM CAD.