Risk Stratification for Percutaneous Coronary Intervention

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KEYWORDS

• SYNTAX score • Risk stratification • Percutaneous coronary intervention • Risk scores

KEY POINTS

- The Synergy Between Percutaneous Coronary Intervention with Taxus and Cardiac Surgery (SYNTAX) score is the most-studied risk model in the setting of percutaneous coronary intervention (PCI).
- Several validation studies have proved the SYNTAX score to be an effective prognostic tool in multiple clinical scenarios.
- Proofs-of-concept studies have shown the predictive ability of the SYNTAX score to be significantly improved by the addition of clinical variables or functional information into the original angiographic model.
- The SYNTAX score II incorporates clinical and angiographic variables into logistic formulas for 4-year mortality estimation after PCI and coronary artery bypass grafting.

INTRODUCTION

In patients with coronary artery disease referred for percutaneous coronary intervention (PCI), anticipating the risk of the procedure to fail at long-term follow-up is important for several reasons. First, patients at high risk of recurrent events after PCI may be considered for alternative treatments (ie, coronary artery bypass grafting [CABG]). Second, patients and their families get a better understanding of the prognostic implications of PCI and provide their consent on a more objective basis. Third, forecasting the risk of PCI assists quality-of-care monitoring and facilitates comparing the outcomes of procedures performed in different hospitals or settings.

Risk stratification for PCI is a relatively young field of interest, fueled in recent years by the introduction of several specific risk models and scores. The 2014 guidelines for myocardial revascularization issued by the European Society of Cardiology recommend 3 clinical scores (European System for Cardiac Operative Risk Evaluation [EuroSCORE] II, Age, Creatinine, Ejection Fraction [ACEF], and National Cardiovascular data Registry [NCDR] PCI) for risk stratification of in-hospital or 30-day mortality.[1] However, the grade of recommendation for these 3 scores is only IIb, reflecting the scarcity of validation studies and the weaker implication of anticipating periprocedural mortality in the PCI setting. In contrast, one score (Synergy Between Percutaneous Coronary Intervention with Taxus and Cardiac Surgery [SYNTAX] score) has been given a class I, and 3 scores (Logistic Clinical SYNTAX score, SYNTAX score II, and ACCF and STS Database Collaboration on the Comparative Effectiveness of Revascularization Strategies [ASCERT] PCI) have been given a class IIa degree of recommendation for assessing the risk of medium- to long-term (≥1 year) outcomes. Indeed, anticipating medium-to long-term outcomes is more reasonable for a procedure like PCI, which is not burdened by excessive perioperative

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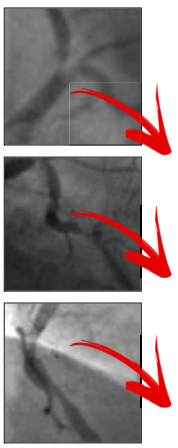
mortality. Notably, this is quite different from other settings like CABG, whereby the individual early risk of the intervention must be weighted against the benefits expected in the longer term.

With more than 50 validation studies, the SYNTAX score is the most-studied risk model in the setting of PCI. In this article, the evolutionary journey of the SYNTAX score is reviewed, with emphasis on its sequential modifications and adaptations, now culminated in the development and validation of the SYNTAX score II.

THE SYNERGY BETWEEN PERCUTANEOUS CORONARY INTERVENTION WITH TAXUS AND CARDIAC SURGERY SCORE

Calculation and Variability

The SYNTAX score can be calculated online at www.syntaxscore.com. The calculation begins by defining the coronary dominance. Second, a single lesion is characterized with regard to the number and location of the branches involved. The third step requires a detailed description of the angiographic features of the lesion (ie, chronic total occlusion, trifurcation, bifurcation, vessel tortuosity, lesion length, heavy calcification, and thrombus). This process is reiterated for each lesion with a visual stenosis more than 50% in vessels of at least 2 mm in diameter. Finally, once all lesions have been scored, the calculator requires indicating whether there are segments that fulfill the criteria for small vessel disease (Fig. 1). A significant issue that comes from this quite cumbersome process[2] is the moderate interobserver variability of the SYNTAX score, with the scoring of bifurcations lesions representing the main source of inconsistency.[3–9] The level of agreement improves after adequate training but remains generally more satisfactory in a core-laboratory setting than in daily routine.[7,8,10]



Left Main

• Segment 5	10 points
• Segment 6	7 points
• Segment 11	3 points
• Medina 1,1,1	2 points
• Heavy Calcification	1 point

Obtuse Marginal

• Segment 12a	2 points
• Severe Tortuosity	2 points

Right Coronary Artery

• Segment 2	2 points
• Length >20 mm	1 points
SYNTAX score	**31 points**

Fig. 1. Case example of SYNTAX score calculation. The grading process to obtain the SYNTAX score is illustrated for a patient with atherosclerotic disease of the left main, the obtuse marginal, and the right coronary artery.

Derivation and Validation

The SYNTAX score was not developed from a PCI dataset, but rather built based on expert consensus by merging several preexisting angiographic schemes.[11,12] At that time, the idea behind the creation of a new and more comprehensive angiographic scoring system was not to apply it for risk stratification but to use it merely as a catheterization laboratory tool to assess the equipoise of PCI and CABG as a prerequisite for randomization in the SYNTAX trial.[13,14] The score sought to surpass the old concept of 3-vessel disease as representing ipso facto the worst degree of coronary burden, introducing a pragmatic instrument to appreciate the substantial differences in lesion complexity that exist even in patients with 3 coronary vessels involved. Subsequently and post hoc, the score proved to work properly as a risk stratification tool either in the SYNTAX trial itself or in early external validation studies conducted in patients with 3-vessel[15] or left main disease.[16]

Over time, the SYNTAX score has proved to be highly transportable to other clinical scenarios, including all-comers PCI,[17–19] PCI with newer-generation drug-eluting stents,[18,20] acute coronary syndromes with[21–30] and without[31–34] ST-segment elevation, and even transcatheter aortic valve implantation.[35,36]

In parallel, studies have demonstrated the ability of the score to assess the risk of other end points softer than mortality or major adverse cardiac events, such as

- No reflow[37,38]
- Distal embolization[39]
- Left ventricle thrombus development[40]
- Culprit vessel vulnerability[41]
- Periprocedural myocardial infarction[42]
- Contrast-induced nephropathy[43,44]

Multiple studies have also proved the (mostly nonindependent) association of the SYNTAX score with blood markers and components, which include

- Fasting glucose[45]
- Hemoglobin A_{1c}[46]
- Creatinine[47,48]
- Albumin[49]
- Lipoprotein (a)[50]
- N-terminal pro-brain natriuretic peptide[51]
- High-sensitivity troponin T[52]