How to Calculate the SYNTAX Score

A step-by-step guide on how to calculate the SYNTAX score, including how to access the program and screen shots from the SYNTAX Web site.

BY KATRIN LEADLEY, MD

The SYNTAX score is a new angiographic tool used to characterize the coronary vasculature and predict outcomes of coronary intervention based on anatomical complexity. The SYNTAX score was developed in connection with the SYNTAX trial, which compared percutaneous coronary intervention (PCI) using Taxus Express paclitaxel-eluting stents (Boston Scientific Corporation, Natick, MA) to cardiac surgery in complex, high-risk patients with left main and/or three-vessel disease.[1,2] A heart team (cardiac surgeon and interventional cardiologist) assessed each patient for suitability for both revascularization modalities, and consequently calculated the patient's SYNTAX score based on coronary lesion complexity prior to the revascularization procedure. Higher SYNTAX scores indicating more complex disease were associated with an increase in the 1-year rate of major cardiac and cerebrovascular events (MACCE) in 903 patients randomized to PCI, with a significant difference in MACCE between patients with low, intermediate, and high SYNTAX scores at 12 months (13.6%, 16.7%, and 23.4%, respectively; *P* = .007) (Figure 1). In contrast, there were no differences in event rates among patients randomized to coronary artery bypass grafting (CABG), with low, intermediate, or high scores having 12-month MACCE rates at 14.7%, 12%, and 10.9%, respectively (*P* = .38).[3] In the Arterial Revascularization Therapies Study Part II (ARTS II), the predictive value of the SYNTAX score was retrospectively examined in 306 PCI patients (1,292 lesions) with three-vessel disease,[4] where it also predicted an almost fourfold adjusted increase in the risk of events in patients with high versus low scores. The predictive value of the SYNTAX score was further validated in a study looking at 255 patients who underwent PCI with left main disease.[5] A higher SYNTAX score was significantly associated with cardiac mortality and major cardiac events.

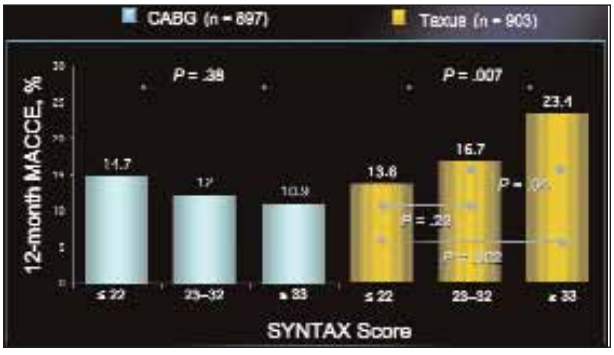

Figure 1. Outcomes according to SYNTAX score tertile. One-year rates of composite MACCE events in patients treated with CABG or PCI. Rates are separated by SYNTAX scores indicating low (0–22), medium (23–32), and high (≥ 33) anatomic lesion complexity. *P* values are from the Chi-square test. (Adapted from Serruys PW. Presented at the Transcatheter Cardiovascular Therapeutics 2008 annual meeting.[3])

A detailed description of the SYNTAX score has been previously reported.[6] Briefly, the SYNTAX score was based on the following: Bypass Angioplasty Revascularization Investigation classification of the coronary tree segment modified for the ARTS study,[7] modified Leaman score,[8] American College of Cardiology/American Heart Association classification system,[9] combination of Duke and International Classification for Patient Safety classification,[10] and the total occlusion (TO) classification.[11] Elements from each of these classification systems were taken into account when developing the SYNTAX score. Anatomical risk factors, including the number of lesions, lesion location, the presence of TOs, bi/trifurcations, aorto-ostial stenosis, tortuosity, lesion length > 20 mm, calcification, thrombus, and small vessels/diffuse disease are considered in the SYNTAX score. The SYNTAX score algorithm takes into account the location of a lesion

Figure 2. The SYNTAX score Web site.

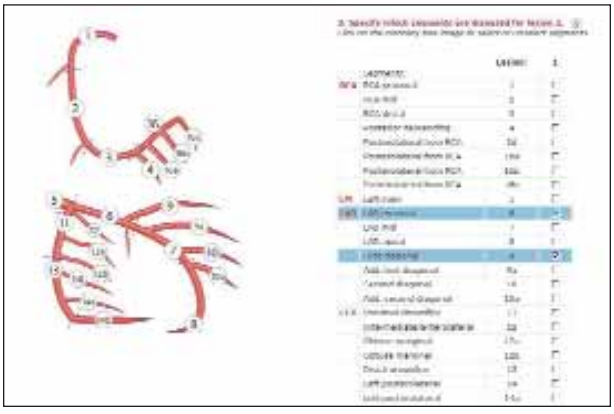

Figure 3. The SYNTAX score calculator Web site—lesion location.

(coronary tree segments are weighted depending on their location), if a lesion is occlusive or nonocclusive (multiplication factor of 5 or 2, respectively), and all other adverse lesion characteristics (assigned additive values). Importantly, it does not include other patient-related clinical risk factors.

A computer program calculates the SYNTAX score after answering a set of interactive, self-guided questions. The on-line SYNTAX score calculator consists of 11 questions. Two questions determine the coronary artery dominance and diffuse disease/small vessels and will be asked only once per patient. The remaining questions refer to detailed adverse lesion characteristics and will be repeated for each lesion separately. The SYNTAX score calculates a point value for each lesion, which will be summed to generate the patient's overall SYNTAX score.

A dedicated Web site (www.syntaxscore.com) has been developed, allowing clinicians to calculate patients' SYNTAX scores at anytime (Figure 2). All SYNTAX score and SYNTAX trial manuscripts and presentations are also conveniently located at the Web site's reference section.

HOW TO CALCULATE THE SYNTAX SCORE CORRECTLY

The SYNTAX score calculator is available directly on-line at the Web site, or it can be downloaded directly to a computer. To ensure correct usage of this new tool, it is strongly recommended to complete the tutorial first. The tutorial includes a detailed description and definition of all SYNTAX score components. In addition, the tutorial illustrates several example cases and demonstrates how lesions should be scored correctly. The last section of the tutorial allows the user to score several test cases independently and provides correct answers immediately afterward, demonstrating the proper scoring methods.

To obtain correct scoring results, it is recommended that scoring be performed by a team; ideally, a panel of three people. Evaluation of the patient's anatomy in a collaborative way, and consequently discussing the score, will result in the most accurate scoring. Furthermore, it is important that the complete left and right coronary vasculature be assessed. Each significant coronary lesion (defined as at least 50% diameter stenosis by visual assessment in vessels with at least 1.5 mm) needs to be scored separately, regardless of the intention to treat the lesion or not. Lesions will be scored in numerical order, therefore, it is recommended to score lesions from proximal to distal for each coronary artery. Lesion location is described using coronary tree segments. If a serial stenosis is less than three vessel diameters apart, they should be scored as one lesion. However, stenoses at a greater distance from each other (more than three vessel reference diameters) are considered separate lesions. After each lesion is scored, the individual lesion scores will be automatically summed, and the patient's overall SYNTAX score will be calculated.

STEP-BY-STEP SYNTAX SCORE CALCULATION

The SYNTAX score Web site (www.syntaxscore.com) has to be accessed, and the scorer needs to navigate to the calculator tab. After a SYNTAX score disclaimer is checked off, the first question will appear. Left or right dominance needs to be determined. During the next step, lesion location will be selected. Each lesion can involve one or more diseased segments. All segments involved in one lesion must be checked, because each lesion segment involved contributes to the lesion scoring. There is no limit to the number of segments per lesion. Of note, a bifurcation lesion will be scored as one lesion and not as two lesions. For example, a proximal left anterior descending artery/diagonal bifurcation lesion will be scored as one lesion with two segments involved (Figure 3). The following classifications are used

Figure 4. The SYNTAX score calculator Web site.

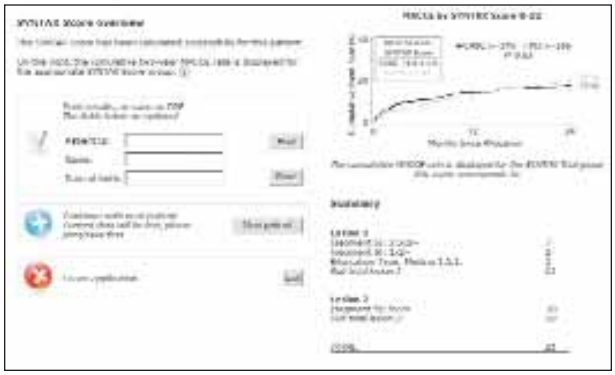

Figure 5. The SYNTAX score Web site overview and summary page.

to characterize the lesion in more detail: TO, tri/bifurcation, aorto-ostial stenosis, severe tortuosity, length > 20 mm, heavy calcification, and thrombus.

Whereas questions inquiring about aorto-ostial stenosis, calcification, lesion length, tortuosity, and thrombus are simple "yes and no" questions, positively answered questions about TO and tri/bifurcation will result in several follow-up questions. For a TO lesion, first the segment in which the occlusion starts needs to be selected. Furthermore, the scorer needs to indicate the age of the TO, side branch involvement, and if the TO is a blunt stump and involves bridging. Lastly, the first visualized segment (by antegrade or retrograde contrast) beyond the occlusion needs to be recorded. In the case of a trifurcation lesion, the scorer will be asked to indicate if one, two, three, or four segments are diseased. There are only a few locations within the coronary tree that could possibly be a trifurcation lesion: segments 5/6/11/12 (most common), 3/4/16/16a, 6/7/9/9a, 7/8/10/10a, and 11/13/12a/12b. Bifurcation lesions are classified according to the Medina classification.[12] Furthermore, the angulation between the side branch and the main branch (< 70%) will be captured. A comment field at the end of the adverse lesion questions will allow for the capture of any additional lesion notes, if desired.

After the first lesion is scored, the scorer will see the next screen (Figure 4) and will chose from the following options: (a) add a lesion, (b) indicate that all lesions are completed and proceed, (c) edit a lesion, or (d) delete a lesion. "Add a lesion" needs to be selected if a patient has more than one lesion. These steps will be repeated for any additional lesion. After all lesions are scored, the proceed button at "all lesions are completed" will lead to the final, nonlesion-specific question inquiring about diffuse disease/small vessels, which needs to be answered only once for each patient. Diffuse disease/small vessels are present when at least 75% of the length of any segment(s) proximal to the lesion, at the site of the lesion, or distal to the lesion has a vessel diameter of less than 2 mm. All segments meeting this definition need to be selected, regardless of the presence or absence of a lesion.

After the last question, the patient's SYNTAX score overview and summary page will appear (Figure 5). The summary page will list all lesions scored and will provide a detailed description of each lesion, including the individual lesion's SYNTAX score. All individual lesion scores will be automatically added, resulting in the overall SYNTAX score. In addition, for patients with three-vessel disease and/or left main disease (SYNTAX trial population), the cumulative MACCE outcomes by SYNTAX score will be illustrated on a Kaplan-Meier curve. The patient's name, ID number, and date of birth can be added, and the SYNTAX score document can be can be saved or printed for the patient's file.

To achieve the most accurate scoring, it is important to avoid some common errors. A bifurcation lesion needs to be scored as one lesion and not as two. For example, a left main/left anterior descending artery bifurcation is one lesion with two segments (segments 5/6) involved. Additionally, a true left main bifurcation (Medina classification 1,1,1) should be described as one lesion with three segments involved (segments 5/6/11). Each lesion, if they are more than three vessel reference diameters apart, needs to be scored as separate lesions and not as one lesion; for example, a proximal and a distal left anterior descending artery lesion will be scored as two lesions. For the description of a TO, only two segments will need to be selected: the segment where the occlusion starts and the first segment beyond the TO that is visualized by antegrade or retrograde contrast (ie, a TO starting at segment 1 and the first visualized segment is segment 3).

SUMMARY

The SYNTAX score is a novel anatomical tool characterizing coronary vasculature. Importantly, the SYNTAX score grades the complexity of coronary artery disease and does not consider lesion treatment. The SYNTAX score described here predicts outcomes for patients treated with PCI but has less predictable value for patients undergoing treatment with bypass surgery. Complex lesion anatomy poses a greater technical challenge and, consequently, a higher risk of adverse events when treated by percutaneous intervention. In contrast, CABG bypasses the lesion and is thus less influenced by lesion complexity. Furthermore, the SYNTAX score is a useful tool to describe the extent of the coronary artery disease complexity for an individual patient, allows for comparison between patients, and can be used effectively to communicate patient disease complexity between physicians. The goal of the SYNTAX score is to assist the clinician in selecting the optimal revascularization strategy, resulting in the best possible outcome for the individual patient. ■

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1. Ong AT, Serruys PW, Mohr FW, et al. The SYNergy between percutaneous coronary intervention with TAXus and cardiac surgery (SYNTAX) study: design, rationale, and run-in phase. Am Heart J. 2006;151:1194-1204.
2. Serruys PW, Morice MC, Kappetein AP, et al. Percutaneous coronary intervention versus coronary artery bypass grafting for severe coronary artery disease. N Engl J Med. 2009;360:961-972.
3. Serruys PW. The SYNTAX Score: a new angiographic tool to grade the complexity of coronary artery disease. Presented at the Transcatheter Cardiovascular Therapeutics annual meeting; October 12-17, 2008; Washington, DC.
4. Valgimigli M, Serruys PW, Tsuchida K, et al. Cyphering the complexity of coronary artery disease using the SYNTAX Score to predict clinical outcome in patients with three-vessel lumen obstruction undergoing percutaneous coronary intervention. Am J Cardiol. 2007;99:1072-1081.
5. Capodanno D, Di Salvo ME, Cincotta G, et al. Usefulness of the SYNTAX Score for predicting clinical outcome after percutaneous coronary intervention of unprotected left main coronary artery disease. Circ Cardiovasc Interv. 2009;2:302-308.
6. Sianos G, Morel MA, Kappetein AR, et al. The SYNTAX score: an angiographic tool grading the complexity of coronary artery disease. EuroInterv. 2005;1:219-227.
7. Serruys PW, Unger F, van Hoout BA, et al. The ARTS study (Arterial Revascularization Therapies Study). Semin Interv Cardiol. 1999;4:209-219.
8. Leaman DM, Brower RW, Meester GT, et al. Coronary artery atherosclerosis: severity of angina pectoris and compromised left ventricular function. Circulation. 1981;63:285-292.
9. Smith SC Jr, Dove JT, Jacobs AK, et al. ACC/AHA guidelines for percutaneous coronary intervention (revision of the 1993 PTCA guidelines)—executive summary: a report of the American College of Cardiology/American Heart Association Task Force on practice guidelines (Committee to revise the 1993 guidelines for percutaneous transluminal coronary angioplasty) endorsed by the Society for Cardiac Angiography and Interventions. Circulation. 2001;103:3019-3041.
10. LefTvre T, Louvard Y, Morice MC, et al. Stenting of bifurcation lesions: classification, treatments, and results. Cathet Cardiovasc Interv. 2000;49:274-283.
11. Hamburger JN, Serruys PW, Scabra-Gomes R, et al. Recanalization of total coronary occlusions using a laser guidewire. J Am Coll Cardiol. 1997;30:649-656.
12. Medina A, Suarez de Lezo J, Pan M. A new classification of coronary bifurcation lesions. Rev ESP Cardiol. 2006;59:183.