VIA MEDICA

TECHNOLOGY NOTE

Cardiology Journal
2023, Vol. 30, No. 5, 846–848
DOI: 10.5603/cj.95508

ISSN 1897–5593
eISSN 1898–018X

AngioScore: An artificial intelligence tool to assess coronary artery lesions

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Coronary artery disease (CAD) is a serious clinical and economic problem, constituting the leading cause of mortality [1–3]. Interventional treatment of CAD includes percutaneous coronary intervention (PCI), coronary artery bypass grafting (CABG), or a combination of both, depending on the anatomical complexity and clinical presentation. The Synergy between Percutaneous Coronary Intervention with Taxus and Cardiac Surgery (SYNTAX) score (SS) is an angiography-based scale to quantify the severity of CAD and to determine optimal treatment in patients with left main or multivessel disease [4]. PCI is a preferable treatment in patients with low SS. In contrast, patients with high SS are eligible for CABG, as higher SS is associated with greater risk and worse PCI outcome [5, 6].

Although SS remains the most accurate scale to determine treatment strategy and prognosis, it has several limitations. SS is based solely on angiographic findings, while consideration of fractional flow reserve would improve revascularization strategy [7]. Currently, SS is calculated using online tools, e.g., syntaxscore.org. The evaluation process is subjective, depends on the experience of the investigator, and requires manual input of all SS parameters. To facilitate SS calculation, we developed an artificial intelligence-based web application, AngioScore, to calculate SS semi-automatically and objectively.

To test AngioScore in assessment of SS parameters (diseased segment, total occlusion, bifurcation, trifurcation, aorto-ostial lesion, severe tortuosity, length > 20 mm, heavy calcification, and thrombus) two investigators evaluated 100 randomly selected coronary artery lesions. Coronary angiograms were exported in DICOM format and uploaded them to AngioScore. The investigators chose the dominant (right or left) coronary artery and marked the lesions with a coloured brush. Subsequently, AngioScore determined initial SS (Fig. 1). Then, the investigators identified and corrected the parameters that required manual revision. These parameters were recorded in the table. To determine the preliminary accuracy of AngioScore in lesion assessment, statistical analysis was performed using Statistica (13.3 version, StatSoft, Krakow, Poland).

Nineteen percent of the lesions were assessed fully and correctly. Of the remaining lesions, 34% required correction of 1 of 9 parameters, 31% — 2 parameters, 14% — 3 parameters, and 2% — 4 or more parameters (Fig. 2). The median number of required corrections was 1 ± 1.04. Incorrectly assessed lesions were in the left anterior descending artery, the right coronary artery, and the circumflex branch of the left coronary artery (39.51% vs. 30.86% vs. 29.63%, respectively). The parameters that most often required corrections were: dis-

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Received: 10.05.2023 Accepted: 27.09.2023 Early publication date: 29.09.2023

Figure 1. AngioScore interface. Screenshot showing: (i) the right coronary artery lesion (marked with red brush), (ii) nine semi-automatically set SYNTAX Score parameters, and (iii) automatically set initial SYNTAX Score (marked with red arrow).

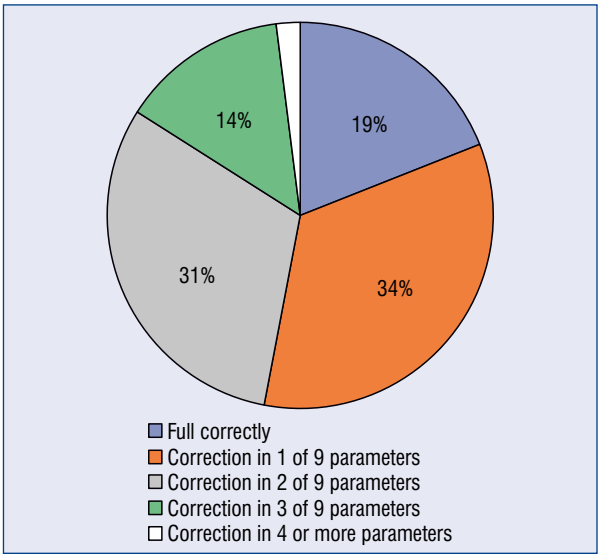

Figure 2. Percentage of lesions that required manual correction; 19% — no correction needed (blue bar), 34% — correction in 1 of 9 parameters (orange bar), 31% — correction in 2 of 9 parameters (gray bar), 14% — correction in 3 of 9 parameters (green bar), 2% — correction in 4 or more parameters (white bar).

eased segment (37.4%), bifurcation (22.4%), and severe tortuosity (15.6%).

AngioScore seems a cost-effective, scalable, interactive and user-friendly tool, which could be applied in teamwork and teaching trainees to recognize angiographic projections, and to find and assess coronary artery lesions. It has a potential to reduce variability and improve consistency in SS calculation. However, further development is required in terms of (i) high dependence on the quality of coronary angiogram, and (ii) limited ability to identify the location, bifurcation and severe tortuosity of the lesion. In further investigations, a greater number of coronary artery lesions must be assessed to improve the accuracy of AngioScore in lesion assessment. Subsequently, AngioScore should be evaluated in comparison to online SS calculators regarding the time needed to assess one coronary angiogram. Moreover, AngioScore sensitivity and specificity in evaluation of particular SS parameters must be determined.

Altogether, the prototype of AngioScore showed promising results regarding the accuracy in assessment of coronary artery lesions. Thereby, AngioScore may be the first tool dedicated to efficient and objective SS calculation.

Conflict of interest: None declared

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