The anatomic Synergy Between Percutaneous Coronary Intervention With TAXUS and Cardiac Surgery (SYNTAX) score is a stratification score illustrating the complexity of angiographic stenosis. It was considered a surrogate for poor prognosis after percutaneous coronary intervention (PCI). Accordingly, in patients with a high baseline SYNTAX score (bSS) requiring coronary revascularization, coronary artery bypass graft surgery was chosen over PCI in the current guidelines. The mechanism by which bSS is a good surrogate for long-term prognosis is evident. Patients with a high bSS compared with those with a low bSS have more complex comorbidities such as old age, diabetes mellitus, multiple stenoses, and low left ventricular function. Subsequently, they receive more complex procedures using multiple stents and devices. Since the SYNTAX score II was revised by taking into consideration clinical risk factors, the function of the scoring model in choosing between PCI and coronary artery bypass graft surgery and prognosis prediction has improved.

The residual SYNTAX score (rSS), which is a variant of the SYNTAX score, was recently constructed to represent the extent of untreated coronary lesions after revascularization treatment. In the Acute Catheterization and Urgent Intervention Triage Strategy (ACUITY) study, comprising patients with acute coronary syndrome, there was a stepwise increase in the rate of major adverse cardiac events, including death, myocardial infarction, and unplanned revascularization, in patients with an rSS of 0 (16.3%), >0 to 2 (18.0%), >2 to 8 (20.0%), and >8 (22.4%). In particular, for patients with an rSS >8, indicating incomplete revascularization (ICR) of multiple lesions after PCI, the mortality rate was significantly higher than in patients with an rSS ≤8. It is worth noting that subjects in the ACUITY study were not suitable to validate the predictive ability of rSS. Acute coronary syndrome patients enrolled in the ACUITY study may have been intentionally treated with a culprit angioplasty, without the goal of complete revascularization (CR). A retrospective angiographic analysis of the SYNTAX study by Farooq et al in this issue of Circulation provides important information on whether the rSS has a good discriminatory power for predicting outcomes in patients presenting with relatively stable symptoms. Patients with an rSS of >8 had a higher risk of 5-year mortality (35.3%) than those with an rSS of 0 (8.5%), >0 to 4 (8.7%), and >4 to 8 (11.4%). Given these findings, rSS appears to be a validated angiographic score to represent the degree of ICR and to predict outcomes after PCI. Combined with the predictive role of bSS before PCI, simulation of postprocedural rSS may synergistically help the heart team decide on the best revascularization approach. For a patient with multiple stenoses who is expected to have an rSS >8 after PCI, coronary artery bypass graft surgery may be a more appropriate approach regardless of the bSS. On the other hand, if a reasonable ICR with a low rSS is expected, PCI may be an alternative approach to surgery, even for patients with a relatively high bSS.

Despite the conceptual usefulness and related evidence, the clinical relevance and application of rSS are still debatable. First, the anatomic rSS still has an inherent limitation on the lack of considering clinical risk factors. Second, marked variability in the prognostic value of angiographic CR across studies has been observed. Some studies showed favorable results after CR compared with ICR in patients receiving PCI with bare metal stents or drug-eluting stents. In 3803 propensity score–matched pairs who received PCI with drug-eluting stents, the 8-year survival rate was higher after CR than ICR (80.8% versus 78.5%; hazard ratio, 1.12; 95% confidence interval, 1.01–1.26; \( P = 0.04 \)). In contrast, another recent study failed to show an association between CR and long-term clinical outcomes. Of 1400 patients with multivessel disease receiving drug-eluting stents, CR was performed in 573 patients (40.9%) with a similar 5-year incidence of major adverse cardiac or cerebrovascular events, comprising death, myocardial infarction, stroke, or target vessel revascularization, compared with ICR patients (24.0% versus 29.3%; adjusted hazard ratio, 0.94; 95% confidence interval, 0.75–1.18; \( P = 0.61 \)). The discrepancy across studies may indicate that CR rate and its clinical impact may be diverse according to geographical and temporal variations. ICR is often performed intentionally by surgeons taking into consideration the clinical presentation, comorbidity, anatomic complexity, functional ischemia, economic status, reimbursement regulation, or institutional policies. In fact, a high rSS caused by multiple residual stenoses may be a consequence of unsuccessful PCI, not an independent covariate influencing outcomes. Because of the multifactorial mechanisms influencing residual lesions after PCI, rSS may be limited to generalized applications in daily practices. In fact, small lesions up to 1.5 mm, which is
the threshold for calculating rSS, are often unvascularized in the procedures.

Third, another serious limitation of rSS is the lack of information on functional ischemia in the scoring model. Inducible myocardial ischemia during functional testing has a crucial prognostic significance in determining whether to treat anatomic stenosis. The Flow Reserve versus Angiography for Multivessel Evaluation (FAME) study, which compared fractional flow reserve–guided PCI with angiography-guided PCI for stable patients, showed that in lesions with a stenosis between 50% and 70%, 71% and 90%, and 91% and 99%, 65%, 20%, and 4%, respectively, were found to be functionally insignificant lesions with fractional flow reserve >0.80. Patients assigned to ischemia-guided PCI using fractional flow reserve received fewer stents (1.9 versus 2.7; P<0.001) and showed a lower 2-year incidence of death or myocardial infarction (8.4% versus 12.9%; P=0.02) compared with angiography-guided PCI. Kim et al also reported that ischemia-guided revascularization with single photon emission computed tomography reduced the incidence of major adverse cardiac or cerebrovascular events compared with non–ischemia-guided revascularization (17.4% versus 22.8%; adjusted hazard ratio, 0.59; 95% confidence interval, 0.43–0.81; P=0.001), driven by a lower incidence of repeat revascularization (9.9% versus 14.8%; adjusted hazard ratio, 0.53; 95% confidence interval, 0.35–0.80; P=0.003) in a single-center registry comprising 2587 patients. Therefore, the integration of clinical and functional information on the anatomic rSS may be warranted for a better performance as a prognostic surrogate. The ongoing International Study of Comparative Health Effectiveness With Medical and Invasive Approaches (ISCHEMIA) trial, comparing the effectiveness of initial optimal medical treatment with revascularization for patients with moderate to severe ischemia, may clarify the differential clinical impact of residual anatomic stenosis versus functional stenosis for stable coronary disease patients.

In conclusion, Farooq et al have validated the angio-

graphic score model of rSS that accurately predicts a long-term prognosis after PCI with drug-eluting stents for multivessel or left main stenosis. The score has advantages and disadvantages for general use in coronary revascularization. Because the bSS and rSS are closely related and easily calculated, the 2 scores improve the predictability of PCI prognosis and help physicians select optimal revascularization strategies. However, the absence of functional data in scoring is a disadvantage to guiding an appropriate revascularization approach. Given this, with the application of these scoring systems, physicians need to re-emphasize the importance of adhering to guidelines recommending ischemia-guided revascularization. An approach of reasonable ICR for stable patients is necessary for optimal outcomes. Future research to construct a better scoring model is required to comprehensively address patients’ clinical, anatomic, and functional complexities and to predict subsequent prognosis.

Disclosures

None.

References


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