The outcome of coronary intervention depends on the skill of the operator and patient selection. It is important to take the following into consideration: 1) lesion anatomy (complex lesions are associated with lower success and more complications); and 2) clinical variables.

Evaluation of the procedural risks is very important for the interventional cardiologist. The first step is to identify the variables that carry the most statistical weight and to standardize variable definition. This enables the comparison of risk between different patient populations and begins to account for the severity of the clinical condition.

In the pre-stent era, the National Heart, Lung and Blood Institute (NHLBI) PTCA Registry, the American College of Cardiology/American Heart Association (ACC/AHA) Task Force, and later the Registry Committee of the Society for Cardiac Angiography and Interventions (SCA&I) accurately identified the relationship between anatomical risk factors and clinical outcome.

The first extensively used lesion classification was drawn up by the ACC/AHA and was published in 1988. Lesions were classified into three categories: A (success more than 85% and low risk); B (success 60–85% and moderate risk); and C (lower success, i.e., less than 60% and high risk). In this morphological classification, twenty-six lesion features were utilized to predict success and complications; this classification was subsequently modified by Ellis et al., who subdivided the B category into B1 and B2 (if two B criteria were present) and Myler et al., who divided the C group into C1 and C2 (when two C criteria were present), but these refinements have not been widely adopted.

Studies of the performance of the ACC/AHA lesion classification showed a lower reproducibility than expected; this suggested that better stratification might be obtained by simplifying the classification and emphasizing highly discriminatory and reproducible characteristics.

The Registry of the Society for Cardiac Angiography and Interventions was established in 1979 as a voluntary, multi-center, prospective database. Since 1990, a computerized database has been utilized; from 1993 to 1996, this was used to evaluate 40,101 patients with single-vessel angioplasty. The objectives were: 1) to evaluate the performance of the ACC/AHA classification; 2) to simplify the classification criteria and provide an improved prediction of success and complications; and 3) to establish the patient risk quantification, comparing it with the predicted results.

Because of similar success and complications, it was decided that type A lesions could be combined with patent B lesions (success was 97.2% versus 96.5%, respectively, a difference of only 0.75), so they were classified as a single class designated "non-C" lesions.

Since lesion success was heavily influenced by patency (96.2% for patent vessels and 82.8% for occluded vessels) (Figure 1), vessel patency was added to the ACC/AHA classification, improving the predictability of lesion success ($p < 0.001$). Therefore, a simplified lesion classification using only 7 lesion characteristics and with improved predictability was created: SCA&I I: non-C/patent; SCA&I II: C/patent; SCA&I III: non-C/occluded; and SCA&I IV: C/occluded (Table 1). This provides
a steep gradation of risk, leaving the majority of patients as "not high risk" (Figure 2). Success decreased according to the morphological complexity of the lesions.

Reproducibility in a classification system is very important, and the two variables can be quite easily identified: a) patency; and b) morphological changes that distinguish the C lesions, i.e., 1) length > 20 mm; 2) tortuosity of proximal segment; 3) angulated segment > 90º; 4) occlusion > 3 months; 5) inability to protect major sidebranches; and 6) vein graft with friable lesions (this one should probably be placed in a different classification group).

Logistic models using lesion class to predict angiographic success showed a better discriminatory ability for the SCA&I lesion classification than the ACC/AHA system. The same strategy was followed for the evaluation of complications. Three endpoints were analyzed: 1) all major complications (death, myocardial infarction, emergency angioplasty and coronary artery bypass surgery); 2) death only; and 3) emergency bypass surgery. Lesion anatomy and plaque complexity were found to be less important as predictors of clinical complications than clinical condition (this is valid for both the ACC/AHA and SCA&I classifications).

The clinical conditions associated with higher complications from balloon angioplasty are: 1) age > 75 years; 2) diabetes mellitus; 3) unstable angina; 4) acute myocardial infarction; 5) congestive heart failure; and 6) multi-vessel coronary disease. Patients treated less than 24 hours after an acute myocardial infarction had more complications for all lesion categories and death rates were 6–7 times higher. Diabetic patients had higher complications than non-diabetic patients (15.4% versus 5.8%, respectively). For the prediction of major complications and death, the SCA&I classification is superior to the ACC/AHA, but they are similar for predicting emergency coronary artery bypass grafting.

The SCA&I classification has also been evaluated in the present stent/device era (1996–1999) in...
patients with single-vessel intervention treated with percutaneous transluminal coronary intervention. There were some procedural changes in the stent era. Plain balloons were utilized in 93.5% in 1993, but in only 25.5% in 1998. The use of stents increased from 6% in the pre-stent era to 60.7% in 1996 through 1999 (SCA&I Registry). Death and emergency bypass surgery were significantly lower in the stent group of patients. The ad-hoc angioplasties increased in 1998 to 55.7%, and the use of IIb/IIIa platelet receptor inhibitor increased to 16.3%.\textsuperscript{15}

The morphology of coronary lesions, mainly the features that are characteristic of C lesions, are still relevant in the stent era. Clinical factors are the same as those specified in the pre-stent era. The C category still retains many features that pose technical problems, even in the stent era.

Modern devices have widened the therapeutic options, decreasing in-hospital complications and acute closure, and improving the long-term outcome. Calcified lesions can be treated with ablative devices, thrombosis with better pharmacological agents (platelet glycoprotein IIb/IIIa receptor inhibitors, thrombolytics and low molecular weight heparins). Also, emboli entrapment devices may be used to prevent peripheral embolism. However, even in the device era, arterial morphology is predictive of success.

Ellis et al. found that non-chronic total occlusion, degenerated vein graft, vein graft age > 10 years, lesion length over 10 mm, severe calcification, lesion irregularity, large filling defect, angulation > 45º plus calcium and eccentricity were associated with adverse outcomes.\textsuperscript{4}

The angioplasty outcome for all types of lesion has changed, but although the applicability of these classifications in the setting of current angioplasty practice has been questioned, their application has been validated. Indeed, it should be pointed out that clinical variables increased the complications in the pre-stent era and continue to do so in the stent era.

The reproducibility of the variables used and the simplification of the classification are of great importance (the SCA&I classification uses 7 variables instead of the 26 in the ACC/AHA classification). Clinical variables, such as age, acute myocardial infarction, congestive heart failure and diabetes mellitus, are more important than lesion morphology in assessing procedural complications (this is valid both for the pre-stent and stent eras). When models were constructed with clinical predictors (age > 75 years, cardiac failure, cardiogenic shock and acute myocardial infarction), the addition of lesion type did not change the model.

In conclusion, it can be stated that although the angioplasty outcome for all types of lesion has not remained the same (in fact, the procedural risks have decreased), the applicability of this classification remains valid in the current stent era.

\textbf{REFERENCES}


15. Laskey WK, Kimmel S, Krone RJ. Contemporary trends in