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Evaluation of comorbidity scores to predict all-cause mortality in patients with established coronary artery disease

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Abstract

Background: To assess the value of scores based on the presence of comorbid conditions for mortality risk-stratification in patients with coronary artery disease (CAD)

Methods: We prospectively followed 305 males with CAD undergoing coronary angiography for 58 months. We correlated the modified Charlson Index (MCI) and the recently proposed CAD-specific index (CSI) with the risk of all-cause mortality.

Results: The odds ratio (OR) for death increased by 31% per point increase in the MCI (95% CI=17–46%; $p<0.0001$). The OR for death increased by 16% per point increase in the CSI (95% CI=8.5–25%; $p<0.0001$). In logistic regression models that adjusted for age, left ventricular ejection fraction, and the number of vessels involved with CAD, both the MCI and the CSI were the strongest predictors of mortality according to the χ^2 value for each term, with the MCI having the highest value. The adjusted OR per point increase in the MCI was 1.32 (95% CI=1.17–1.48; $p<0.0001$); the corresponding adjusted OR per point increase in the CSI was 1.17 (95% CI=1.09–1.26; $p<0.0001$). The model including the MCI had a slightly higher χ^2 value (45.1 vs. 39.1) and area under the receiver operator characteristic curve (0.742 vs. 0.727) than the model including the CSI.

Conclusion: The MCI and the newly proposed CSI are powerful tools to predict all-cause mortality in patients with established CAD. Although the CSI was not superior to the MCI, its simplicity might make it useful in populations with a low prevalence of comorbidities not included in this score.

Keywords: Coronary artery disease; Comorbidity; Prognosis; Risk stratification

1. Introduction

Coronary artery disease (CAD) remains the leading cause of death in the United States [1]. However, patients with CAD often have associated health conditions that may profoundly impact their overall mortality risk. Extensive data exist on risk-stratification in patients with CAD based on functional testing for ischemia, the presence and severity of congestive heart failure, the angiographic severity of CAD, biomarkers of plaque vulnerability, myocardial vulnerability and thrombogenicity, and propensity to develop fatal arrhythmias [2–9]. However, there is limited data on risk-stratification for all-cause mortality in patients with CAD based on the presence of comorbidities [10]. Such data would be very useful for both outcomes researchers and clinicians who wish to undertake an objective assessment of the mortality risk imposed by comorbidities in individual patients.

The Charlson Index, a global index of comorbidity derived from a cohort of general medical patients, [11] has been extensively used to assess comorbidities in different

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Table 1
Weights assigned to different comorbid states in the modified Charlson score and coronary artery disease-specific score

Points	Condition
Modified Charlson score	
1	Dementia, peptic ulcer disease, connective tissue disease, mild liver disease, cerebrovascular disease, diabetes mellitus, chronic pulmonary disease, peripheral vascular disease.
2	Hemiplegia, leukemia, any tumor, diabetes mellitus with end-organ damage, moderate or severe renal disease (patients with serum creatinine > 3 mg/dL, undergoing dialysis or post-kidney transplant), lymphoma.
3	Moderate or severe liver disease.
6	Acquired immunodeficiency syndrome, metastatic solid tumors.
CAD-specific score	
1	Current smoking, hypertension, cerebrovascular disease.
2	Diabetes mellitus, chronic pulmonary disease, peripheral vascular disease, any tumor.
3	Diabetes mellitus with end-organ damage.
5	Metastatic solid tumors.
7	Moderate or severe renal disease.

populations [12–18]. A modified Charlson Index (which removes the points for the CAD complications of myocardial infarction and heart failure from the original index) has been applied in patients with CAD [19]. Recently, a CAD-specific score that weighs comorbid conditions according to their impact on all-cause mortality in patients with CAD has been developed in a population of patients referred for cardiac catheterization at Duke University Medical Center [19]. Both scores along with the weights that they assign to each specific comorbid condition are shown in Table 1.

The performance of the CAD-specific score was at least as good as that of the modified Charlson Index in an independent sample of patients from the same population from which the score was derived [19]. Given the potential variation in underlying disease and other population characteristics, direct use of this score cannot be assumed to be valid for risk prediction in other populations. Critically important for the evaluation of the performance of these scoring systems is to test them in independent populations, and confirmatory studies are needed to judge the value of the newly proposed CAD-specific comorbidity score. In this study, we aimed to test the ability of the CAD-specific score and the modified Charlson score to predict all-cause mortality in patients with established CAD.

2. Patients and methods

2.1. Study population

We studied a cohort of 420 male veterans undergoing coronary angiography at the Miami Veterans Administration Medical Center between October 1998 and February 2000. The study was approved by the Hospital's Institutional Review Board and written informed consent was obtained from all patients. In the entire cohort study, indications for angiography included stable angina, abnormal cardiac stress test, acute coronary syndromes, cardiomyopathy, and valvular disease. Only subjects with at least one hemodynamically significant coronary artery stenosis (defined as >50% luminal stenosis) were selected for this study (n=315).

2.2. Data collection

A full demographic and clinical characterization was done at study entry. Relevant data were prospectively recorded upon enrollment, including age, ethnicity, height, weight, peripheral and central blood pressures, left ventricular ejection fraction (LVEF), current smoking, history of myocardial infarction, history of peripheral vascular disease, congestive heart failure, hypertension, diabetes mellitus and its complications, renal disease, stroke, or revascularization procedures (coronary artery bypass surgery or percutaneous coronary intervention), renal disease, connective tissue disease and family history of CAD. The indication for cardiac catheterization and the medications that patients were receiving at that time were also recorded. Additional comorbidity information required to calculate the modified Charlson and CAD-specific indexes was collected by chart review, including the presence of chronic pulmonary disease, liver disease, acquired immunodeficiency syndrome, hemiplegia, solid neoplasms and hematologic malignancies.

2.3. Coronary angiography

Coronary angiography was carried out and images of the coronary tree were obtained in routine standardized projections. The number of coronary vascular territories with at least one 50% or greater diameter stenosis prior to percutaneous or surgical coronary revascularization was used as an index of CAD severity (0-, 1-, 2-, or 3-vessel disease). Left main lesions were categorized as 2-vessel disease.

2.4. Follow-up

Subjects were prospectively followed for 5 years. Events were documented by patient interview and review of electronic hospital records. In this study patients were followed for the development of major adverse cardiac events, including death from any cause, myocardial infarction, unstable angina, coronary revascularization and stroke. For this analysis, the endpoint used was death from any cause for 5 years after the date of cardiac catheterization.

2.5. Statistical analysis

Normally distributed continuous variables are expressed as mean ± standard deviation (SD). Non-normally distributed continuous variables are expressed as median and interquartile range (IQR). Proportions are expressed as counts and percentages. We constructed Kaplan–Mayer survival plots for different risk categories according to both scores;