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Improvement of Risk Prediction After Transcatheter Aortic Valve Replacement by Combining Frailty With Conventional Risk Scores

Andreas W. Schoenenberger, MD,[a] André Moser, PhD,[a,b] Dominic Bertschi, MD,[a] Peter Wenaweser, MD,[c] Stephan Windecker, MD,[c] Thierry Carrel, MD,[d] Andreas E. Stuck, MD,[a] Stefan Stortecky, MD[c]

ABSTRACT

OBJECTIVES This study sought to evaluate whether frailty improves mortality prediction in combination with the conventional scores.

BACKGROUND European System for Cardiac Operative Risk Evaluation (EuroSCORE) or Society of Thoracic Surgeons (STS) score have not been evaluated in combined models with frailty for mortality prediction after transcatheter aortic valve replacement (TAVR).

METHODS This prospective cohort comprised 330 consecutive TAVR patients ≥70 years of age. Conventional scores and a frailty index (based on assessment of cognition, mobility, nutrition, and activities of daily living) were evaluated to predict 1-year all-cause mortality using Cox proportional hazards regression (providing hazard ratios [HRs] with confidence intervals [CIs]) and measures of test performance (providing likelihood ratio [LR] chi-square test statistic and C-statistic [CS]).

RESULTS All risk scores were predictive of the outcome (EuroSCORE, HR: 1.90 [95% CI: 1.45 to 2.48], LR chi-square test statistic 19.29, C-statistic 0.67; STS score, HR: 1.51 [95% CI: 1.21 to 1.88], LR chi-square test statistic 11.05, C-statistic 0.64; frailty index, HR: 3.29 [95% CI: 1.98 to 5.47], LR chi-square test statistic 22.28, C-statistic 0.66). A combination of the frailty index with either EuroSCORE (LR chi-square test statistic 38.27, C-statistic 0.72) or STS score (LR chi-square test statistic 28.71, C-statistic 0.68) improved mortality prediction. The frailty index accounted for 58.2% and 77.6% of the predictive information in the combined model with EuroSCORE and STS score, respectively. Net reclassification improvement and integrated discrimination improvement confirmed that the added frailty index improved risk prediction.

CONCLUSIONS This is the first study showing that the assessment of frailty significantly enhances prediction of 1-year mortality after TAVR in combined risk models with conventional risk scores and relevantly contributes to this improvement. (J Am Coll Cardiol Intv 2018;11:395–403) © 2018 by the American College of Cardiology Foundation.

Risk stratification before transcatheter aortic valve implantation (TAVR) is important when selecting those patients with severe aortic stenosis who will most likely benefit from the intervention. The Society of Thoracic Surgeons (STS) score and European System for Cardiac Operative Risk Evaluation (EuroSCORE) are frequently used for risk evaluation before TAVR, but both have been

From the [a]Department of Geriatrics, Inselspital, Bern University Hospital, and University of Bern, Bern, Switzerland; [b]Institute of Social and Preventive Medicine, University of Bern, Bern, Switzerland; [c]Department of Cardiology, Swiss Cardiovascular Center Bern, Bern University Hospital, Bern, Switzerland; and the [d]Department of Cardiovascular Surgery, Swiss Cardiovascular Center Bern, Bern University Hospital, Bern, Switzerland. This study was supported by research grants from Bern University Hospital, Bern, Switzerland; and a grant of the Swiss National Science Foundation, Bern, Switzerland (SNF Grant 32003B_135807). Dr. Windecker has received institutional research grant support from Bracco, Boston Scientific, and Terumo. All other authors have reported that they have no relationships relevant to the contents of this paper to disclose. Drs. Schoenenberger and Moser contributed equally to the manuscript.

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ABBREVIATIONS AND ACRONYMS

BADL = basic activities of daily living

CI = confidence interval

CS = C-statistic

EuroSCORE = European System for Cardiac Operative Risk Evaluation

HR = hazard ratio

IADL = instrumental activities of daily living

LVEF = left ventricular ejection fraction

LR = likelihood ratio

MGA = multidimensional geriatric assessment

MMSE = Mini-Mental State Exam

MNA = Mini Nutritional Assessment

STS = Society of Thoracic Surgeons

TAVR = transcatheter aortic valve replacement

TUG = Timed Up and Go test

VARC = Valve Academic Research Consortium

developed for conventional cardiac surgery procedures and are therefore not precise and complete enough for patients being considered for TAVR (1–6). So far, TAVR-specific variables are missing in conventional risk scores. In recent years, evidence has grown that functional assessment, in particular frailty measures, may improve risk stratification in patients undergoing TAVR (7–19). So far, the previous studies provided evidence that frailty measures are predictors of worse outcomes independent of the conventional risk scores (STS score or EuroSCORE) and thus have the potential to improve risk prediction of the conventional risk scores (7–19). However, no previous study has evaluated the potential improvement, when frailty measures are added to the conventional risk scores in combined prediction models. Thus, the present work evaluates whether a frailty score based on multidimensional geriatric assessment (MGA) may improve prediction of 1-year mortality after TAVR in combined models with the conventional risk scores and determined the magnitude of the added value.

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METHODS

STUDY POPULATION. Between September 1, 2009, and June 30, 2013, consecutive patients ≥70 years of age with symptomatic, severe aortic stenosis, referred for TAVR evaluation to Bern University Hospital, Switzerland, were eligible for this prospective cohort study. Aortic stenosis was considered severe, if the effective orifice area was <1 cm^2 or <0.6 cm^2/m^2 body surface area. An interdisciplinary team of interventional cardiologists and cardiac surgeons formed a consensus on treatment selection (TAVR, surgical aortic valve repair, or medical treatment). The consensus was based on several parameters including underlying comorbidities, general clinical condition, and perioperative risk as calculated with the logistic EuroSCORE and the STS score. We excluded patients who received a treatment other than TAVR (i.e., surgical aortic valve repair or medical treatment), patients in whom TAVR was performed as emergency procedure, patients who lived abroad and were unable to undergo follow-up evaluation, and patients who refused geriatric baseline examination or in whom the examination was not possible due to logistic reasons. In all other patients, a geriatric baseline examination was performed in addition to the cardiologic examination. We also excluded patients who died while waiting for TAVR and patients in whom the time between geriatric baseline examination and TAVR was >3 months. The final study population consisted of all patients in whom TAVR and the geriatric baseline examination was performed during the study period. This study complies with the Declaration of Helsinki and was approved by the local ethics committee.

BASELINE DATA. All participating patients received an extensive cardiologic baseline examination during an in-hospital evaluation. In addition to the recording of the patient's history, transthoracic or transesophageal echocardiography (for determination of left ventricular ejection fraction [LVEF], aortic valve orifice area, and transvalvular mean gradient) and cardiac catheterization (for determination of transvalvular gradient, cardiac output, aortic valve area, right side filling pressures, and presence of coronary artery disease) were performed. Anemia was defined based on a cutoff point of 122 g/l hemoglobin concentration for women and 132 g/l for men. Based on the gathered information, the logistic EuroSCORE and the STS score were calculated. All participating patients also received a geriatric baseline examination consisting of the following validated instruments: Mini-Mental State Exam (MMSE) for cognitive function (20), Timed Up and Go test (TUG) for gait function (21), Mini Nutritional Assessment (MNA) for nutritional status (22), basic activities of daily living (BADL) (23), and instrumental activities of daily living (IADL) (24). For the purpose of this analysis, the instruments were dichotomized at standard cutpoints that were defined a priori according to current literature: MMSE at <27 points (cognitive impairment) versus ≥27 points (normal cognitive function), TUG at ≥20 s (mobility impairment) versus <20 s (normal gait function), and MNA at <12 points (at risk of malnutrition) versus ≥12 points (not at risk of malnutrition) (20–22). BADL and IADL were considered abnormal, if the patient had a difficulty in performing 1 or more activities (23,24).

FRAILTY INDEX. We used the frailty index previously developed by Schoenenberger et al. (8). This frailty index was developed a priori (i.e., there was no derivation cohort and no specific intention to predict mortality). The index was calculated as summary score from the following baseline components: 2 points were assigned, if MMSE was <21 points; 1 point was assigned for each of the following: MMSE ≥21 and <27 points, TUG ≥20 s, MNA <12 points, BADL ≥1 limited activity, IADL ≥1 limited activity, and a