JACC: HEART FAILURE
VOL. 3, NO. 10, 2015

ISSN 2213-1779/$36.00
PUBLISHED BY ELSEVIER INC.
http://dx.doi.org/10.1016/j.jchf.2015.05.007

MINI-FOCUS ISSUE: ACUTE HEART FAILURE

Identification of Emergency Department Patients With Acute Heart Failure at Low Risk for 30-Day Adverse Events

The STRATIFY Decision Tool

Sean P. Collins, MD, MSc,*† Cathy A. Jenkins, MS,‡ Frank E. Harrell, Jr, PhD,‡ Dandan Liu, PhD,‡ Karen F. Miller, RN, MPA,* Christopher J. Lindsell, PhD,§ Allen J. Naftilan, MD,‖ John A. McPherson, MD,‖ David J. Maron, MD,¶ Douglas B. Sawyer, MD, PhD,# Neal L. Weintraub, MD,** Gregory J. Fermann, MD,§ Susan K. Roll, RN, BSN,§ Matthew Sperling, BA,§ Alan B. Storrow, MD*

ABSTRACT

OBJECTIVES No prospectively derived or validated decision tools identify emergency department (ED) patients with acute heart failure (AHF) at low risk for 30-day adverse events who are thus potential candidates for safe ED discharge. This study sought to accomplish that goal.

BACKGROUND The nearly 1 million annual ED visits for AHF are associated with high proportions of admissions and consume significant resources.

METHODS We prospectively enrolled 1,033 patients diagnosed with AHF in the ED from 4 hospitals between July 20, 2007, and February 4, 2011. We used an ordinal outcome hierarchy, defined as the incidence of the most severe adverse event within 30 days of ED evaluation (acute coronary syndrome, coronary revascularization, emergent dialysis, intubation, mechanical cardiac support, cardiopulmonary resuscitation, and death).

RESULTS Of 1,033 patients enrolled, 126 (12%) experienced at least one 30-day adverse event. The decision tool had a C statistic of 0.68 (95% confidence interval: 0.63 to 0.74). Elevated troponin ($p < 0.001$) and renal function ($p = 0.01$) were significant predictors of adverse events in our multivariable model, whereas B-type natriuretic peptide ($p = 0.09$), tachypnea ($p = 0.09$), and patients undergoing dialysis ($p = 0.07$) trended toward significance. At risk thresholds of 1%, 3%, and 5%, we found 0%, 1.4%, and 13.0% patients were at low risk, with negative predictive values of 100%, 96%, and 93%, respectively.

CONCLUSIONS The STRATIFY decision tool identifies ED patients with AHF who are at low risk for 30-day adverse events and may be candidates for safe ED discharge. After external testing, and perhaps when used as part of a shared decision-making strategy, it may significantly affect disposition strategies. (Improving Heart Failure Risk Stratification in the ED [STRATIFY]; NCT00508638) (J Am Coll Cardiol HF 2015;3:737–47) © 2015 by the American College of Cardiology Foundation.

From the *Department of Emergency Medicine, Vanderbilt University Medical Center, Nashville, Tennessee; †Department of Veterans Affairs, Tennessee Valley Healthcare System, Nashville, Tennessee; ‡Department of Biostatistics, Vanderbilt University School of Medicine, Nashville, Tennessee; §Department of Emergency Medicine, University of Cincinnati, Cincinnati, Ohio; ‖Department of Medicine, Division of Cardiovascular Medicine, Vanderbilt University Medical Center, Nashville, Tennessee; ¶Department of Medicine, Division of Cardiovascular Medicine, Stanford University School of Medicine, Stanford, California; #Department of Medicine, Division of Cardiovascular Medicine, Maine Medical Center, Portland, Maine; and the **Department of Medicine and Vascular Biology Center, Georgia Regents University, Augusta, Georgia. Dr. Storrow and this study were funded by National Institutes of Health (NIH) grant R01 HL088459 with supplement 3R01 HL088459-03S1. Dr. Storrow was additionally funded by K12 HL109019, UL1TR000445 from the National Center for Advancing Translational Sciences

ABBREVIATIONS AND ACRONYMS

ACS = acute coronary syndrome(s)

AHF = acute heart failure

BNP = B-type natriuretic peptide

CI = confidence interval

ED = emergency department

HF = heart failure

SDM = shared decision making

Nearly 1 million U.S. emergency department (ED) visits for acute heart failure (AHF) occur annually. More than 80% result in hospital admission (1) and account for the largest proportion of the projected $70 billion to be spent on heart failure (HF) care by 2030 (2,3). This high admission proportion remained unchanged from 2006 to 2010 (1). ED visits for AHF are expected to rise because of our aging population and increased survival in both chronic HF and acute coronary syndromes (ACS) (3,4). Importantly, up to 20% of hospitalized AHF patients will be readmitted within 30 days (5). Recent health policy modifications place significant pressure on hospitals and medical systems to break this cycle of admission-readmission or face financial consequences (6,7).

SEE PAGE 748

The identification of AHF patients who may be discharged safely from the ED is crucial to reduce costly inpatient admissions (8). Patients discharged from an ED are reportedly at increased risk of readmission and death compared with those who are hospitalized (9–12). Furthermore, post-discharge events are often perceived as unpredictable and undesirable (13). Thus, ED discharge of AHF patients becomes a challenging proposition (14,15).

Studies of risk factors in patients with AHF have identified variables associated with adverse outcomes such as death, inpatient complications, and readmission (9,16–18). They are limited in clinical applicability and have thus far not led to the development of an acute care setting decision tool. Data from inpatient sources have been combined with outpatient sources (16,18), retrospective chart review methodology has been used (9,16,18–20), and large databases designed for other purposes have been analyzed in an attempt to identify risk factors for poor outcomes (18–20). These models may be useful to identify patients who require admission for intensive monitoring and therapy; however, when more than 80% of ED patients are already being admitted, a tool to identify patients who are safe for discharge would be of greater value. Two of the above retrospective ED-based risk models have identified a cohort of 18% to 25% of AHF patients who would be considered low risk (19,20). Their external validation and impact on clinical care, however, have not been analyzed prospectively.

Shared decision making (SDM), a structured interaction between provider and patient to determine a management plan, has been successful in other ED disease processes (21). Patients, clinicians, and guideline experts believe HF patients would benefit from SDM initiatives (6,22). Objective decision support in the form of a useful decision tool is a first step toward a SDM approach for patients with AHF, perhaps facilitating early, safe ED discharge.

We designed our prospective cohort study of ED patients diagnosed with and treated for AHF to address these past limitations. Our aim was to develop an AHF decision tool to identify ED patients at low risk of death or serious complications who could therefore be considered for ED discharge and subsequent outpatient management.

METHODS

We conducted a prospective, observational cohort study, STRATIFY (Improving Heart Failure Risk Stratification in the ED), from July 20, 2007, to February 4, 2011, at 2 university-affiliated tertiary care EDs and 2 community EDs. The rationale and design have been reported previously (23). Briefly, the study team, which consisted of the principal physician investigator, trained research assistants, and study coordinator, screened ED patients and

and the Centers for Medicare and Medicaid Services. This material is the result of work supported with resources and the use of facilities at the Veterans Administration, Tennessee Valley Healthcare System, Nashville, Tennessee. The views expressed in this article are those of the authors and do not necessarily reflect the position or policy of the Department of Veterans Affairs or the U.S. government. Dr. Collins was funded by K23 HL085387, and Dr. Weintraub was funded by HL076684 and HL112640 from the NIH. The content is solely the responsibility of the authors and does not necessarily represent the official views of the NIH. Dr. Collins has received research support from NIH/National Heart, Lung, and Blood Institute, Radiometer, Medtronic, Cardiorentis, Novartis, The Medicines Company, and Abbott Point of Care; and consultant support from Novartis, The Medicines Company, Trevena, BRAHMS, Bayer, Radiometer, Otsuka, Cardiorentis, Cardioxyl, Abbott Point of Care, and Intersection Medical. Dr. Fermann has received research support from Novartis, Cardiorentis, Trevena, Intersection Medical, Radiometer, Siemens, Insys Therapeutics, The Mayday Foundation, and Pfizer; serves as a consultant for Intersection Medical, Janssen, and Insys Therapeutics; and is on the speakers bureau for Janssen. Dr. Storrow has received grant support from Abbott Diagnostics, Roche Diagnostics, Beckman-Coulter, and Novartis Pharmaceuticals; and consultant support from Roche Diagnostics, Beckman-Coulter, Novartis Pharmaceuticals, and Trevena. All other authors have reported that they have no relationships relevant to the contents of this paper to disclose.

Manuscript received March 2, 2015; revised manuscript received May 19, 2015, accepted May 25, 2015.