Usefulness of Age, Creatinine and Ejection Fraction - Modification of Diet in Renal Disease Score for Predicting Survival in Patients with Heart Failure

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Abstract

Background: While many risk models have been developed to predict prognosis in heart failure (HF), these models are rarely useful for the clinical practitioner as they include multiple variables that might be time-consuming to obtain, they are usually difficult to calculate and they may suffer from statistical overfitting. Present study aimed to investigate whether a simpler model, namely ACEF-MDRD score, could be used for predicting one-year mortality in HF patients. Methods: 748 cases within the SELFIE-HF registry had complete data to calculate ACEF-MDRD score. Patients were grouped into tertiles for analyses. Results: Significantly more patients within the ACEF-MDRDhigh tertile (30.0%) died within one year, as compared to other tertiles (10.8% and 16.1%, respectively, for ACEF-MDRDlow and ACEF-MDRDmed, p<0.001 for both comparisons). There was a stepwise decrease in one-year survival as ACEF-MDRD score increased (log-rank p<0.001). ACEF-MDRD was an independent predictor of survival after adjusting for other variables (OR: 1.14, 95%CI:1.04 – 1.24, p=0.006). ACEF-MDRD score offered similar accuracy to GWTG-HF score for prediction of one-year mortality (p=0.14). Conclusions: ACEF-MDRD is a predictor of mortality in patients with HF, and its usefulness is comparable to similar yet more complicated models.

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for prediction of one-year mortality (p=0.14). **Conclusions:**ACEF-MDRD is a predictor of mortality in patients with HF, and its usefulness is comparable to similar yet more complicated models.

Keywords: *Heart failure; mortality; survival; ACEF.*

What is already known about this topic?

While there are multiple risk models to predict outcomes in patients with heart failure, none of them gained widespread attention as they are difficult for routine clinical practice. Age, creatinine and ejection fraction is a simple score that is useful for predicting outcomes after cardiovascular surgery and in patients with coronary artery disease, but it is unknown whether it is useful in patients with heart failure.

What does this article add?

Age, creatinine and ejection fraction - modification of diet in renal disease score is a predictor of all-cause mortality in heart failure and its predictive accuracy is similar to more complex models such as Get With the Guidelines - Heart Failure score. As this is an easily obtainable score needing only a few parameters for calculation, ACEF-MDRD could be useful in routine clinical care for patients with heart failure.

Introduction

It has been estimated that there are at least 23 million people with heart failure (HF), making it one the most common cardiovascular disorders in the contemporary age [1]. Despite the advances in the screening, diagnosis and management of HF; mortality rates remain high, with a rate of 121 per 1000 patient years for patients with preserved ejection fraction (HFpEF) and 141 per 1000 patients for patients with a reduced ejection fraction (HFrEF) [2]. While clinical judgement and individual parameters are commonly employed for prognostication, multiple risk models are also available to estimate mortality and to guide management decisions [3-7]. A common issue with these risk models is that they generally suffer from "overfitting" of multiple redundant variables that are not useful in estimating prognosis in other HF cohorts where mortality rate is different from the original derivation cohort [8]. Moreover, the necessity of using numerous (and sometimes laborious to obtain) variables to calculate a single risk score for each HF patient usually renders these scores impractical for clinical use in a busy clinic. Age, creatinine and ejection fraction (ACEF) score was initially developed to predict postoperative mortality after cardiovascular surgery, while keeping the "law of parsimony" in mind [8]. However, later studies have found the ACEF score or its simple modifications - such as the ACEF-MDRD score - were useful to predict mortality or complications following percutaneous coronary or structural interventions, as well as those who had acute coronary syndromes [9-12]. Individual variables used to calculate ACEF score have already been shown as predictors of hospitalizations and mortality in patients with HF, and it is reasonable to consider that a score calculated using these variables would have better usefulness to predict mortality in HF [13-16]. In the present analysis, we sought to investigate whether ACEF-MDRD score could predict one-year mortality in HF patients, and to understand how ACEF-MDRD score compares to other established but more complex models, such as the Get With The Guidelines - Heart Failure (GWTG-HF) score.

Methods

Design and execution of the SELFIE-TR registry has been published before [17]. To summarize, 23 study centres representing all geographic areas in Turkey were included in the SELFIE-TR study. The diagnosis of HF was established using a combination of clinical evaluation, echocardiographic and laboratory findings, and the diagnosis was independently confirmed by at least two cardiologists working at each individual study centre. All patients who were 18 years old or older and accepted enrolment to the study were included; no exclusion criteria were used. A total of 1054 patients were enrolled, and one-year survival data became recently available for 1022 out of these 1054 patients [18]. Of these patients, 748 had complete data to calculate ACEF-MDRD score, and all analyses were done using these records.

All patients who were included to the SELFIE-TR registry gave their informed consent before inclusion and present study was conducted according to the principles outlined in 1975 Declaration of Helsinki and

its revisions. The study was approved by an ethics committee (approval no 288-AU/003) and a regulatory approval was obtained in each study centre per laws and other regulations.

All laboratory measurements were done at the individual centres and samples used for analyses were withdrawn soon after the inclusion of the patient to the study. Not all measurements were available for all patients due to the differences between the centres in terms of local resources. Ejection fraction was measured with two-dimensional echocardiography in each study centre by two cardiologists blinded to each other's measurement, and an average of these two measurements were taken as the final result.

Statistical Analyses

Continuous variables were given as mean ± SD or median and interquartile range (IQR) as appropriate. Categorical variables are presented as percentages. Patterns of distribution of continuous variables and equality of variances across groups were tested with Shapiro-Wilk and Levene tests, respectively. For continuous variables, either one-way ANOVA test with Welch correction or Kruskal-Wallis tests were used depending on the presence of normal distribution pattern. Post-hoc analyses for variables with a normal distribution were done using Tukey's HSD or Games-Howell tests; for the remaining post-hoc analyses Dwass-Steel-Critchlow-Fligner test was used. For categorical variables, chi-square test was used for comparisons. Kaplan-Meier curves were drawn for survival analysis, and individual groups were compared with log-rank test. Cox proportional hazards model was used to determine individual predictors of one-year mortality. All parameters that had ap value <0.10 on univariates Cox regression were included in the initial model, and a backwards selection criterion was used to construct the final model. Receiver-operator curves were drawn to analyze the predictive accuracy of ACEF-MDRD for prediction of one-year mortality. Additionally, DeLong's test was used to determine whether ACEF-MDRD is noninferior to GWTG-HF score in terms of accuracy. Net reclassification improvement index (NRI) was calculated as described before [19]. For all analyses, a p value of <0.05 was accepted as statistically significant. All statistical analyses were done using Jamovi (The jamovi project (2020). jamovi version 1.2 for Microsoft Windows), which is a graphical user interface for R language (R Core Team (2019). R: A Language and environment for statistical computing. Version 3.6 for Microsoft Windows) and SPSS 25.0 (IBM Inc, Armonk, USA).

To avoid data loss in Cox regression and DeLong's test, a multiple imputation procedure was used to predict missing values. A total of 5 imputations were done and results from a pooled estimate of these 5 imputations were given as the result whenever possible. For all other statistical tests, original data was used and number of cases in whom data was available was indicated in parentheses.

Results

Mean age of the study population was 63.7 ± 13.1 years, and 524 patients (70.1%) were male. Median ACEF-MDRD score in the study population was 2.43 (1.73 - 3.74), and median ACEF-MDRD score in the study groups were 1.51 (1.29 - 1.73), 2.41 (2.13 - 2.80) and 4.60 (3.74 - 5.77), respectively. 142 patients (19.0%) were dead at the end of the one-year follow up.

Demographic, anthropometric, clinical and laboratory characteristics of the patients were summarized in Tables 1 and 2. As expected, there were significant differences across groups in terms of characteristics. Patients within the ACEF-MDRD$_{\text{high}}$ group were more likely to be older and male as compared to ACEF-MDRD$_{\text{low}}$ group, and patients within the ACEF-MDRD$_{\text{high}}$ group are more likely to be symptomatic, with lower functional capacity. Besides having a higher creatinine and lower glomerular filtration rate at baseline; hemoglobin and albumin were significantly lower and NT-proBNP was significantly higher in ACEF-MDRD$_{\text{high}}$ group. Finally, both the frequency of patients with at least one hospitalization and the total number of repeat hospitalizations were more frequent in the ACEF-MDRD$_{\text{high}}$ group, and mortality was significantly higher in the latter group compared to both ACEF-MDRD$_{\text{med}}$and ACEF-MDRD$_{\text{low}}$ (Bonferroni-corrected p-value <0.001 for both pairwise comparisons) (Figure 1).

Kaplan-Meier curves for one-year survival and cumulative hazards for study groups were provided in Figure 2. There were significant differences between the ACEF-MDRD tertiles in terms of one-year survival (log-rank

p<0.001). On pairwise comparisons, patients within the $ACEF_{high}$ tertile had a significantly lower one-year survival as compared to ACEF-$MDRD_{low}$ and ACEF-$MDRD_{med}$ groups (p<0.001). There was also a trend towards lower survival in the ACEF-$MDRD_{med}$ group as compared to ACEF-$MDRD_{low}$ group, but this was not statistically significant (p=0.08).

Univariate and multivariate predictors of mortality were provided in Table 3. After adjustment, each one-point increase in the ACEF-MDRD score was associated with a 14% (95%CI: 4% - 24%) increase in one-year mortality. In addition to ACEF-MDRD, other parameters that were associated with mortality were the presence of congestive symptoms at admission, lower sodium and higher NYHA class.

ACEF-MDRD had an overall c-statistic of 0.66 ± 0.03 for prediction of one-year mortality, and for a cut-off point of 2.71, it had a sensitivity of 71.1%, specificity of 61.9%, positive predictive value of 30.1% and negative predictive value of 90.1%. All component variables of ACEF-MDRD had a lower c-statistic for predicting one-year mortality as compared to ACEF-MDRD (age: 0.62 ± 0.03, left ventricular ejection fraction: 0.64 ± 0.03, glomerular filtration rate: 0.56 ± 0.03, overall p=0.001).

On a multivariate regression model consisting of ACEF-MDRD and GWTG-HF score, both scores were found as independent predictors of one-year mortality (OR:1.08 (95%CI:1.05 - 1.11), p<0.001 for GWTG-HF score and OR:1.12 (95%CI: 1.02 - 1.23), p=0.02 for ACEF-MDRD). For predicting one-year mortality, GWTG-HF score had a c-statistic of 0.70 ± 0.02, and the difference between GWTG-HF score and ACEF-MDRD was not statistically different (p=0.14) (Figure 3). Overall NRI was 0.107, indicating an improvement of prediction of mortality with ACEF-MDRD score over GWTG-HF score. Individual components of the NRI analyses have shown that correct prediction of one-year mortality was slightly inferior with ACEF-MDRD (NRIe -0.023) but prediction of survival was much better when ACEF-MDRD was used (NRIne 0.130).

Discussion

Like many other disorders in medicine, the prognosis of a particular patient with HF has a stochastic - rather than deterministic - nature. As a direct result, a risk model could never have a perfect discriminatory ability for mortality, regardless of the complexity of the model. Using too many variables for a risk model not only makes it less useful for clinical practice, but also increases the risk of 'overfitting' - which threatens the accuracy of a model when applied to populations other than the original derivation sample [20]. Preferably, a model should follow the "law of parsimony" and contain least number of variables that has the most value, rather than including every variable that only provides a marginal increase in accuracy. Present study showed that a simple risk score only consisting of three variables have a good predictive accuracy for one-year mortality and performs rather comparably to more complex risk scores such as GWTG-HF model.

Risk models have important drawbacks that limit their usefulness. A HF risk model could give inaccurate results when applied to populations beyond their initial derivation, they are rarely accurate to predict prognosis for individual patients with HF and they can become obsolete with time [21,22]. However, they are still convenient as risk models enable a more objective assessment of the average life expectancy and they could be useful for selecting optimal management strategy for a given HF patient [21,22]. Even risk models with external validation are underutilized in daily clinical practice, perhaps not only because of the limitations but because of the inconvenience of finding and entering multiple data to calculate the final score [23]. MAGGIC risk score, which has a good evidence base for validity and a formidable c-score of 0.74 for mortality when applied to other HF cohort, needs 13 different variables to be entered [24]. GWTG-HF score had an acceptable predictive ability for one-year mortality (c-score varied between 0.64 - 0.67 for HFrEF and HFpEF, respectively), though it needed a mere 7 variables that made GWTG-HF score somewhat easier to calculate and more compatible with the law of parsimony [25]. Present findings indicate that ACEF-MDRD score could predict one-year mortality with an accuracy comparable to the GWTG score, and similar to the GWTG-HF score it could be applied to HF populations regardless of the presenting phenotype. ACEF-MDRD score had the additional advantage of using three simple and universally available parameters that makes it convenient to calculate, thus making it somewhat better suited to move beyond the "research realm" to the real world, as compared to other risk models.

The components of the ACEF score are not only used as standalone predictors of prognosis in HF, but also one or more of these variables are commonly found in nearly all HF risk scores [3,4,16,26]. Combining these variables allows an overall estimation of life expectancy, comorbidities, end-organ function and left ventricular performance. Despite the availability of multiple studies demonstrating the predictive ability of ACEF score in a multitude of different cardiovascular conditions, including patients with recent myocardial infarction or those undergoing cardiovascular surgery or percutaneous interventions, data on the prognostic usefulness of ACEF score in patients with HF is extremely limited [8-12]. Chen and associates have studied ACEF and ACEF-MDRD in 862 patients with ischemic cardiomyopathy and found that both scores had a good discriminative ability (c-statistics were 0.73 for ACEF and 0.72 for ACEF-MDRD, respectively), though it was not clear whether these patients had accompanying HF or not as this study was only presented as an abstract [27]. Present findings suggest that ACEF-MDRD score is an independent predictor of mortality in all HF patients, regardless of the underlying etiology, presentation, or phenotype, thus making it a potentially useful tool for a wide variety of patients.

To note, ACEF-MDRD score was not developed from the present sample but rather applied to it, and as such present analysis itself should be considered as a validation study. While there were many studies that have reported a more impressive predictive accuracy for their models than the figures provided in this study, they either lack external validation or their predictive accuracy is substantially lower when tested in samples other than their derivation cohorts [28]. Given that provided c-statistics rarely exceed 0.8 for nearly all models, using an index with a rather modest predictive accuracy could be justified given the sheer simplicity of the calculation (which could be done even with a pen and paper) making it practical for daily use and the lack of "overfitting" - making it suitable for use in different HF populations [22].

Available treatments for HF are numerous in the contemporary era and algorithms provided to guide management strategies are not evidence based. While the main expectation from a risk model is estimation of overall mortality, it is nonetheless more useful when it could guide treatment decisions. Several studies have already shown that risk models could indeed be utilized for this aim. For example, Seattle Heart Failure Model (SHFM) has been shown to predict mortality after left ventricular assist device implantation [29]. Whether ACEF-MDRD score could be utilized in a similar manner would be an interesting prospect to research in future studies.

Present findings indicate that ACEF-MDRD score had a rather modest discriminative ability for mortality. Adding new variables to the equation would be one way to improve the accuracy, since our findings indicate that ACEF score itself does not explain all the variability in mortality. However, this approach would violate the founding principle of ACEF score, which was using a limited number of predictors rather than every variable with statistical significance on multivariate analysis. Another way would be finding similar yet more powerful predictors of mortality to redesign ACEF-MDRD score. Although individual components of ACEF score are standalone predictors of mortality, it is not clear whether they are the best predictors, as ACEF score was not developed to predict mortality after HF. As such, better predictors could be used to replace core components of the ACEF score, but the law of parsimony should still be applied to keep the predictors at a minimum.

Study limitations

Despite the multicenter design of the study, the number of patients enrolled were rather limited, thus affecting the power of the analysis. Some variables were missing and needed to be imputed for multivariate analyses. The amount of data that was missing was higher than 50% for some variables and thus, these could not be included to the multivariate analyses. Most notable of those were natriuretic peptides, and it remains to be determined whether ACEF-MDRD score has additional usefulness over natriuretic peptides. Finally, while present findings provide an external verification for the ACEF-MDRD score, more data from additional studies would increase the reliability for future clinical use of ACEF-MDRD score in HF patients.

Conclusions

ACEF-MDRD score is an independent predictor of one-year mortality in patients with heart failure, and

its predictive accuracy is comparable to the GWTG-HF score. In contrast to other "complex" models needing multiple variables and specialized tools for calculation, ACEF-MDRD needs three simple variables for estimation of mortality, making it a rather more convenient alternative for daily clinical practice.

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Disclosures

The Authors declare that there is no conflict of interest.

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Table 1. Anthropometric, demographic and clinical characteristics of ACEF-MDRD tertiles.

Characteristics	ACEF-MDRD$_{low}$ (n=249)	ACEF-MDRD$_{med}$ (n=249)	ACEF-MDRD$_{high}$ (n=250)	P value
Demographic Characteristics	**Demographic Characteristics**	**Demographic Characteristics**	**Demographic Characteristics**	**Demographic Characteristics**
Age (years)	57.5 ± 13.3	65.1 ± 11.6***	68.6 ± 11.7***	**<0.001**
Gender (%Female)	61 (24.5%)	62 (24.9%)	101 (40.4%)	**<0.001**
Weight (kg) (n=624)	79.1 ± 14.9	76.3 ± 14.6	74.8 ± 14.2*	**0.02**
Height (cm) (n=620)	167.0 ± 8.22	167.0 ± 8.34	165.0 ± 8.45	0.11
BMI (kg/m2) (n=616)	28.5 ± 4.9	27.3 ± 4.8*	27.4 ± 4.7	**0.01**
Clinical Characteristics	**Clinical Characteristics**	**Clinical Characteristics**	**Clinical Characteristics**	**Clinical Characteristics**
Vital Signs Systolic BP (mmHg) (n=663) Diastolic BP (mmHg) (n=663) Heart rate (beats/m) (n=657)	120.0 ± 18.3 73.8 ± 10.3 79.0 ± 17.1	121.0 ± 17.9 73.2 ± 11.2 80.2 ± 17.7	119.0 ± 19.8 74.1 ± 12.1 82.1 ± 16.7*	0.49 0.81 **0.04**
Active smoking (%)	51 (2.05%)	37 (14.9%)	39 (15.6%)	0.19
Diabetes (%)	50 (20.1%)	75 (30.1%)	85 (34.0%)	**0.002**
Hypertension (active or past) (%)	96 (38.6%)	112 (45.0%)	133 (53.2%)	**0.004**
Chronic Obstructive Pulmonary Disease (%)	28 (11.2%)	39 (15.7%)	29 (11.6%)	0.261
Previous Myocardial Infarction (%)	123 (49.4%)	122 (49.0%)	120 (48.0%)	0.95

Characteristics	**ACEF-MDRD$_{low}$ (n=249)**	**ACEF-MDRD$_{med}$ (n=249)**	**ACEF-MDRD$_{high}$ (n=250)**	**P value**
Previous Revascularization PCI (%) CABG (%)	96 (38.6%) 47 (18.9%)	91 (36.5%) 64 (25.7%)	93 (37.2%) 51 (20.4%)	0.89 0.15
Atrial Fibrillation (%) (n=672)	57 (25.6%)	68 (29.8%)	58 (26.2%)	0.55
Etiology (n=666) Ischemic Cardiomyopathy (%) Dilated Cardiomyopathy/Other (%)	134 (62.0%) 82 (28.0%)	140 (61.9%) 86 (38.1%)	143 (63.8%) 81 (36.2%)	0.89
De Novo Heart Failure (%)	43 (17.3%)	59 (23.7%)	89 (35.6%)	**<0.001**
Presentation Acute Heart Failure (%) Chronic Heart Failure (%)	67 (26.9%) 182 (73.1%)	83 (33.3%) 166 (66.7%)	116 (46.4%) 134 (53.6%)	**<0.001**
Symptoms at presentation Dyspnea on daily exertion (%) Paroxysmal dyspnea Congestive symptoms (%) Palpitations (%)	55 (22.1%) 23 (9.2%) 39 (15.7%) 13 (5.2%)	69 (27.7%) 29 (11.6%) 54 (21.7%) 15 (6.0%)	117 (48.8%) 31 (12.4%) 105 (42.0%) 24 (9.6%)	**<0.001** 0.50 **<0.001** 0.12
Examination Findings Jugular Venous Distention (%) Pretibial Edema (%) Crepitations (%) (n=737)	28 (11.2%) 77 (30.9%) 58 (23.9%)	72 (28.9%) 89 (35.7%) 89 (35.9%)	78 (31.2%) 108 (43.2%) 136 (55.3%)	**<0.001 0.02 <0.001**
NYHA Class NYHA 1 or 2 (%) NYHA 3 or 4 (%)	160 (76.9%) 48 (23.1%)	143 (63.3%) 83 (36.7%)	93 (41.5%) 131 (58.5%)	**<0.001**
Cardiac Implantable Devices VVI Pacemaker (%) DDD Pacemaker (%) ICD (%) Cardiac Resynchronization (%)	15 (5.6%) 9 (3.6%) 35 (14.1%) 5 (2.0%)	10 (4.0%) 8 (3.2%) 52 (20.9%) 15 (6.0%)	16 (6.4%) 11 (4.4%) 49 (19.6%) 18 (7.2%)	0.48 0.77 0.11 **0.02**

P values below 0.05 were given in bold. BMI: Body mass index, BP: Blood pressure, CABG: Coronary artery bypass grafting, ICD: Implantable cardioverter defibrillator, NYHA: New York Heart Association, PCI: Percutaneous coronary intervention.

* p value <0.05 compared to ACEF-MDRD$_{low}$ group

** p value <0.01 <0.05 compared to ACEF-MDRD$_{low}$ group

*** p value <0.001 <0.05 compared to ACEF-MDRD$_{low}$ group

Table 2. Laboratory values, medications and outcomes for ACEF-MDRD tertiles.

Characteristic	**ACEF-MDRD$_{low}$ (n=249)**	**ACEF-MDRD**
Laboratory characteristics	**Laboratory characteristics**	**Laboratory ch**
Hemoglobin (g/dl) (n=738)	13.5 ± 2.01	13.2 ± 1.77
Blood urea nitrogen (n=621)	21.0 ± 11.1	28.1 ± 14.7***
Creatinine	0.90 ± 0.16	1.00 ± 0.23**
GFR-MDRD	91.8 ± 23.7	79.7 ± 23.5***
BNP (n=44)	27.9 (20.4-64.2)	70.7 (33.3-116.0
NT-proBNP (n=211)	941.0 (498.0-2660.0)	1537.0 (634.0-48
Sodium (n=739)	138.0 ± 4.0	138.0 ± 3.9
Albumin (n=426)	3.94 ± 0.60	3.92 ± 0.69
Medications	**Medications**	**Medications**
ACE inhibitors (%)	171 (68.7%)	162 (65.1%)
Angiotensin receptor blockers (%)	82 (32.9%)	84 (33.7%)
Beta blockers (%)	224 (90.0%)	229 (92.0%)
Mineralocorticoid receptor blockers (%)	149 (59.8%)	160 (64.3%)
Diuretics (%)	96 (38.6%)	114 (46.0%)
Digoxin (%)	22 (8.8%)	39 (15.7%)
Outcomes	**Outcomes**	**Outcomes**
At least one hospitalization during follow up (%) (n=670)	112 (51.1%)	137 (60.1%)
Total number of hospitalizations during follow up (%) (n=668)	1.00 (0.00-1.00)	1.00 (0.00-2.00)
All-cause mortality (%)	27 (10.8%)	40 (16.1%)

P values below 0.05 were given in bold. BNP: B-type natriuretic peptide, GFR-MDRD: Glomerular filtration rate calculated with Modified Diet in Renal Disease formula, NT-proBNP: N-terminal of the pro-B-type natriuretic peptide.

* p value <0.05 compared to ACEF-MDRD$_{low}$ group

** p value <0.01 <0.05 compared to ACEF-MDRD$_{low}$ group

*** p value <0.001 <0.05 compared to ACEF-MDRD$_{low}$ group

Table 3. Univariate and multivariate predictors of one-year mortality. All variables that had a p value <0.1 were provided in the table. Variables that were present in the final model were provided in the relevant columns.

Characteristic	Univariate Analysis	Univariate Analysis	Multivariate Analysis	Multiva
	OR (95% CI)	**P value**	**OR (95% CI)**	**P valu**
Presentation (Acute HF)	3.56 (2.54 – 5.00)	<0.001	2.26 (1.55 – 3.29)	<0.001
Congestive symptoms (presence of)	2.95 (2.12 – 4.10)	<0.001		
Dyspnea (presence of)	2.43 (1.75 – 3.38)	<0.001		

Characteristic	Univariate Analysis	Univariate Analysis	Multivariate Analysis	Multiva
Heart rate (per beats/minute increase)	1.01 (1.00 – 1.02)	0.02		
Paroxysmal nocturnal dyspnea (presence of)	2.02 (1.34 – 3.05)	0.001		
Jugular distention (presence of)	2.10 (1.50 – 2.96)	<0.001		
Pretibial oedema (presence of)	1.50 (1.08 – 2.09)	0.02		
Crepitations (presence of)	3.12 (2.21 – 4.39)	<0.001		
Hemoglobin (per g/dl increase)	0.84 (0.78 – 0.91)	<0.001		
Sodium (per g/dl increase)	0.96 (0.94 – 0.98)	<0.001	0.97 (0.95 – 0.99)	0.013
NYHA (Class 3/4)	4.02 (2.77 – 5.82)	<0.001	2.45 (1.60 – 3.72)	<0.001
ACEF-MDRD (per 1 point increase)	1.28 (1.17 – 1.38)	<0.001	1.14 (1.04 – 1.24)	0.006

NYHA, New York Heart Association.

Figure Legends

Figure 1. Bar graphs showing percent of patients died within one year of follow up. Predicted mean one-year mortality rates were 0.12, 0.16 and 0.29, respectively, for low, intermediate and high ACEF-MDRD tertiles.

Figure 2. Kaplan-Meier Curve for one-year survival **(A)**and cumulative hazard ratio **(B)** for ACEF-MDRD tertiles. Colored areas around the solid lines indicate confidence intervals.

Figure 3. Receiver-operator curves for ACEF-MDRD and GWTG-HF models for predicting one-year mortality in the study population. Interrupted lines show actual curves, while solid lines show LOESS smoothing for comparison of two models.