Diabetes Mellitus and Outcomes of Cardiac Resynchronization With Implantable Cardioverter-Defibrillator Therapy in Older Patients With Heart Failure

Justin B. Echouffo-Tcheugui, MD, PhD; Frederick A. Masoudi, MD, MSPH; Haikun Bao, PhD; Erica S. Spatz, MD, MHS; Gregg C. Fonarow, MD

Background—Large-scale data on outcomes with cardiac resynchronization therapy with defibrillator in patients with diabetes mellitus are limited. We compared outcomes after cardiac resynchronization therapy with defibrillator implantation among patients with heart failure who have diabetes mellitus versus those without diabetes mellitus.

Methods and Results—Survival curves and covariate adjusted hazard ratio (HR) or odds ratio were used to assess the risks for death, readmission, and device-related complications by diabetes mellitus status among 18,428 patients at least 65 years old receiving cardiac resynchronization therapy with defibrillator from the National Cardiovascular Data Registry, implantable cardioverter-defibrillator registry between 2006 and 2009, with up to 3 years of follow-up. Accounting for differences between groups, compared with those without diabetes mellitus (n=11,345), patients with diabetes mellitus (n=7083) had a higher risk of death both at 1 year (HR, 1.16 [95% confidence interval (CI), 1.05–1.29]; P=0.0037) and 3 years (HR, 1.21 [1.14–1.29]; P<0.001) after device implantation and higher risks of all-cause readmission (sub-HR, 1.16 [1.11–1.21] at 1 year; P<0.0001; sub-HR, 1.15 [1.11–1.19] at 3 years; P<0.0001) and heart failure–related readmission (sub-HR, 1.18 [1.09–1.28] at 1 year; P<0.0001; and sub-HR, 1.22 [1.15–1.30] at 3 years; P<0.0001). Device-related complications within 90 days did not differ between those with and without diabetes mellitus (odds ratio: 0.90 [0.77–1.06]; P=0.37). Interactions of age, sex, ischemic cardiomyopathy, renal failure, or QRS duration were not significant.

Conclusions—In older patients with heart failure receiving cardiac resynchronization therapy with defibrillator, diabetes mellitus was independently associated with greater risks of death and rehospitalization, but similar risks of procedural complications. (Circ Arrhythm Electrophysiol. 2016;9:e004132. DOI: 10.1161/CIRCEP.116.004132.)

Key Words: cardiac resynchronization ▪ diabetes mellitus ▪ heart failure ▪ implantable cardioverter-defibrillators ▪ outcome assessment (health care)

Diabetes mellitus and heart failure (HF) are increasingly common in the United States, both posing major public health threats. Diabetes mellitus increases HF risk by 2.4- to 5-fold and is associated with poor HF outcomes. HF prevalence ranges between 10% and 22% among patients with diabetes mellitus, 4 times higher than that of the general population. Diabetes mellitus leads to HF through a variety of mechanisms including atherosclerosis and microvascular dysfunction, deposition of interstitial myocardial fibrosis, and specific neurohumoral deregulations. These pathogenic changes lead to systolic dysfunction and diastolic dysfunction, which are associated with long-term mortality.

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Because patients with diabetes mellitus more frequently have ischemic heart disease and renal dysfunction, diabetes mellitus may be associated with poorer outcomes of cardiac resynchronization therapy (CRT) and implantable cardioverter-defibrillator (ICD) combination therapy (CRT-D). Indeed, CRT-D is an established therapy in patients with HF, a left ventricular ejection fraction (LVEF) of ≤35%, and a wide QRS duration, with improvement in clinical outcomes. The magnitude of the influence of diabetes mellitus on outcomes of CRT-D therapy remains unclear. Data on the effectiveness of this therapy in this population are mixed or inconclusive, with some studies suggesting comparable outcomes of CRT-D therapy among patients with diabetes mellitus and those without diabetes mellitus, and others reporting worse outcomes. Hitherto, most studies examining this question have been subgroup analyses of randomized trials. However, the populations enrolled in trials may not closely resemble patients who receive therapies in clinical practice, particularly among the elderly. An adverse
Diabetes and Cardiac Resynchronization Therapy

WHAT IS KNOWN

- Diabetes mellitus increases the risk of incident heart failure and short-term mortality among patients with heart failure.
- Whether diabetes mellitus influences the outcomes of CRT and ICD combination therapy (CRT-D) remains unknown. Data on the effectiveness of this therapy among patients with diabetes mellitus are scarce.

WHAT THE STUDY ADDS

- For patients receiving CRT-D therapy those with diabetes mellitus exhibit poorer outcomes, including long-term mortality and readmissions.
- Diabetes mellitus was not associated with increased short-term device-related complications.
- The association of diabetes mellitus with outcomes was not influenced by age, sex, ischemic cardiomyopathy, renal failure, or QRS interval duration.

Methods

Data Source

Data originated from the NCDR-ICD Registry including patients who received a CRT-D, and the Centers for Medicare & Medicaid Services’ Medicare claims data. The ICD Registry contains data on all ICD and CRT-D implantations from >80% US hospitals covering almost all centers that implant cardiac rhythm devices. The NCDR data includes patient-level clinical, demographic, and procedural information using standardized data elements and definitions, with a multistage data processing including quality checks on submitted data, outlier analysis, and medical record audits. The Centers for Medicare & Medicaid Services files include data (including patient demographic characteristics, medical history, and clinical and procedural information) on all Medicare beneficiaries receiving ICD therapy for primary prevention. Medicare data include inpatient and outpatient claims and the corresponding denominator files. The ICD Registry data were linked to the Medicare claims data using a previously validated method.

The study was reviewed and approved by the Research and Publications Committee of the NCDR-ICD Registry. The Yale University Human Investigation Committee approved the study.

Study Cohort

In the data set resulting from the linkage of the NCDR-ICD Registry to the CMS data, we identified patients aged ≥65 years, with an LVEF of ≤35% and a QRS duration of ≥120 ms, admitted to the hospital for the first-time CRT-D implantation between January 1, 2006, and December 31, 2009. If multiple implantation records were linked for a single patient, we used the earliest record for the analysis. Of the original sample of patients aged ≥65 years identified by matching the NCDR-ICD Registry to the CMS data (n=187,809), we sequentially excluded participants with an LVEF of >35% (n=34,864), with a QRS duration of <120 ms (n=60,726), not undergone their first CRT-D implantation (n=47,083), admitted for reasons other than device implantation (n=16,363), had undergone an epicardial lead placement (n=925), had a previous placement of a pacemaker or an ICD (n=82,45), had an implantation for secondary prevention (n=877), underwent a coronary artery bypass graft surgery or percutaneous coronary intervention during the implantation hospitalization (n=46), and had myocardial infarction within 40 days before the index discharge (n=252). The final study sample consisted of 18,428 patients.

Diabetes Mellitus Status

The diabetes mellitus status of patients was based on previous medical history or a new clinical diagnosis during the index hospital admission for the first-time CRT-D implantation.

Outcomes

The outcomes were all-cause mortality, all-cause readmission, readmission for HF, and device-related complications. We assessed mortality at 1 year and 3 years and readmission at 30 days, 90 days, 1 year, and 3 years. The complication outcomes included a composite end point of mechanical complications (including pneumothorax, hemothorax, hemothoma, cardiac tamponade, or pericardial effusion requiring pericardiocentesis) requiring a system revision or device-related infection at 90 days. Mortality was ascertained on the basis of death dates in the Medicare denominator files and readmission on the basis of subsequent Medicare inpatient claims.

Covariates

The covariates measured at the time of the index hospital admission for the first-time CRT-D implantation included age, sex, race, insurance status, renal failure (chronic kidney disease/dialysis), hypertension, atrial fibrillation/flutter, chronic lung disease (chronic obstructive pulmonary disease/asthma), cerebrovascular disease, ischemic heart disease, previous myocardial infarction, previous coronary artery bypass grafting surgery, previous percutaneous coronary intervention, HF duration, history of syncope, history of ventricular tachycardia, previous congestive HF hospitalization, New York Heart Association class, LVEF, systolic blood pressure, serum sodium level, serum creatinine level, blood urea nitrogen level, hemoglobin levels, estimated glomerular filtration rate, year of procedure, annualized implanting clinician ICD volume, annualized site-level ICD volume, QRS duration, left bundle branch block (LBBB), ventricular tachycardia/ventricular fibrillation, and discharge medications (including β-blocker, angiotensin-converting enzyme inhibitor or angiotensinreceptor blocker, digoxin, and diuretics).

Statistical Analysis

We present baseline characteristics of patients by diabetes mellitus status, with continuous variables, presented as mean and SD (or median and interquartile range for variables with skewed distributions), and categorical variables as percentages. Differences in baseline...
characteristics were tested using χ² tests for categorical variables and appropriate parametric or nonparametric tests for continuous variables.

Kaplan–Meier methods were used to estimate mortality and log-rank tests to assess differences in unadjusted mortality rates by diabetes mellitus status. For readmission outcomes, we used the cumulative incidence function, which accounts for the competing risk of death, and Cox, valvular surgery, cardiac arrest, ventricular tachycardia, myocardial infarction, coronary artery bypass graft, percutaneous coronary intervention, and cystolic blood pressure. LBBB and non-LBBB patients will be divided into groups, defined by 10-ms increments in QRS duration. We considered patients to be receiving optimal medical therapy if they received a β-blocker and an angiotensin-converting enzyme inhibitor or angiotensin-receptor blocker in the absence of contraindications. In all analyses, the proportional hazards assumption was tested for diabetes mellitus category. Multivariable logistic regression was used to examine the association between groups (diabetes mellitus versus no diabetes mellitus) and the complications within 90 days.

We tested for interactions between diabetes mellitus and the following variables: age, sex, cause of HF (ischemic versus nonischemic cardiomyopathy), levels of kidney function (no chronic kidney disease [CKD], CKD stage 3, CKD stage 4, and end-stage renal disease or dialysis, defined on the basis of estimated glomerular filtration rate), race (non-Hispanic black versus nonblack), and QRS/LBBB categories (LBBB/QRS of >150 ms, LBBB/QRS of 120–149 ms, no LBBB/QRS of >150 ms, and no LBBB/QRS of 120–140 ms), through an inclusion of a multiplicative term between diabetes mellitus and each of these variables in the regression models and a test of significance of the interaction terms.

Missing data were rare for all variables (ranging between 0.1% and 0.6%) and were imputed by using the most common value for categorical variables and medians for continuous variables. All statistical inference testing was 2-sided with results considered statistically significant at P<0.01 for all hypotheses, to correct for multiple comparisons. All analyses were performed using the SAS statistical package version 9.2 (SAS Institute, Cary, NC).

**Results**

**Characteristics of Study Population**

The study population included 18,428 patients receiving CRT-D, of whom 7,083 (38%) had diabetes mellitus and 11,345 (62%) did not (Table 1). Patients with diabetes mellitus were on average younger (74.0 versus 75.4 years), more often men (68.9% versus 66.4%), white, and had higher rates hypertension (85.1% versus 74.3%), CKD (3.9% versus 2.2%), or a longer duration of HF (greater than 9 months – 72.8% versus 68.1%). Patients with diabetes mellitus also had higher frequency of ischemic cardiomyopathy (72.3% versus 60%). Overall, the majority of patients (with or without diabetes mellitus) had New York Heart Association functional class III HF symptoms (82.7% and 85.4%).

**Outcomes**

The cumulative incidence rates and hazards of mortality were higher in patients with diabetes mellitus than in those without diabetes mellitus (Table 2; Figure 1). Patients with diabetes mellitus had higher mortality rates that those without diabetes mellitus (cumulative 1-year incidence of death of 10.9% versus 8.1%, absolute difference 2.5%, adjusted HR 1.16 [95% CI 1.05–1.29], P<0.0001) and cumulative 3-year incidence of 28.7% versus 22.1%; absolute difference, 6.6%; adjusted HR, 1.21 [95% CI, 1.13–1.29]; P<0.0001).

The readmission rates among patients with diabetes mellitus were also higher than among those without diabetes mellitus (Table 2), the cumulative incidences for these outcomes are shown Figures 2 and 3. More specifically, patients with diabetes mellitus had higher rates of all-cause readmission at 30 days (cumulative incidence, 11.7% versus 9.7%; absolute difference, 2.0%; adjusted sub-HR, 1.16 [95% CI, 1.05–1.27]; P=0.0036), 90 days (cumulative incidence, 23.6% versus 19.3%; absolute difference, 4.3%; adjusted sub-HR, 1.17 [1.09–1.25]; P<0.0001), 1 year (cumulative incidence, 47.6% versus 40.2%; absolute difference, 7.4%; adjusted sub-HR, 1.16 [95% CI, 1.11–1.21]; P<0.0001), and 3 years (cumulative incidence, 70.6% versus 63.6%; absolute difference, 7.0%; adjusted sub-HR, 1.15 [1.11–1.19]; P<0.0001). Patients with diabetes mellitus also had a higher risk of HF-related readmission at 30 days (cumulative incidence, 2.7% versus 2.0%; absolute difference, 0.7%; adjusted sub-HR, 1.17 [95% CI, 0.96–1.42]; P=0.13), 90 days (cumulative incidence, 7.0% versus 5.2%; absolute difference, 1.8%; adjusted sub-HR, 1.19 [95% CI, 1.04–1.35]; P=0.0091), 1 year (cumulative incidence, 16.4% versus 12.2%; absolute difference, 4.2%; adjusted sub-HR, 1.18 [95% CI, 1.09–1.28]; P<0.0001), and 3 years (cumulative incidence, 28.3% versus 21.0%; absolute difference, 7.3%; adjusted sub-HR, 1.22 [95% CI, 1.15–1.30]; P<0.0001) than those without diabetes mellitus.

**Complications**

Complications within 90 days after device implantation occurred in 259 (3.7%) patients with diabetes mellitus compared with 504 (4.4%) patients without diabetes mellitus. There were no significant differences between the diabetes mellitus and the no-diabetes mellitus groups in terms of device-related complications within 90 days after accounting for differences in other patient characteristics (adjusted OR, 0.90 [0.77–1.06]; P=0.20).

**Interaction Analyses**

With respect to outcomes at 3 years, there were no significant interactions between diabetes mellitus and age, sex, cause of HF (ischemic versus nonischemic cardiomyopathy), levels of kidney function (no CKD, CKD stage 3, CKD stage 4, and end-stage renal disease or dialysis, defined on the basis of
estimated glomerular filtration rate), race (non-Hispanic black versus nonblack), and QRS/LBB categories (defined by 10-ms increments in QRS duration in ms: LBBB/QRS of >150 ms, LBBB/QRS of 130–149 ms, LBBB/QRS of 120–129 ms, no LBBB/QRS of >150 ms, no LBBB/QRS of 130–149 ms, and no LBBB/QRS of 120–129 ms) in terms of all-cause mortality (Table 3). These findings indicate that the effect of diabetes mellitus did not vary by the presence of levels of the tested variables.
In this large, real-world population of 18,428 older patients in the NCDR-ICD Registry with reduced LVEF and predominantly New York Heart Association functional class II–IV HF symptoms treated with CRT-D, diabetes mellitus was present in 38%. Those with diabetes mellitus had significantly higher risks of death and HF readmission, but no difference in device-related complications after CRT-D compared with those without diabetes mellitus. Our finding of the lack of difference in implant complications (mechanical and infectious) between patients with diabetes mellitus and those without diabetes mellitus is consistent with a previous report from a clinical trial.²⁰

Previous studies of the impact of diabetes mellitus on clinically meaningful outcomes after CRT-D therapy have been conflicting, perhaps, in part, because of differences in study design, population, time period, and length of follow-up. Some have found that diabetes mellitus is not related to prognosis among patients receiving CRT-D therapy,³–⁵ others have reported worse outcomes.¹¹–¹² A meta-analysis of the post hoc analyses of individual randomized trials of CRT (including 5 randomized controlled trials with 2923 patients, among whom 955 with diabetes mellitus) found that diabetes mellitus increased the risk of death after device insertion.²⁵ Because of potential differences between the populations enrolled in trials and those receiving device therapy in practice,²⁶ observational studies provide complementary information. Although our finding of a higher mortality risk among patients with diabetes mellitus is similar to that of the aforementioned meta-analysis, some individual studies have previously reported no mortality differences.⁸–¹² However, these studies have included a limited number of patients with diabetes mellitus or patients receiving CRT therapy only without ICDs and also had a shorter time frame of follow-up not extending beyond 1 year, which possibly influenced the frequency and correlates of adverse outcomes. These studies have also lacked the diversity of our study population with respect to race, age, or sex and did not always characterize outcomes other than death. Some of the previous studies included populations younger (≤65 years of age) than ours (≥65 years and above), with possibly a shorter duration diabetes mellitus and thus a potentially weaker effect.⁸ Our results suggest that the presence of diabetes mellitus among patients receiving CRT-D therapy is associated with a substantial burden of hospitalization in the postdevice implantation period. Further investigation is needed to determine whether diabetes mellitus screening and early optimization of the management of diabetes mellitus among those with HF amounts to better outcomes of CRT-D therapy.

### Discussion

*Table 2. Cumulative Incidence of Study Outcomes in the Cohort*

<table>
<thead>
<tr>
<th>Outcomes*</th>
<th>Non–Diabetes Mellitus (n=11,345), n (%)</th>
<th>Diabetes Mellitus (n=7,083), n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Death at 30 d</td>
<td>89 (0.8)</td>
<td>71 (1.0)</td>
</tr>
<tr>
<td>Death at 90 d</td>
<td>227 (2.0)</td>
<td>192 (2.7)</td>
</tr>
<tr>
<td>Death at 1 y</td>
<td>920 (8.1)</td>
<td>773 (10.9)</td>
</tr>
<tr>
<td>Death at 3 yr</td>
<td>2511 (22.1)</td>
<td>2031 (28.7)</td>
</tr>
<tr>
<td>Heart failure readmission at 30 d</td>
<td>232 (2.0)</td>
<td>194 (2.7)</td>
</tr>
<tr>
<td>Heart failure readmission at 90 d</td>
<td>586 (5.2)</td>
<td>498 (7.0)</td>
</tr>
<tr>
<td>Heart failure readmission at 1 yr</td>
<td>1385 (12.2)</td>
<td>1159 (16.4)</td>
</tr>
<tr>
<td>Heart failure readmission at 3 y</td>
<td>2378 (21.0)</td>
<td>2002 (28.3)</td>
</tr>
<tr>
<td>All-cause readmission at 30 d</td>
<td>1098 (9.7)</td>
<td>827 (11.7)</td>
</tr>
<tr>
<td>All-cause readmission at 90 d</td>
<td>2184 (19.3)</td>
<td>1675 (23.6)</td>
</tr>
<tr>
<td>All-cause readmission at 1 y</td>
<td>4558 (40.2)</td>
<td>3371 (47.6)</td>
</tr>
<tr>
<td>All-cause readmission at 3 y</td>
<td>7219 (63.6)</td>
<td>4999 (70.6)</td>
</tr>
<tr>
<td>Complications at 90 d</td>
<td>504 (4.44)</td>
<td>259 (3.66)</td>
</tr>
</tbody>
</table>

*P values of comparison <0.0001.

In this large, real-world population of 18,428 older patients in the NCDR-ICD Registry with reduced LVEF and predominantly New York Heart Association functional class II–IV HF symptoms treated with CRT-D, diabetes mellitus was present in 38%. Those with diabetes mellitus had significantly higher risks of death and HF readmission, but no difference in device-related complications after CRT-D compared with those without diabetes mellitus. Our finding of the lack of difference in implant complications (mechanical and infectious) between patients with diabetes mellitus and those without diabetes mellitus is consistent with a previous report from a clinical trial.²⁰

Previous studies of the impact of diabetes mellitus on clinically meaningful outcomes after CRT-D therapy have been conflicting, perhaps, in part, because of differences in study design, population, time period, and length of follow-up. Some have found that diabetes mellitus is not related to prognosis among patients receiving CRT-D therapy,³–⁵ others have reported worse outcomes.¹¹–¹² A meta-analysis of the post hoc analyses of individual randomized trials of CRT (including 5 randomized controlled trials with 2923 patients, among whom 955 with diabetes mellitus) found that diabetes mellitus increased the risk of death after device insertion.²⁵ Because of potential differences between the populations enrolled in trials and those receiving device therapy in practice,²⁶ observational studies provide complementary information. Although our finding of a higher mortality risk among patients with diabetes mellitus is similar to that of the aforementioned meta-analysis, some individual studies have previously reported no mortality differences.⁸–¹² However, these studies have included a limited number of patients with diabetes mellitus or patients receiving CRT therapy only without ICDs and also had a shorter time frame of follow-up not extending beyond 1 year, which possibly influenced the frequency and correlates of adverse outcomes. These studies have also lacked the diversity of our study population with respect to race, age, or sex and did not always characterize outcomes other than death. Some of the previous studies included populations younger (≤65 years of age) than ours (≥65 years and above), with possibly a shorter duration diabetes mellitus and thus a potentially weaker effect.⁸ Our results suggest that the presence of diabetes mellitus among patients receiving CRT-D therapy is associated with a substantial burden of hospitalization in the postdevice implantation period. Further investigation is needed to determine whether diabetes mellitus screening and early optimization of the management of diabetes mellitus among those with HF amounts to better outcomes of CRT-D therapy.

### Mechanisms

Many underlying mechanisms may explain the difference in outcomes of CRT-D therapy between patients with diabetes mellitus and those without diabetes mellitus. These
findings may reflect the fact that patients with diabetes mellitus at intrinsically higher risk for mortality and hospitalizations compared with those without diabetes mellitus. Alternatively, patients with diabetes mellitus may derive less benefit after CRT-D placement. Although some studies found similar improvements in LV performance and remodeling in diabetic and nondiabetic patients after CRT,8,11,17 others reported a more pronounced LV reverse remodeling and function improvement after CRT among patients without diabetes.13–15 The latter findings suggest that limited reverse remodeling among patients with diabetes may partially explain differential outcomes of CRT. Limited reverse remodeling can be related to diabetes mellitus–specific pathophysiologic processes including an impaired microvascular coronary circulation,27 a larger myocardial scarring burden because of more frequent coronary artery disease (as noted in our study), advanced glycation end-product deposition,28 increased myocardial fat and interstitial fibrotic tissue content,4,29 and neurohumoral and autonomic functional changes.5 Cardiac autonomic neuropathy is associated with LV dysfunction independent of known factors in the pathogenesis of myocardial disease and reflects underlying regional relationships of sympathetic integrity and function, with probably a distinct autonomic cardiomyopathy in the setting of diabetes mellitus.30 Recent evidence suggests that the beneficial effect of CRT above and beyond restoration of conduction by improving LV neuroadrenergic function is less likely to occur in patients with structural neuroautonomic damage or with neuroautonomic hibernation, which is more common in diabetes mellitus.51

Limitations
Our study was observational and primarily included patients with HF aged ≥65 years, thus we were unable to assess the relationship between diabetes mellitus and outcomes of CRT-D above and beyond this patient population. Residual measured and unmeasured confounding may have influenced the findings. Multiple comparisons were performed; however, we employed conservative statistical approaches to account for this multiplicity. Entry errors or missing data may have resulted in misdiagnosis of baseline characteristics including QRS morphology and QRS duration; however,
previous analysis has shown that data accuracy for the NCDR-ICD Registry is \( \approx 91\% \).\(^{21}\) The main end point for this analysis was all-cause mortality; the causes of death are not known as we did not have access to this information (including cardiovascular causes). We did not have prospective data on electrocardiography or echocardiography parameters of response to CRT-D therapy, nor could we evaluate functional outcomes or quality of life. However, differences in overall and HF-related readmissions rates point to a potentially high contribution of cardiovascular diseases including HF to deaths. Our study did not include information on the degree of glycemic control (as represented by glycated hemoglobin), duration of diabetes mellitus, or diabetes therapies, which may influence outcomes of CRT-D therapy. It is also possible that we underreported diabetes mellitus by using clinically diagnosed and documented diabetes mellitus, rather than using strict laboratory criteria. Likewise, we did not ascertain cases of diabetes mellitus that developed during the study follow-up.

### Conclusions

This study demonstrated that among older patients treated with CRT-D in contemporary practice, of whom 38\% had diabetes mellitus, mortality risk in those with diabetes mellitus is higher than in those without diabetes mellitus. Furthermore, diabetes mellitus is also associated with a higher short- and long-term burden of hospitalizations (overall and HF related) among those who underwent CRT-D therapy. However, device complication rates at 3 months after device implantation were similar between patients with and without CRT. Further mechanistic studies on the pathways through which diabetes mellitus affect outcomes of CRT-D are needed.

### Sources of Funding

The Implantable Cardioverter-Defibrillator Registry is an initiative of the American College of Cardiology Foundation.

### Disclosures

Dr Fonarow reports consultant to Amgen, Baxter, Janssen, Novartis, and Medtronic and research funding from the Agency for Healthcare Research and Quality and National Heart, Lung, and Blood Institute. Dr Masoudi has a contract with the American College of Cardiology as the Chief Science Officer of the National Cardiovascular Data Registries. The other authors report no conflicts.

### References


#### Table 3. Hazard Ratios of the Diabetes Mellitus and Outcome of Cardiac Resynchronization-Defibrillator Therapy Relationship Within Strata of Specific Patient Characteristics

<table>
<thead>
<tr>
<th>Table 3. Hazard Ratios of the Diabetes Mellitus and Outcome of Cardiac Resynchronization-Defibrillator Therapy Relationship Within Strata of Specific Patient Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age, y</strong></td>
</tr>
<tr>
<td>&lt;75</td>
</tr>
<tr>
<td>≥75</td>
</tr>
<tr>
<td><strong>Sex</strong></td>
</tr>
<tr>
<td>Men</td>
</tr>
<tr>
<td>Women</td>
</tr>
<tr>
<td><strong>Race</strong></td>
</tr>
<tr>
<td>Nonblack</td>
</tr>
<tr>
<td>Black</td>
</tr>
<tr>
<td><strong>Ischemic origin of heart failure</strong></td>
</tr>
<tr>
<td>No</td>
</tr>
<tr>
<td>Yes</td>
</tr>
<tr>
<td><strong>Chronic kidney disease</strong></td>
</tr>
<tr>
<td>No</td>
</tr>
<tr>
<td>III</td>
</tr>
<tr>
<td>IV</td>
</tr>
<tr>
<td>V</td>
</tr>
<tr>
<td><strong>LBBB/QRS, ms</strong></td>
</tr>
<tr>
<td>LBBB QRS 120–129</td>
</tr>
<tr>
<td>LBBB QRS 130–149</td>
</tr>
<tr>
<td>LBBB QRS ≥150</td>
</tr>
<tr>
<td>No LBBB QRS 120–129</td>
</tr>
<tr>
<td>No LBBB QRS 130–149</td>
</tr>
<tr>
<td>No LBBB QRS ≥150</td>
</tr>
</tbody>
</table>

Cl indicates confidence interval; and LBBB, left bundle branch block.


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