Prevalence of Conduction Abnormalities in a Systolic Heart Failure Population by Race, Ethnicity, and Gender

Kathy Hebert, M.D., M.M.M., M.P.H.,[1]* Henry C. Quevedo, M.D.,[1]† Leonardo Tamariz, M.D., M.P.H.,† Andre Dias, M.D.,* Dylan L. Steen, M.D.,* Rosario A. Colombo, M.D.,† Emiliana Franco, M.D.,* Sholom Neistein,‡ and Lee M. Arcement, M.D., M.P.H.§

*From the *University of Miami, Miller School of Medicine, Division of Cardiology, Miami, FL; †University of Miami, Miller School of Medicine, Division of Internal Medicine, Miami, FL; ‡Florida International University, Miami, FL; §Leonard J. Chabert Medical Center, Houma, LA*

Background: There is paucity of data regarding conduction abnormalities in the Hispanic population with systolic heart failure (HF). We aimed to evaluate the prevalence of electrocardiogram (ECG) abnormalities in a systolic HF population, with attention to the Hispanic population.

Methods: A cross sectional study of 926 patients enrolled in a systolic HF disease management program. ECGS were obtained in patients with an ejection fraction (EF) $\leq$ 40% by echocardiography at enrollment. Univariate and multivariate analysis adjusted by ethnicities was performed.

Results: White patients exhibited higher prevalence of atrial fibrillation (14.7%) than black patients (8.0%, P = 0.01) whereas Hispanics presented higher prevalence of paced rhythm (14.3% in Hispanics vs. 6.5% in whites and 5.2% in blacks, P<0.01 for both comparisons), higher prevalence of left bundle branch block (LBBB, 14.5% in Hispanics vs. 8.8% in whites and 5.8% in blacks, P = 0.002) and increased frequency of abnormal QT intervals (76.7% in Hispanics) than whites (59.6%) and blacks (69%) patients (P< 0.01 for both comparisons). A QRS interval greater than 120 ms was less prevalent among blacks (15.8% vs. 26.0% in whites and 25.3% in Hispanics, P = 0.01 for both comparisons). Univariate and multivariate analysis disclosed no influence of other characteristics (age, sex, coronary artery disease, hypertension, ejection fraction, medications) in the ECG findings.

Conclusions: Hispanics with Systolic HF presented with increased prevalence of paced rhythm, LBBB, and abnormal QT intervals. Attention should be addressed to these ECG variations to recommend additional guidance for therapeutic interventions and provide important prognostic information.

Ann Noninvasive Electrocardiol 2012;17(2):113–122

electrocardiogram; abnormalities; systolic heart failure; race and gender

Heart failure is responsible for over 1 million hospitalizations an year, with an annual cost of approximately $35 billion.[1,2] Systolic heart failure (HF) may have a number of etiologies, with subsequent deleterious effects to both the myocardium and its conduction pathways. The myocardial conduction system is vulnerable to ischemia, inflammation, fibrosis, and aging, with subsequent altered conduction properties.[3,4] The presence of such electrocardiographic conduction abnormalities as complete left bundle branch block (LBBB) and chronic atrial fibrillation (AF) have each been associated with HF, with LBBB seen in about one-third of cases and chronic AF present in up to 25% of patients.[5–7]

Both LBBB and AF have independently been associated with a significant increase in mortality in

[1]*These authors contributed equally to this article.*

Address for correspondence: Kathy Hebert, M.D., M.M.M., M.P.H, Miller School of Medicine, University of Miami, 1611 NW 12th Avenue, Jackson Memorial Hospital North Wing 210, Miami, FL 33136. Tel: 305–585–5547; Fax: 305–585–6490; E-mail: Khebert1@gmail.com

Conflict of interest: None declared

HF patients[6–10] and their appearance together have also been shown to have a cumulative effect on mortality, thus making them important markers in the complete evaluation of a patient with HF.[6]

While there have been several studies evaluating the prevalence of these elecrocardiographic (ECG) conduction abnormalities such as LBBB and AF in the general population, there are none currently describing that of the Hispanic population. Given the need for examining race and ethnic differences in ECG abnormalities, the aim of this study is to compare the prevalence of ECG conductions abnormalities in three systolic heart failure populations (i.e., whites, blacks, and Hispanics) from two indigent heart failure clinics (Florida and Louisiana).

METHODS

Study Population

A cross sectional study that included 926 patients was performed in two health care facilities (Florida and Louisiana). We enrolled patients with an ejection fraction ≤ to 40% by echocardiography at both sites. Electrocardiograms were obtained closest to the date of enrollment. At the Louisiana site, recruitment of study participants took place from August 1999 to December 2007 within in the heart failure disease management program (HFDM) at Leonard J. Chabert Medical Center (LJCMC) in Houma, Louisiana (n = 536). All patients were indigent with the following ethnicity composition: white: (n = 319) and black (n = 217). LJCMC is located in rural south Louisiana and as a safety-net hospital provides care primarily to the uninsured and underinsured patients with a severely depressed socioeconomic (SES) background (more than 55% of patients were below 200% the federal poverty level).

At the Florida facility (n = 390), we included all Hispanic patients enrolled in the Heart Failure Clinic at Jackson Memorial Hospital (JMH). JMH is a large, urban 1600 bed safety net hospital located in Miami, Florida. This hospital serves a population that is largely indigent (50% indigent, 31% had either Medicare or Medicaid, and 19% had private insurance). In addition, the patient population at this facility is largely comprised of immigrants with 98% born outside the United States. Recruitment of study participants took place from September 2007 to January 2009. The Institutional Review Board approval was obtained from the University of Miami Miller School of Medicine and the Louisiana State University Health Sciences Center. Patients signed an informed consent to enroll in an electronic data registry.

Electrocardiogram

A computerized electrocardiogram system (GE Marquette) was used to collect, store, and analyze electrocardiograms. All the ECGs were read by the electrocardiograph's built in algorithm (Marquette 12 SL Library Version 14).

Based on the most current ECG criteria from the ACC guidelines, two independent cardiologists reviewed all tracings specifically focusing on atrial fibrillation, paced rhythm, interventricular conduction delay, left anterior fascicular block, left posterior fascicular block, LBBB, right bundle branch block, PR interval, QT interval, and QRS interval.

Statistical Analyses

SPSS v18.0 (SPSS Inc., Chicago, IL, USA) was used to conduct all analyses. Categorical variables are presented as an absolute number and percentage. Continuous variables are presented as means and standard deviation. Crosstabs were used to analyze ethnic/race and gender differences in prevalence rates. For categorical variables, the chi-square statistic was used to evaluate group differences. Analysis of variance (ANOVA) was used to evaluate group differences for continuous variables. Univariate analysis between dependent variables (chronic AF, paced rhythm, interventricular conduction delay, left posterior fascicular block, left anterior fascicular block, first degree AV block, LBBB, right bundle branch block) and independent variables (age, sex, body mass index, systolic blood pressure [SBP], diastolic blood pressure [DBP], left ventricular ejection fraction [LVEF], New York Heart Association class [NYHA], history of myocardial infarction [MI], medications) adjusted by ethnicity group was performed to assess any influence in the ECG findings. We next evaluated multiple factor interaction in the ECG's findings by a multivariate analysis. Assuming the same variable classification, we analyzed each dependent variable in combination with the overall independent variables. For all analyses a $P < 0.05$ was considered statistically significant.

Table 1. Demographic Characteristics by Race and Ethnicity

Variable	White (n = 339)	Black (n = 364)	Hispanic (n = 223)	Total (n = 926)	P-value
Age, years, M (SD)	57.65 (11.31)[a]	54.44 (10.76)[ab]	57.19 (11.37)[b]	56.28 (11.21)	**0.000**
Male, n (%)	220 (64.9)	236 (64.8)	152 (68.2)	608 (65.7)	0.665
Education level, years, M (SD)	9.41 (3.30)[ab]	10.53 (3.17)[a]	10.53 (4.23)[b]	10.15 (3.57)	**0.000**
BMI, kg/m^2 M (SD)	32.58 (8.85)[a]	31.58 (9.21)	30.40 (8.13)[a]	31.58 (8.82)	**0.043**
Systolic blood pressure, mmHg, M (SD)	130.13 (23.75)[ab]	135.30 (27.09)[a]	135.13 (26.72)[b]	133.49 (25.98)	**0.027**
Diastolic blood pressure, mmHg, M (SD)	73.01 (14.22)[ac]	81.06 (16.69)[ab]	84.24 (15.85)[bc]	79.19 (16.30)	**0.000**
Ischemic cardiomyopathy, n (%)	116 (47.2)[ac]	77 (26.6)[ab]	93 (44.7)[bc]	286 (38.5)	**0.000**
EF, %, M (SD)	31.61 (10.80)[ac]	28.17 (10.91)[ab]	25.11 (10.09)[bc]	28.46 (10.94)	**0.000**
NYHA, n (%)					**0.030**
I	89 (32.8)[abc]	70 (22.3)[ab]	50 (24.8)[c]	209 (26.6)	
II	82 (30.3)[a]	101 (32.2)[a]	65 (32.2)	248 (31.5)	
III	78 (28.8)[b]	100 (31.8)[b]	55 (27.2)	233 (29.6)	
IV	22 (8.1)[c]	43 (13.7)	32 (15.8)[c]	97 (12.3)	
MI, n (%)	38 (11.2)[a]	54 (14.9)[b]	73 (33.3)[ab]	165 (17.9)	**0.000**
Aspirin, n (%)	143 (42.3)[a]	142 (39.0)[b]	125 (58.1)[ab]	410 (44.7)	**0.000**
Digoxin, n (%)	5 (3.7)[ac]	31 (13.3)[ab]	71 (32.6)[bc]	107 (18.2)	**0.000**
Spironolactone, n (%)	3 (1.8)[ab]	38 (15.9)[a]	48 (22.0)[b]	89 (14.3)	**0.000**
Beta-blocker, n (%)	334 (98.5)[ac]	344 (94.5)[ab]	197 (88.3)[bc]	875 (94.5)	**0.000**
ACE/ARB, n (%)	336 (99.1)[ac]	323 (88.7)[ab]	173 (77.6)[bc]	832 (89.8)	**0.000**

M = mean; SD = standard deviation; n = number of individuals; EF = ejection fraction; NYHA = New York Heart Association functional class; ACE = angiotensin converting-enzyme inhibitors; ARB = angiotensin receptor blockers.
[a]White versus blacks
[b]Hispanics versus blacks
[c]Hispanics versus whites

RESULTS

Demographic characteristics of the three race/ethnic groups, whites, blacks, and Hispanics by sex are described in Table 1 and 2 respectively. Multiple statistically significant race/ethnic group differences were found for age, education level, SBP, DBP, BMI, prevalence of ischemic cardiomyopathy, EF, and prescription of medications (i.e., aspirin, ACE inhibitors/ angiotensin receptor blockers [ACE/ARB], spironolactone, and digoxin, Table 1), but only differences in body mass index (BMI), DBP, EF, and prevalence of ischemic cardiomyopathy were found between males and females (Table 2). Overall, black patients were younger, had more education years, presented with higher blood pressure, lower EF, were more likely to be using beta blockers, digoxin, and spironolactone, had less prevalence of using ACE/ARB than white patients and less prevalence of ischemic cardiomyopathy ($P < 0.05$ for all comparisons by chi-square test, except for EF and blood pressure comparison performed by ANOVA). Conversely, Hispanic population was older had more years of formal education, lower BMI and EF, higher levels of blood pressure, and were less likely to be using spironolactone than white patients ($P < 0.05$ for all comparisons by chi-square test). Hispanics were also more likely to have a previous myocardial infarction, more likely to be prescribed aspirin, beta blockers, ACE/ARB, and digoxin than white and black population ($P < 0.001$ for all comparisons by chi-square test).

Race and Ethnic Differences in ECG Abnormalities

In Table 3 we present race and ethnic differences in ECG abnormalities. White patients presented

Table 2. Demographic Characteristics by Gender

Variable	Male	Female	Total	P-value
Age, years, M (SD)	55.99 (11.39)	56.84 (10.83)	56.28 (11.21)	0.278
Race/Ethnicity, N (%)				0.665
White	220 (36.2)	119 (37.4)	339 (36.6)	
Black	236 (38.8)	128 (40.3)	364 (39.3)	
Hispanic	152 (25.0)	71 (22.3)	223 (24.1)	
Education level, years, M (SD)	10.21 (3.65)	10.04 (3.39)	10.15 (3.57)	0.549
BMI, kg/m^2 M (SD)	31.12 (8.97)	32.63 (8.39)	31.58 (8.82)	**0.043**
Systolic blood pressure, mmHg, M (SD)	133.19 (26.13)	134.12 (25.70)	133.49 (25.98)	0.628
Diastolic blood pressure, mmHg, M (SD)	80.69 (16.86)	75.99 (14.56)	79.19 (16.30)	**0.000**
Ischemic cardiomyopathy, n (%)	217 (43.8)	69 (27.8)	286 (38.5)	**0.000**
EF, %, M (SD)	27.61 (10.74)	30.17 (11.14)	28.46 (10.94)	**0.002**
NYHA, N (%)				0.245
I	134 (25.6)	75 (28.5)	209 (26.6)	
II	175 (33.4)	73 (27.8)	248 (31.5)	
III	147 (28.1)	86 (32.7)	233 (29.6)	
IV	68 (13.0)	29 (11.0)	97 (12.3)	
MI, N (%)	122 (20.2)	43 (13.6)	165 (17.9)	0.013
Aspirin, N (%)	291 (48.3)	119 (37.8)	410 (44.7)	0.002
Digoxin, N (%)	69 (17.3)	38 (20.1)	107 (18.2)	0.417
Spironolactone, N (%)	65 (15.3)	24 (12.3)	89 (14.3)	0.330
Beta-blocker, N (%)	572 (94.1)	303 (95.3)	875 (94.5)	0.446
ACE/ARB, N (%)	550 (90.5)	282 (88.7)	832 (89.8)	0.394

M = mean; SD = standard deviation; n = number of individuals; EF = ejection fraction; NYHA = New York Heart Association functional class; ACE = angiotensin converting-enzyme inhibitors; ARB = angiotensin receptor blockers.

higher prevalence of atrial fibrillation than black patients (14.7% vs. 8.0% respectively, $P = 0.01$ by chi-square test), whereas Hispanics presented with higher prevalence of paced rhythm (14.3% in Hispanics vs. 6.5% in whites and 5.2% in blacks, $P < 0.01$ for both comparisons), higher prevalence of left bundle branch block (14.5% in Hispanics vs. 8.8% in whites and 5.8% in blacks, $P = 0.002$) and increased frequency of the abnormal QT intervals (76.7%) than whites (59.6%) and blacks (69%) patients ($P < 0.01$ for all comparisons by chi-square test). A QRS interval greater than 120 ms was less prevalent among blacks (15.8% vs. 26.0 in whites and 25.3% in Hispanics, $P = 0.01$).

Gender Differences in ECG Abnormalities

Right bundle branch block that was much more prevalent in men (7.4% in men vs. 3.5% in women, $P = 0.01$ by chi-square test, Table 4). No significant gender differences within race and ethnic groups were found in the total sample (Table 5).

We next performed independent univariate analysis of the ECG's abnormalities to assess whether the demographic characteristics (independent variables) can influence the ECG findings. We found in the univariate analysis that paced rhythm was influenced by SBP (R square = 0.025, Adjusted R square = 0.021, $P < 0.01$) and EF (R square = 0.021, Adjusted R square = 0.017, $P < 0.05$), and LBBB was only influenced by initial NYHA class (R square = 0.06, Adjusted R square = 0.05, $P = 0.03$, Table 6). Furthermore, in order to evaluate multiple interactions in the ECG's findings we also performed a multivariate analysis taking similar assumption of the variables. Multivariate analysis documented that intraventricular conduction delay was influenced by SBP ($P = 0.04$) and left anterior fascicular block was influenced by DBP ($P < 0.01$) but neither of the other factors disclosed an impact in the prevalence of ethnicity variances (Table 7).

DISCUSSION

This study describes the prevalence of ECG abnormalities in three systolic heart failure populations: whites, blacks, and Hispanics. Significant race and ethnic differences were found for atrial fibrillation, paced rhythm, LBBB, QRS interval greater than 120 ms, and QT interval that were

Table 3. ECG Abnormalities by Race and Ethnicity

Variable	White (n = 339) n (%)	Black (n = 364) n (%)	Hispanic (n = 223) n (%)	Total (n = 926) n (%)	P-value
Atrial fibrillation, n (%)	50 (14.7)[a]	29 (8.0)[a]	24 (10.8)	103 (11.1)	**0.017**
Paced rhythm, n (%)	22 (6.5) [a]	19 (5.2)[b]	32 (14.3)[ab]	73 (7.9)	**0.000**
Interventricular conduction delay, n (%)	26 (7.7)	25 (6.9)	11 (4.9)	62 (6.7)	0.440
Left posterior fascicular block, n (%)	5 (1.5)	4 (1.1)	1 (0.4)	10 (1.1)	0.515
Left anterior fascicular block, n (%)	46 (13.6)[a]	34 (9.3)	16 (7.2)[c]	96 (10.4)	**0.037**
First degree AV block, n (%)	36 (10.7)	45 (12.4)	23 (10.3)	104 (11.2)	0.681
LBBB, n (%)	30 (8.8)[a]	21 (5.8)[b]	32 (14.3)[bc]	83 (9.0)	**0.002**
RBBB, n (%)	25 (7.4)	21 (5.8)	10 (4.5)	56 (6.0)	0.357
Heart rate #bpm					0.457
≤59	50 (19.1)	48 (15.1)	24 (14.1)	122 (16.3)	
60 to 100	192 (73.3)	237 (74.8)	127 (74.7)	556 (74.2)	
≥101	20 (7.6)	32 (10.1)	19 (11.2)	71 (9.5)	
PR interval #msec					0.240
≤119	4 (1.5)	2 (0.6)	2 (1.2)	8 (1.1)	
121 to 200	215 (82.1)	248 (78.5)	145 (85.3)	608 (81.3)	
≥201	43 (16.4)	66 (20.9)	23 (13.5)	132 (17.6)	
QT interval*					**0.000**
Normal	137 (40.4)[ac]	113 (31.0)[ab]	52 (23.3)[bc]	302 (32.6)	
Abnormal	202 (59.6)[ac]	251 (69.0)[ab]	171 (76.7)[bc]	624 (67.4)	
QRS interval #msec					**0.013**
≤110	173 (66.0)[a]	236 (74.4)[ac]	118 (69.4)[c]	527 (70.4)	
111 to 119	21 (8.0)[a]	31 (9.8)[bd]	9 (5.3)	61 (8.1)	
≥120	68 (26.0)[b]	50 (15.8)[abc]	43 (25.3)[c]	161 (21.5)	

LBBB = left bundle branch block; RBBB = right bundle branch block; bpm = beats per minute; msec = milliseconds.
*Corrected QT interval > 460 miliseconds was considered abnormal.
[(a)]White versus blacks.
[(b)]Hispanics versus blacks.
[(c)]Hispanics versus whites.

not statistically significant related to other demographic characteristics or comorbidities of the population. Consistent with results from past studies, we found that white patients had significantly more atrial fibrillation than black patients.[11–15] Ruo and colleagues also reported a higher prevalence of atrial fibrillation among whites when compared to blacks.[16] This study also found that blacks were more likely to have some risk factors for atrial fibrillation including hypertension and prior diagnosed HF. In addition, the study found that blacks were less likely to be diagnosed with coronary disease, revascularization, hypothyroidism, or valve replacement than whites.

The increased prevalence of atrial fibrillation among white patients with systolic HF presents a concern for this population for several reasons. First, AF is characterized by irregular and often rapid ventricular rate, loss of atrial contraction, loss of atrioventricular synchrony, elevated filling pressures causing atrial dilatation and reduction in stroke volumes,[17] and is the most common cardiac arrhythmia, responsible for approximately one-third of all hospital admissions with a cardiac rhythm disturbance. Second, AF is associated with an increased risk of stroke and similarly is systolic HF which is responsible for an increased number of emergency department visits and hospitalizations.[18] Finally, HF and AF frequently coexist carrying severe hemodynamic consequences for the patient.[19,20]

There are several well-known risk factors for AF such as hypertension, coronary disease, prior diagnosed of HF, mitral stenosis, valvular repair, chronic lung disease, hyperthyroidism, left ventricular systolic function status, and medication. Differences in these risk factors and in baseline characteristics, when comparing white patients with black patients, may account for the differences found in AF prevalence, but was not found in our study. A lower prevalence of AF in blacks compared to whites with HF could also be explained by

Table 4. ECG Abnormalities by Gender

Variable	Male (N = 608)	Female (N = 318)	P-value
Atrial fibrillation	72 (11.8)	31 (9.7)	0.336
Paced rhythm	55 (9.0)	18 (5.7)	0.069
Interventricular conduction delay	134 (22.0)	54 (17.0)	0.069
Left posterior fascicular block	8 (1.3)	2 (0.6)	0.336
Left anterior fascicular block	66 (10.9)	30 (9.4)	0.500
First degree AV block	71 (11.7)	33 (10.4)	0.562
LBBB	47 (7.7)	36 (11.3)	0.069
RBBB	45 (7.4)	11 (3.5)	0.017
Heart rate#			0.199
≤59	77 (16.0)	45 (16.8)	
60 to 100	365 (75.9)	191 (71.3)	
≥101	39 (8.1)	32 (11.9)	
PR interval#			0.194
≤120	6 (1.3)	2 (0.7)	
121 to 200	381 (79.4)	227 (84.7)	
≥201	93 (19.4)	39 (14.6)	
QT interval #			0.282
Normal	191 (31.4)	111 (34.9)	
Abnormal	417 (68.6)	207 (65.1)	
QRS interval#			0.210
≤110	328 (68.2)	199 (74.3)	
111 to 119	43 (8.9)	18 (6.7)	
≥120	110 (22.9)	51 (19.0)	

LBBB = left bundle branch block; RBBB = right bundle branch block.

intrinsic racial differences in atrial membrane stability and conduction pathways, or even by genetic polymorphisms leading to different susceptibility to the development of AF.[16]

We found that Hispanic patients had more paced rhythm and evidence of LBBB than whites and blacks. By comparison, Perez et al. [21] recently reported a lower prevalence of LBBB in black and Hispanic patients compared to white patients. The mean age of the Hispanic cohort in Perez study is 54 years, slightly lower than in our study, considering that age is a risk factor for the development of LBBB.[22] Another explanation for this difference could be the low-SES background. Our group of patients with low SES may not receive consistent reliable medical therapy or medical assistance and therefore have more advanced disease. Our population, in both Florida and Louisiana, is predominately indigent. The patients enrolled in Perez study received medical assistance at Palo Alto Veterans Affairs Health Care System that offers "equal access to healthcare regardless of race or socioeconomic status and provide a distinct advantage for studying race-based differences." No specific information about the SES of the patients was provided.

Likewise, we found that abnormal QT interval was more prevalent in the Hispanic group compared to blacks and whites. Indeed, Perez et al. reported a higher prevalence of prolonged QTc among Hispanics comparing to non-Hispanics. The QT interval measured in the ECG is a representation of global repolarization duration in the ventricular myocardium. Abnormal QTc prolongation on the electrocardiogram should be viewed as an independent risk factor for sudden cardiac death (SCD) and seems to be associated with fivefold increased odds of SCD.[23]

Intraventricular conduction disturbances are commonly found in HF patients and seem to be associated with increased mortality.[6] Patients associated with intraventricular conduction disturbances are at an increased risk and could potentially benefit from electrophysiologic therapies such as atrial synchronized biventricular pacing or cardiac resynchronization therapy (CRT).[24,25] CRT has been found to be beneficial by improving the left ventricular filling, decreasing mitral regurgitation, and reducing septal dyskinesis.[24] Indeed, we found 122 patients in this study that met the criteria for CRT.

Table 5. ECG Abnormalities by Gender within Race/Ethnic Groups

	White			Black			Hispanic		
Variable	**Male (n = 220) n (%)**	**Female (n = 119) n (%)**	**P-value**	**Male (n = 236) n (%)**	**Female (n = 128) n (%)**	**P-value**	**Male (n = 152) n (%)**	**Female (n = 71) n (%)**	**P-value**
Atrial fibrillation	36 (16.4)	14 (11.8)	0.254	23 (9.7)	6 (4.7)	0.089	13 (8.6)	11 (15.5)	0.119
Paced rhythm	15 (6.8)	7 (5.9)	0.738	14 (5.9)	5 (3.9)	0.407	26 (17.1)	6 (8.5)	0.086
Interventricular conduction delay	19 (8.6)	7 (5.9)	0.363	17 (7.2)	8 (6.3)	0.731	10 (6.6)	1 (1.4)	0.097
Left posterior fascicular block	4 (1.8)	1 (0.8)	0.476	3 (1.3)	1 (0.8)	0.666	1 (0.7)	0 (0.0)	0.493
Left anterior fascicular block	33 (15.0)	13 (10.9)	0.296	24 (10.2)	10 (7.8)	0.461	9 (5.9)	7 (9.9)	0.288
First degree AV block	23 (10.5)	13 (11.0)	0.873	32 (13.6)	13 (10.2)	0.346	16 (10.5)	7 (9.9)	0.879
LBBB	15 (6.8)	15 (12.6)	0.073	13 (5.5)	8 (6.3)	0.772	19 (12.5)	13 (18.3)	0.249
RBBB	19 (8.6)	6 (5.0)	0.227	17 (7.2)	4 (3.1)	0.111	9 (5.9)	1 (1.4)	0.129
Heart rate#			0.206			0.359			0.991
≤59	32 (19.3)	18 (18.8)		29 (14.4)	19 (16.4)		16 (14.0)	8 (14.3)	
60 to 100	125 (75.3)	67 (69.8)		155 (77.1)	82 (70.7)		85 (74.6)	42 (75.0)	
≥101	9 (5.4)	11 (11.5)		17 (8.5)	15 (12.9)		13 (11.4)	6 (10.7)	
PR interval#			0.381			0.252			0.578
≤120	2 (1.2)	2 (2.1)		2 (1.0)	0 (0)		2 (1.8)	0 (0)	
120 to 200	133 (80.1)	82 (85.4)		152 (76.0)	96 (82.8)		96 (84.2)	49 (87.5)	
≥201	31 (18.7)	12 (12.5)		46 (23.0)	20 (17.2)		16 (14.0)	7 (12.5)	
QT interval#			0.255			0.861			0.406
Normal	84 (38.2)	53 (44.5)		74 (31.4)	39 (30.5)		33 (21.7)	19 (26.8)	
Abnormal	136 (61.8)	66 (55.5)		162 (68.6)	89 (69.5)		119 (78.3)	52 (73.2)	
QRS interval#			0.085			0.754			0.148
≤110	106 (63.9)	67 (69.8)		148 (73.6)	88 (75.9)		74 (64.9)	44 (78.6)	
111 to 119	18 (10.8)	3 (3.1)		19 (9.5)	12 (10.3)		6 (5.3)	3 (5.4)	
≥120	42 (25.3)	26 (27.1)		34 (16.9)	16 (13.8)		34 (29.8)	9 (16.1)	

Table 6. Univariate Analysis

Dependent Variable	Parameter	B	Standard Error	*t*	R-square	Adjusted R-square	P-value
Atrial fibrillation	HTN	0.01	0.008	1.159	0.002	−0.002	0.247
	MI	0.003	0.011	0.322	0.001	−0.003	0.748
	Smoker	−0.011	0.01	−1.114	0.002	−0.002	0.266
	SBP	3.93E-05	0	0.24	0.001	−0.004	0.81
	DBP	8.71E-06	0	0.034	0	−0.004	0.973
	Initial NYHA	0.002	0.004	0.564	0.001	−0.003	0.573
	EF	−5.75E-05	0	−0.124	0.001	−0.004	0.902
Left anterior fascicular block	HTN	0.013	0.021	0.612	0.004	0	0.541
	MI	−0.024	0.027	−0.905	0.005	0.001	0.366
	Smoker	0.031	0.024	1.288	0.006	0.002	0.198
	SBP	0	0	0.28	0.005	0.001	0.78
	DBP	0	0.001	0.322	0.005	0.001	0.747
	Initial NYHA	0.011	0.011	1.03	0.008	0.003	0.303
	EF	−0.003	0.001	−2.457	0.12	0.07	0.014
Left posterior fascicular block	HTN	−0.005	0.007	−0.688	0.005	0.001	0.492
	MI	−0.007	0.009	−0.782	0.006	0.002	0.434
	Smoker	−0.012	0.008	−1.529	0.007	0.003	0.126
	SBP	0	0	2.115	0.011	0.006	0.035
	DBP	0.001	0	3.041	0.016	0.012	0.002
	Initial NYHA	−0.005	0.003	−1.41	0.008	0.004	0.159
	EF	0	0	1.162	0.008	0.003	0.245
Intraventricular conduction delay	HTN	0.031	0.026	1.202	0.03	0.026	0.23
	MI	−0.065	0.034	−1.894	0.03	0.026	0.059
	Smoker	−0.006	0.031	−0.208	0.025	0.021	0.836
	SBP	0	0	−0.686	0.03	0.026	0.493
	DBP	0	0.001	−0.552	0.03	0.025	0.581
	Initial NYHA	0.007	0.014	0.528	0.029	0.025	0.597
	EF	−0.001	0.001	−0.854	0.028	0.023	0.393
LBBB	HTN	0.01	0.007	1.402	0.052	0.048	0.161
	MI	0.006	0.009	0.648	0.05	0.046	0.517
	Smoker	0.002	0.008	0.254	0.054	0.05	0.799
	SBP	0	0	−1.007	0.063	0.058	0.314
	DBP	0	0	−1.244	0.061	0.057	0.214
	Initial NYHA	0	0.004	−0.034	0.06	0.055	0.973
	EF	0	0	0.527	0.058	0.053	0.598
Paced rhythm	HTN	0.011	0.007	1.402	0.042	0.038	0.361
	MI	0.007	0.009	0.648	0.029	0.024	0.417
	Smoker	0.024	0.008	0.254	0.022	0.019	0.899
	SBP	0.001	0	2.611	0.025	0.021	0.009
	DBP	0	0	−1.244	0.062	0.052	0.314
	Initial NYHA	0	0.01	0.029	0.017	0.013	0.977
	EF	0.003	0.001	2.298	0.021	0.017	0.022

HTN = hypertension; MI = myocardial infarction; SBP = systolic blood pressure; DBP = diastolic blood pressure; NYHA = New York Heart Association functional class; EF = ejection fraction; LBBB = left bundle branch block.

A QRS interval greater than 120 ms was less prevalent among blacks compared to whites and Hispanics. QRS prolongation is an independent predictor of both increased total mortality and SCD.[26] A duration greater than 120 ms has been shown to have 99% specificity for left ventricular dysfunction and may be a potent marker for adverse outcome.[26] Early identification of patients at risk can allow precocious therapeutic interventions such as CRT thereby improving morbidity and mortality rates.

Limitations

The composition of our population is variable and therefore we could not compare the same ethnicity group between the two HFDM program sites. We do not have full access to the past medical

Table 7. Multivariate Analysis

Dependent Variable	Parameter	B	Standard Error	*t*	R-square	Adjusted R-square	P-value
Atrial fibrillation	Intercept	0.07	0.092	0.762	0.018	0.008	0.447
	NYHA	−0.001	0.012	−0.116			0.908
	EF	2.04E−05	0.001	0.014			0.989
	DBP	0.001	0.001	0.61			0.542
	SBP	0	0.001	−0.243			0.808
	MI	0.014	0.029	0.461			0.645
Paced rhythm	Intercept	0.077	0.087	0.88	0.049	0.039	0.379
	NYHA	0.008	0.012	0.66			0.509
	EF	0.003	0.001	2.248			0.025
	DBP	−0.004	0.001	−4.029			0
	SBP	0.002	0.001	3.708			0
	MI	−0.014	0.028	−0.517			0.605
Interventricular conduction delay	Intercept	0.017	0.075	0.226	0.012	0.001	0.821
	NYHA	−0.002	0.01	−0.182			0.856
	EF	0.001	0.001	0.819			0.413
	DBP	−0.002	0.001	−1.93			0.054
	SBP	0.001	0.001	2.024			0.043
	MI	0.012	0.024	0.509			0.611
Left posterior fascicular block	Intercept	−0.01	0.028	−0.342	0.005	−0.005	0.732
	NYHA	−0.001	0.004	−0.331			0.741
	EF	0	0	0.597			0.551
	DBP	0	0	0.641			0.522
	SBP	−1.61E-05	0	−0.085			0.933
	MI	−0.01	0.009	−1.129			0.259
Left anterior fascicular block	Intercept	0.218	0.091	2.402	0.032	0.022	0.017
	NYHA	0.007	0.012	0.561			0.575
	EF	0	0.001	0.268			0.789
	DBP	−0.003	0.001	−3.247			0.001
	SBP	0.001	0.001	1.256			0.209
	MI	−0.014	0.029	−0.473			0.637
First degree AV block	Intercept	0.156	0.092	1.697	0.008	−0.003	0.09
	NYHA	0.005	0.012	0.391			0.696
	EF	0	0.001	−0.316			0.752
	DBP	0	0.001	−0.321			0.749
	SBP	0	0.001	−0.232			0.817
	MI	−0.024	0.029	−0.816			0.415
LBBB	Intercept	0.309	0.09	3.429	0.022	0.012	0.001
	NYHA	−0.006	0.012	−0.535			0.593
	EF	−0.001	0.001	−0.711			0.477
	DBP	0	0.001	0.169			0.865
	SBP	−0.001	0.001	−1.567			0.117
	MI	−0.024	0.029	−0.845			0.398
Right bundle branch block	Intercept	0.093	0.072	1.297	0.007	−0.003	0.195
	NYHA	−0.011	0.01	−1.178			0.239
	EF	−0.001	0.001	−0.599			0.549
	DBP	0	0.001	−0.364			0.716
	SBP	6.01E-05	0	0.124			0.901
	MI	0.031	0.023	1.334			0.183

NYHA = New York Heart Association functional class; EF = ejection fraction; SBP = systolic blood pressure; DBP = diastolic blood pressure; MI = myocardial infarction; LBBB = left bundle branch block.

history of these patients nor all medications they were prescribed or taking which clearly could influence the results. It would be important to have a better knowledge of the patient's medical and surgical history, selected medications which affect conduction and an accurate physical examination report. A more advanced cardiovascular disease could be the explanation for the difference in the prevalence and not necessarily the race or ethnicity. ECGs were obtained at enrollment of the

HFMD programs but we could not gather data of a second ECG after any particular event or hospital re-admission, which could have shown ECG variations and progression of the disease. We also do not have a full disclosure of the specific causes of mortality or hospital readmission which could be useful for establishing risk-prediction models and hazard ratios.

Clinical Implications

Currently there are available several pharmacological and nonpharmacological therapeutic options for patients with atrial fibrillation. Several recently published studies have had promising results regarding catheter ablation as an option for a broad spectrum of patients with atrial fibrillation. Keeping in mind that these treatment options are expensive and these patients are from low SES, many without insurance, early detection to identify patients at risk could prove to result in cost savings by diminishing further development of the pathology and its consequences.

CONCLUSION

Hispanics with systolic heart failure showed more prevalence of baseline paced rhythm, LBBB, and abnormal QT intervals that were not statistically related to other demographic factors. Adequate medical attention should be addressed to these variations since relevant ECG findings can provide additional guidance for therapeutic interventions, provide important prognostic information, and potentially modify morbidity and mortality rate.

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