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CARDIAC MRI SCAR PATTERNS DIFFER BY GENDER IN AN IMPLANTABLE CARDIOVERTER DEFIBRILLATOR AND CARDIAC RESYNCHRONIZATION COHORT

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Abstract

Background—Recent meta-analyses suggest that the effectiveness of cardiac devices may differ between genders. Compared to men, women may not benefit as much from implantable defibrillators (ICDs), yet benefit more from cardiac resynchronization therapy (CRT). Myocardial scar burden is associated with increased incidence of appropriate ICD shocks but decreased response to CRT and may explain gender differences in device benefit.

Objective—To test the hypothesis that the extent of myocardial scar is less in women than men.

Methods—In 235 patients referred for primary prevention ICDs who underwent cardiac magnetic resonance imaging, we compared scar size by gender. Analyses were performed for all patients (ICD cohort) and those receiving biventricular pacemakers (CRT subgroup).

Results—In the ICD cohort, women (vs. men) had a higher prevalence of non-ischemic cardiomyopathy (NICM, 64% vs. 39%, $p < 0.001$) which accounted for a smaller overall scar burden (0.5% vs 13%, $p < 0.01$). Likewise, in the CRT subgroup, the higher prevalence of NICM in women (83% vs. 46%, $p = 0.01$) also contributed to a smaller scar size (0 vs 13%, $p < 0.01$). Women also had significantly less scarring of the inferolateral LV wall.

Conclusions—In a cohort of patients undergoing clinically indicated ICD and CRT, women had less myocardial scar than men. This difference was primarily driven by a higher prevalence of NICM in women. These findings may have important implications for the future study of gender disparities in ICD and CRT outcomes.

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Disclosures

Use of the custom research software tool, Cinetool, was obtained through a research agreement between Dr. Wu and GE Healthcare. Dr. Wu receives modest royalties for the licensing rights to use the gray zone methodology described in this article.

Keywords

Cardiac Magnetic Resonance Imaging; Implantable Cardioverter-Defibrillators; Cardiac Resynchronization Therapy; Gender

Introduction

In patients with reduced left ventricular ejection fraction (LVEF), implantable cardioverter-defibrillators (ICDs) and cardiac resynchronization therapy (CRT) improve prognosis and have become standard treatments in patients with heart failure.^{1–4} Although clinical guidelines recommend ICD implantation for primary prevention of sudden cardiac death (SCD) uniformly in both genders,⁵ under-representation of women in clinical trials, underutilization of ICDs in women and mixed results of small studies make it difficult to assess the true risk/benefit of such devices in women.⁶ Three recent meta-analyses of data pooled from several large ICD trials, as well as data from a prospective ICD database, demonstrated that women experienced a significantly lower rate of appropriate ICD therapies^{7,8} and no significant mortality reduction compared to men.^{8,9} Additionally, women have higher rates of perioperative and other ICD-related complications compared to men, which potentially impacts the risk/benefit ratio of device therapy.^{8,10}

In contrast to reduced benefit from ICD therapy, women appear to derive better long-term survival after CRT than men.^{11–13} A retrospective analysis of the Multicenter automatic Defibrillator Implantation Trial–Cardiac Resynchronization Therapy (MADIT-CRT) found that following CRT, women had a significant reduction in death or heart failure compared to men (69% vs. 28%, $p < 0.01$) as well as greater improvement of echocardiographic indices associated with reverse remodeling.¹² A more complete understanding of the gender-based differences in device recipient characteristics may improve patient selection strategies.

Myocardial tissue characteristics may play a significant role in defining how much benefit a patient derives from ICDs and CRT. Large myocardial scars have been associated with a higher probability of appropriate ICD discharges and a lower likelihood of a response to CRT.^{14,15} Additionally, myocardial scar involving the inferolateral LV wall has been associated with decreased CRT response.^{16,17} Another important predictor of CRT response is LV conduction type. Multiple studies have shown that patients with left bundle branch block (LBBB) have higher rates of CRT responsiveness than other conduction types.^{18–20}

In this study, we compared baseline clinical characteristics between men and women with cardiomyopathy referred clinically for primary prevention ICDs and the subgroup of ICD candidates who also received CRT, to test the hypothesis that women have smaller myocardial scars, less inferolateral LV wall scar, and a higher prevalence of LBBB than men.

Methods

Study Population

This study included patients who were referred clinically to Johns Hopkins Medical Institutions for ICD implantation for primary prevention of SCD and were enrolled in the CMR imaging arm of the Prospective Observational Study of Implantable Cardioverter Defibrillators (CMR-PROSE-ICD) study which has been previously described.^{21,22} The primary variable of interest in the CMR-PROSE-ICD study was prespecified as CMR scar extent. Briefly, patients enrolled all had LVEFs $\geq 35\%$, coronary angiography, no other indications for ICD placement and no contraindications to CMR. Consecutive patients were

approached for enrollment and only patients receiving new ICD implants (not device upgrades) were enrolled. Patients were classified as having ischemic cardiomyopathy (ICM) if they had a history of myocardial infarction (MI) or revascularization, evidence of coronary artery stenosis >50% of the left main or proximal left anterior descending coronary arteries, or >50% stenosis of two or more epicardial vessels. Other patients were classified as having non-ischemic cardiomyopathy (NICM). All MIs occurred > 1 month before enrollment. Patients in whom CRT was indicated based on 2008 ACC/AHA/HRS Guidelines for Device Based Therapy of Cardiac Rhythm Abnormalities were implanted with CRT devices.⁵ All CRT patients in this cohort thus had QRS duration > 120 msec. This study protocol was approved by the Johns Hopkins Institutional Review Board. All patients gave written informed consent.

ECG Acquisition and Analysis

Prior to device implantation, 12-lead electrocardiograms (ECGs) were acquired using a GE-Marquette system. At the time of ECG analysis, investigators were blinded to all patient data (heart failure etiology, CMR imaging results, etc.) except age and gender. ECGs were analyzed for the presence of conduction defects and left ventricular hypertrophy according to the following prespecified definitions:²³

- Left bundle branch block (LBBB): QRS duration ≥ 140 ms (men) or 130 ms (women), QS or rS in V1 with mid-QRS notching/slowing in 2 of the leads I, aVL, V1, V2, V5 or V6;
- Left anterior fascicular block (LAFB): QRS duration ≥ 100 ms (men) or 90 ms (women), and left axis deviation ≥ 45°;
- Right bundle branch block (RBBB): QRS duration ≥ 120 ms with rR' or qR in V1;
- LAFB+RBBB: meeting both RBBB and LAFB criteria;
- Left ventricular hypertrophy (LVH): increased voltage satisfying Sokolow-Lyon or Cornell criteria²⁴ and not meeting other classifications; and
- No confounders: not meeting any of previously mentioned criteria.

CMR Acquisition and Analysis

The CMR protocol has been previously described.^{21,25} Briefly, patients underwent cine and CMR with late gadolinium enhancement (LGE) imaging using a 1.5 Tesla scanner (Signa CV/I, GE Healthcare Technologies or Siemens Avanto). Two observers blinded to all other patient data used custom research tool, CINEtool (GE Healthcare Technologies), to analyze the CMR images. Cine images were used to measure LVEF, LV mass and LV volumes and LGE images were used to measure total scar size. Left ventricular volumes and masses were corrected for body size. After LGE images were obtained, endocardial and epicardial LV borders were outlined in short axis slices and scar size was determined by published methodology.^{21,22} Briefly, the LGE area was outlined and pixels with signal intensity (SI) >50% of the maximal SI within the LGE area were defined as the scar “core” region. A region of normal myocardium was then selected and the peak SI for this area was determined (peak remote). Myocardium with SI greater than peak remote but less than 50% of maximal SI within the LGE region was defined as the “gray” zone to represent the heterogeneous peri-scar zone. Core zone, gray zone and total scar sizes were expressed as a percentage of the total LV volume.

Infarction location was estimated using the American Heart Association 17-segment model of the left ventricle.²⁶ Patients with ICM were grouped into those having infarct with a left anterior descending (LAD), right coronary artery (RCA) and/or left circumflex (LCX)

infarction pattern. Patients with NICM were grouped into 6 patterns: no scar present, scar confined to the mid-wall myocardium, scar confined to the epicardium, scar confined to the endocardium, transmural scar and scar at the right ventricle (RV) insertion points based on previously described patterns.²⁷ Scar transmural grade in each of the 17 segments was graded on a 0–4 point scale as previously described (0 for 0% hyperenhancement, 1 for 1–25% hyperenhancement, 2 for 26–50% hyperenhancement, 3 for 51–75% hyperenhancement and 4 for 76–100% hyperenhancement).²⁸ For the CRT subgroup, the average scar transmural grade in the inferolateral segments (segments 4, 5, 10 and 11) was assessed, which corresponds to the most common location of biventricular lead placement and has been shown to predict CRT response.¹⁶

Statistical Analysis

Variables following Gaussian distributions were compared by gender with parametric measures (two-sample t-test, one-way ANOVA) while those not following Gaussian distributions were analyzed non-parametrically (Wilcoxon rank sum, non-parametric one-way ANOVA). Categorical variables were evaluated by Chi-square. Analysis was performed for the overall ICD eligible population (ICD Cohort) and the subgroup who received CRT (CRT Subgroup) independently. Two-sided significance was set at $\alpha=0.05$.

Results

ICD Cohort

Two hundred thirty-five patients were included in this analysis (56 women [24%], 179 men [76%]). Men and women had similar QRS-durations, QRS-axes, LVEFs, LV volumes and ethnicity distributions (Table 1). Women (compared to men) were younger (54 vs. 58 years old, $p=0.04$) had smaller LV mass indices (67 vs. 76 grams/m², $p=0.01$), and had higher prevalences of NYHA Class III heart failure (48% vs. 31%, $p=0.02$), NICM (64% vs. 39%, $p<0.001$) and left bundle branch block (29% vs. 16%, $p=0.02$).

Analysis of CMR scar patterns demonstrated significant differences between men and women (Table 2). Overall, women had smaller myocardial scar sizes than men (0.5% vs. 13.0% of the LV, $p<0.001$), due to the higher prevalence of NICM in women. Core and gray zones were also smaller in women than men (0.9% vs. 9.2%, $p<0.01$ and 0.2% vs. 5.2%, $p<0.01$ respectively). Among patients with ICM, there was no significant gender difference in scar size or coronary artery infarction distribution. Among patients with NICM, women had significantly smaller scar sizes than men (0% vs. 0.7%, $p=0.02$). Non-ischemic women also had significantly smaller core zones (0% vs. 0.6%, $p=0.03$) and gray zones (0% vs. 0.2% of the LV, $p=0.01$). Of the non-ischemic scar distributions, women more frequently demonstrated “No Scar” than men (69% vs. 45% of non-ischemic patients, $p=0.02$).

CRT Subgroup

Sixty-four of the patients (27%) in the overall cohort also received clinically-indicated CRT (18 women [28%], 46 men [72%]). Men and women in this subgroup were similar in age and had similar QRS-durations, QRS-axes, LVEFs, LV volumes, LV masses, and ethnicity and NYHA class distributions (Table 3). As seen in the overall cohort, women had a higher prevalence of NICM (83% vs. 46%, $p<0.001$). There was no significant difference in the prevalence of LBBB between men and women; however, because this subgroup was defined as having a prolonged QRS-duration, the prevalence of LBBB was high in both genders (56% of women, 43% of men).

Among the CRT subgroup, women had smaller total myocardial scar sizes than men (0% vs. 13.0% of the LV, $p<0.001$) due to both smaller LGE estimated core and gray zones (Table

4). Overall, women exhibited significantly less scarring of the inferolateral wall (average transmural scar grade 0.21 vs. 0.77, $p=0.002$) than men. Among patients with ICM, there was no significant gender difference in scar size or coronary artery infarction pattern; however this comparison is limited by the small sample size (3 women, 25 men). Patients with NICM, however, demonstrated smaller scar sizes in women (0% vs. 3.0 % of the LV, $p=0.003$) as well as smaller core and gray zones (Table 4). Of the non-ischemic scar patterns, women more frequently demonstrated “No Scar” than men (80% vs. 29% of non-ischemic patients, $p=0.002$).

The transmural extent of scar by LV segment for both the overall ICD cohort and CRT subgroup by gender is displayed in Figure 1. In both groups, men demonstrate significantly greater transmural scar involvement than women. In these plots, the gender differences in scar distribution are more pronounced in the CRT subgroup than the overall ICD cohort. Women with NICM selected for CRT exhibited the least transmural scar involvement in any given myocardial segment.

Discussion

This study demonstrates that in an observational cohort of unselected patients undergoing ICD and CRT for clinical indications, significant gender differences exist in myocardial scar characteristics. Compared to men, women in this cohort had a significantly higher prevalence of NICM with resultant smaller myocardial scar sizes and transmural extents, particularly involving the inferolateral region. These characteristics highlight potential differences in baseline characteristics and may help explain observed gender disparities in ICD and CRT outcomes reported in prior analyses of clinical trials.^{7, 9, 12}

Gender Differences and Ventricular Arrhythmia Risk

In prior large ICD and CRT trials and registries of post-market device utilization, women have been an underrepresented subgroup,^{4, 11, 29–31} making it difficult to definitively assess for gender differences in device therapeutic benefit. Gender differences in the underlying epidemiology of SCD seem to exist since the incidence of SCD in women is <50% that of men in the Framingham study in all age groups.³² Hence, if gender-specific differences in myocardial substrate were identifiable, more targeted approaches to prescribing cardiac implantable devices could be entertained.

Our cohort had a similar gender distribution compared to prior studies with ~25% women and the scar characteristics by gender were distinctly different. Among the overall ICD cohort, the women referred for ICD implantation were younger and more likely to have LBBB, NICM and smaller scars. While among NICM patients, women had statistically smaller scar sizes than men, the clinical significance of this difference (0% vs. 0.7%) is difficult to interpret, in part due to the small sample size of this subgroup (36 women, 69 men). Myocardial scar size has been associated with a higher probability of arrhythmic outcomes, such as appropriate device therapies.^{15, 22, 33} Additionally, the CMR gray zone, which represents scar tissue heterogeneity, has been strongly associated with spontaneous ventricular arrhythmia in ICD patients.^{22, 34, 35} The current study's findings that women have smaller total scar and gray zones may reflect a lower baseline risk for ventricular arrhythmias in women referred for ICD implantation. Differences in baseline risk could explain in part why women have not demonstrated significant mortality reduction with ICD implantation in large clinical trials.^{7, 9}

Considerations for CRT

Analysis of the subgroup who received CRT also demonstrated smaller myocardial scar sizes and more frequent NICM in women. Men and women with ICM had similar scar sizes; whereas, in non-ischemic patients, women demonstrated significantly smaller scar sizes as well as smaller core and gray zones. This suggests that the difference in scar size is driven by both a lower prevalence of ICM in women as well as smaller scar sizes among women with NICM. Given that larger scar sizes are associated with decreased CRT response,¹⁴⁻¹⁷ the larger scar sizes seen in men could contribute to their lower CRT response rates. Another interesting finding of this study is the gender differences in the transmural extent of inferolateral wall scar in the CRT subgroup, particularly among the non-ischemic cohort. Previously, in infarct patients, Bleeker et al. showed that patients with significant scar involving the inferolateral LV wall do not respond to CRT even in the presence of extensive LV dyssynchrony.¹⁶ Since the target region for the LV pacing lead is generally the inferolateral wall, more transmural scar tissue in this area (regardless of etiology) may be unresponsive to electrical stimulation and hence the benefits of CRT such as the reduction of mechanical dyssynchrony and the subsequent improvement in cardiac output cannot be achieved.¹⁷ The higher transmural inferolateral scar burden in men eligible for CRT seen in the current study may play a role in the reported gender disparities in CRT outcomes. The clinical significance of this difference (grade 0.21 vs. 0.77) is again difficult to interpret due to the small sample size of this subgroup (18 women, 46 men).

LBBB was more common in women in the overall ICD cohort but not in the CRT subgroup. This may be due to the fact that all of the patients who received CRT had prolonged QRS-durations and thus, both men and women were more likely to have some type of conduction block in this group. Additionally, women did demonstrate a trend toward more frequent LBBB than men (56% vs. 43%) although a large sample size would be required to validate this trend. Recent studies have shown that benefit from CRT may be limited to patients with LBBB.¹⁸⁻²⁰ A higher prevalence of LBBB in women could also be a factor in observed gender differences in CRT response rates.

Limitations

This study does not evaluate outcomes of either ICD or CRT device therapies by gender. The aim was to highlight differences in myocardial substrate in a cohort of patients undergoing clinically indicated device therapy. Future work will evaluate the relationship between differences in scar characteristics and clinical outcomes. The ICD-cohort analyses included both patients who received ICDs and CRT-D devices since both of these patient groups received defibrillators. Analyses were repeated for the "ICD-only" subgroup that did not receive a CRT device and there was an overall trend towards smaller scar sizes in women compared to men (2.5 vs 14.0% of the LV, $p=0.10$), with similar scar sizes in ICM patients by gender (23.0 vs 22%, $p=0.53$). This suggests a possible lower prevalence and/or extent of scar in NICM women compared to NICM men; however, the sample size of the current ICD-cohort was not sufficiently large and suggests that the effect size between men and women in the ICD-only cohort may be less pronounced. This will require larger patient numbers to confirm. Interpretation of these results is limited by the retrospective nature of this study and the small sample size. Specifically, analyzing coronary artery distribution patterns in the CRT-cohort is limited given that only 3 women in this subgroup had ICM. The percentage of women enrolled was low at 24%, which reflects the nationwide trend of reduced utilization of ICD therapies in women.³⁰ The CRT-cohort of this referral population had a relatively narrow QRS duration overall (mean QRSD of 138 msec) and 17% were NYHA class I at the time of the CMR. Extrapolation of the results to other study cohorts requires further study. This study is a retrospective analysis of a prospective registry and thus may be subject to referral bias.

Conclusion

Identifiable gender differences in baseline clinical and myocardial characteristics can be observed in cardiomyopathy patients receiving ICDs and CRT under current clinical guidelines. This observed heterogeneity in risk profiles suggests that more detailed phenotyping of the myocardial substrate could be beneficial in leading to targeted, individualized therapy in patients who are currently candidates for ICDs and/or CRT. Further investigation of how phenotypic differences influence clinical outcomes may help to explain current gender disparities in ICD and CRT outcomes and could inform the development of more patient-specific risk stratification algorithms.

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Abbreviations

ICD	Implantable Cardioverter-Defibrillator
CRT	Cardiac Resynchronization Therapy
SCD	sudden cardiac death
CMR	cardiac magnetic resonance
LGE	late gadolinium enhancement
LVEF	left ventricular ejection fraction
NYHA	New York Heart Association
MI	myocardial infarction
ECG	electrocardiogram
LBBB	left bundle branch block
LAFB	left anterior fascicular block
RBBB	right bundle branch block
LVH	left ventricular hypertrophy
SI	signal intensity
LAD	left anterior descending
RCA	right coronary artery
LCX	left circumflex
RV	right ventricle
LVEDV	left ventricular end diastolic volume
LVESV	left ventricular end systolic volume

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Figure 1. Circumferential polar plot of scar transmural distribution by gender for ICD Cohort (A) and CRT Subgroup (B)

Each numbered segment corresponds to the standard AHA 17 segment model (i.e. segment 1 represents the basal anterior wall, segment 2 the basal anteroseptal wall, etc.)²⁶ and the average scar transmural distribution in each segment is shown from no scar (white) to 75% transmural scar (black). In both the ICD cohort and CRT subgroup, men had more transmural scars. Within the CRT subgroup, scarring of the inferolateral wall (segments 4, 5, 10 and 11) is more substantial in men.

Table 1
Baseline clinical characteristics by gender for the Overall ICD Cohort

Continuous variables are reported as mean $\pm$ standard deviation and categorical variables are reported as N (% of population).

Variable	Women (N=56)	Men (N=179)	P-value
Age (yrs)	54 $\pm$ 14	58 $\pm$ 12	0.04
QRS Duration (ms)	124 $\pm$ 30	118 $\pm$ 29	0.26
QRS Axis	18 $\pm$ 62	13 $\pm$ 53	0.63
LVEF (%)	28 $\pm$ 10	26 $\pm$ 9	0.09
LVEDV [*] (mL)	115 (96–131)	125 (95–144)	0.25
LVESV [*] (mL)	84 (63–104)	94 (64–112)	0.16
LV Mass [*] (g)	67 (54–79)	76 (58–88)	0.01
Ethnicity			0.21
Caucasian	35 (63%)	129 (72%)	0.18
African American	20 (36%)	43 (24%)	0.09
Other	1 (2%)	6 (3%)	0.55
Heart Failure Etiology			<0.001
Ischemic	20 (36%)	110 (61%)	<0.001
Non-ischemic	36 (64%)	69 (39%)	<0.001
NYHA Class			0.04
I	9 (16%)	48 (27%)	0.09
II	20 (46%)	75 (42%)	0.41
III	27 (48%)	55 (31%)	0.02
Conduction type			0.26
No Confounders	19 (34%)	88 (49%)	0.03
LVH	12 (21%)	34 (19%)	0.65
LAFB	3 (5%)	13 (7%)	0.74
RBBB	3 (5%)	5 (3%)	0.35
LAFB+RBBB	2 (4%)	9 (5%)	0.67
LBBB	16 (29%)	29 (16%)	0.02
ECG unavailable	1 (2%)	1 (<1%)	0.39

Variables following non-parametric distributions (*) are reported as median (IQR).

Table 2
MRI characteristics by gender for the Overall ICD Cohort

Continuous variables are reported as mean $\pm$ standard deviation and categorical variables are reported as N (% of population).

Overall ICD Cohort	Women (N=56)	Men (N=179)	P-value
Scar Size (% LV) *	0.5 (0–19.2)	13.0 (2.0–24.0)	<0.01
Scar Core Size (% LV) *	0.9 (0–15.0)	9.2 (1.5–17.0)	<0.01
Scar Gray Size (% LV) *	0.2 (0–7.2)	5.2 (0.9–13.4)	<0.01
Ischemic Etiology	N=20 (36%)	N=110 (61%)	
Scar Size *	23.5 (16.5–29.0)	22.0 (14.0–26.3)	0.42
Scar Core Size *	17.0 (13.8–21.7)	15.3 (9.8–19.4)	0.30
Scar Gray Size *	12.6 (6.5–16.9)	11.2 (5.0–15.9)	0.60
Coronary infarction pattern			0.75
No Scar	1 (5%)	5 (5%)	0.93
LAD	15 (75%)	70 (64%)	0.33
RCA	3 (15%)	31 (28%)	0.22
LCX	3 (15%)	21 (19%)	0.67
Non-ischemic Etiology	N=36 (64%)	N=69 (39%)	
Scar Size *	0 (0–0.5)	0.7 (0–4.0)	0.02
Scar Core Size *	0 (0–0.9)	0.6 (0–2.8)	0.03
Scar Gray Size *	0 (0–0.2)	0.2 (0–2.1)	0.01
Scar Pattern			0.06
No Scar	25 (69%)	31 (45%)	0.02
Mid-Wall	0 (0%)	4 (6%)	0.14
Epicardial	0 (0%)	4 (6%)	0.14
Endocardial	0 (0%)	4 (6%)	0.14
Transmural	6 (17%)	9 (13%)	0.62
RV Insertion	5 (14%)	17 (25%)	0.20

Variables following non-parametric distributions (*) are reported as median (IQR).

Table 3
Baseline clinical characteristics by gender for CRT Subgroup

Continuous variables are reported as mean $\pm$ standard deviation and categorical variables are reported as N (% of population).

Variable	Women (N=18)	Men (N=46)	P-value
Age (yrs)	55 $\pm$ 12	58 $\pm$ 11	0.29
QRS Duration (ms)	139 $\pm$ 28	135 $\pm$ 34	0.66
QRS Axis	9 $\pm$ 73	15 $\pm$ 58	0.72
LVEF (%)	26 $\pm$ 8	24 $\pm$ 9	0.64
LVEDV * (mL/m ²)	124 (99–136)	142 (110–179)	0.12
LVESV * (mL/m ²)	94 (71–108)	110 (78–140)	0.21
LV Mass * (g/m ²)	72 (59–86)	81 (62–93)	0.27
Ethnicity			0.56
Caucasian	15 (83%)	33 (72%)	0.34
African American	3 (17%)	10 (22%)	0.66
Other	0 (0%)	2 (4%)	0.38
Heart Failure Etiology			0.01
Ischemic	3 (17%)	25 (54%)	0.01
Non-ischemic	15 (83%)	21 (46%)	0.01
NYHA Class			0.95
I	3 (17%)	8 (17%)	0.95
II	6 (33%)	17 (37%)	0.79
III	9 (50%)	21 (46%)	0.76
Conduction type			0.39
No Confounders	3 (17%)	17 (37%)	0.12
LVH	2 (11%)	3 (7%)	0.55
LAFB	1 (6%)	2 (4%)	0.84
RBBB	0 (0%)	0 (0%)	n/a
LAFB+RBBB	1 (6%)	4 (9%)	0.68
LBBB	10 (56%)	20 (43%)	0.39
ECG unavailable	1 (6%)	0 (0%)	0.11

Variables following non-parametric distributions (*) are reported as median (IQR).

Table 4
MRI characteristics by gender for CRT Subgroup

Continuous variables are reported as mean $\pm$ standard deviation and categorical variables are reported as N (% of population).

CRT Cohort	Women (N=18)	Men (N=46)	P-value
Scar Size (% LV) *	0 (0–0)	13.0 (4.0–24.0)	<0.01
Scar Core Size (% LV) *	0 (0–0)	9.0 (2.3–17.0)	<0.01
Scar Gray Size (% LV) *	0 (0–0)	6.7 (1.1–13.4)	<0.01
Average Inferolateral Scar grade *	0.21 (0–0)	0.77 (0–1.25)	<0.01
Ischemic Etiology	N=3 (17%)	N=25 (54%)	
Scar Size *	28.1 (0–42.9)	22.8 (14.0–26.0)	0.60
Scar Core Size *	21.3 (0–27.8)	15.8 (9.8–18.8)	0.82
Scar Gray Size *	13.5 (0–30.3)	10.0 (7.2–13.6)	0.71
Coronary infarction pattern			0.28
No Scar	1 (33%)	1 (4%)	0.26
LAD	2 (67%)	19 (76%)	0.74
RCA	0 (0%)	8 (32%)	0.26
LCX	0 (0%)	4 (16%)	0.47
Non-ischemic Etiology	N=15 (83%)	N=21 (46%)	
Scar Size *	0 (0–0)	3.0 (0–8.0)	<0.01
Scar Core Size *	0 (0–0)	2.2 (0–4.8)	<0.01
Scar Gray Size *	0 (0–0)	1.0 (0–4.2)	<0.01
NICM Pattern			0.08
No Scar	12 (80%)	6 (29%)	<0.01
Mid-Wall	0 (0%)	1 (5%)	0.41
Epicardial	0 (0%)	2 (10%)	0.23
Endocardial	0 (0%)	1 (5%)	0.41
Transmural	1 (7%)	3 (14%)	0.49
RV Insertion	2 (13%)	8 (38%)	0.11

Variables following non-parametric distributions (*) are reported as median (IQR).