Assessment of Implantable Cardioverter-Defibrillator Used in Heart Failure with Reduced Ejection Fraction as Primary Prevention in an Underserved Population

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INTRODUCTION

Implantable cardioverter-defibrillator (ICD) implantation has been one of the milestones in the treatment of heart failure providing a significant survival benefit.[1,2] Current guidelines[3,4] recommend that patients who have a sustained low left ventricular ejection fraction (LVEF) of 35% or less should be evaluated for ICD for primary prophylaxis (P-ICD). Our study aimed to investigate the use of P-ICD and associated outcomes in Jacobi Medical Center, a municipal New York City public teaching hospital serving an inner-city patient population located in Bronx, NY.

METHODS

Our study was a retrospective cohort study of patients with at least one admission with the diagnosis of congestive heart failure (*International Classification of Diseases*, Ninth Revision, Clinical Modification (ICD-9-CM) code 428.0) between July 1, 2012, and June 30, 2014, and followed patients through until October 31, 2015. The study was considered exempt from the Institutional Review Board of Albert Einstein College of Medicine. We used 2010 median household income by dwelling zip code from the United States Census Bureau[5] as a surrogate for socioeconomic status. Information regarding inpatient mortality was retrieved from electronic medical records.

RESULTS

Medical records of 2735 consecutive adult heart failure patients from 2012 to 2014 were reviewed; among them, 642 had LVEF ≤35% on transthoracic echocardiogram (TTE). The following groups were excluded from analysis: 88 had prior ICD implantation; 130 were followed by physicians outside our facility or had no follow-up outpatient visit; 45 died during the index admission; and 2 received ICD as secondary prevention (see Fig. 1).

The final cohort consisted of 377 patients (mean age 64 ± 15 years, female 34%) of which 106 had persistently low LVEF. Table 1 shows the baseline demographic characteristics of the study population. The majority of patients were Black (42%) or Hispanic (22%), and 80% had dwelling zip codes associated with median household income ≤ $50,000.

ICDs were implanted in 27 (25%) of these 106 patients, and only 19 received P-ICD within 1 year of repeat TTE showing LVEF ≤35%. The median time between repeat TTE and ICD placement was 3 months (interquartile range 1–19 months). For patients who had repeat TTEs, 47% (108 out of 231 patients) eventually had improvement of their EFs to above 35%. Among the 79 patients who had persistently low LVEF but did not receive ICD, 23 (29%) refused, 22 (28%) were lost to follow-up, 10 (13%) were non-compliant to medication/appointment and thus not able to achieve guideline-directed medical therapy for heart failure, 4 (5%) were not referred to cardiologists, 10 (13%) were still under evaluation, 1 (1%) was not referred by cardiologists to electrophysiologists, 2 (2%) had a cardiac arrest and died in the hospital during the evaluation period for an ICD, 7 (9%) died from other causes (heart failure, 4; stroke, 1; HIV, 1; diarrhea and altered mental status, 1).

We were able to collect the following reasons for refusal of ICDs from retrospective review of medical records: relatively well-preserved exercise tolerance and disbelief in the possibility of sudden cardiac death in 5 patients, anxiety toward invasive procedures in 4, fear of device malfunction in 1, religious beliefs in 1 patient, hesitancy and no specific reason mentioned in 12 patients.

DISCUSSION

To our knowledge, our study is the first investigation on the use of P-ICD implantation in an underserved patient population. In our study, underutilization of ICDs and a significant delay in ICD placement were observed and could potentially lead to lethal outcomes. In this

Table 1 Demographics

Characteristics	Overall	ICD candidate			ICD implantation among ICD candidates		
		No	Yes	*p* value	No	Yes	*p* value
	(*n* = 377)	(*n* = 271)	(*n* = 106)		(*n* = 79)	(*n* = 27)	
Age, mean(SD), year	64 (15)	64 (15)	62 (14)	0.25	62 (15)	63 (11)	0.98
Age groups, year				0.04			0.10
< 55	113 (30)	80 (30)	33 (31)	0.76	28 (35)	5 (19)	0.15
55–64	94 (25)	72 (27)	22 (21)	0.24	13 (16)	9 (33)	0.10
65–74	78 (21)	47 (17)	31 (29)	0.01	21 (27)	10 (37)	0.33
≥ 75	92 (24)	72 (27)	20 (19)	0.12	17 (22)	3 (11)	0.27
Female	129 (34)	96 (35)	33 (31)	0.43	23 (29)	10 (37)	0.48
Race				< 0.01			0.12
Black	158 (42)	108 (40)	50 (47)	0.20	39 (49)	11(41)	0.44
Hispanic	82 (22)	51 (19)	31 (29)	0.03	19 (24)	12 (44)	0.04
White	48 (13)	41 (15)	7 (7)	0.03	7 (9)	0 (0)	0.19
Asian	16 (4)	8 (3)	8 (8)	0.08	5 (6)	3 (11)	0.42
Other	73 (19)	63 (23)	10 (9)	< 0.01	9 (11)	1 (4)	0.45
Median income at dwelling zip code, in US dollars				< 0.01			0.17
< 35,000	125 (33)	78 (29)	47 (44)	< 0.01	36 (46)	11 (41)	0.66
35,000–50,000	179 (47)	142 (52)	37 (35)	< 0.01	24 (30)	13 (48)	0.09
> 50,000	73 (19)	51 (19)	22 (21)	0.67	19 (24)	3 (11)	0.18

ICD, implantable cardioverter-defibrillator; SD, standard deviation
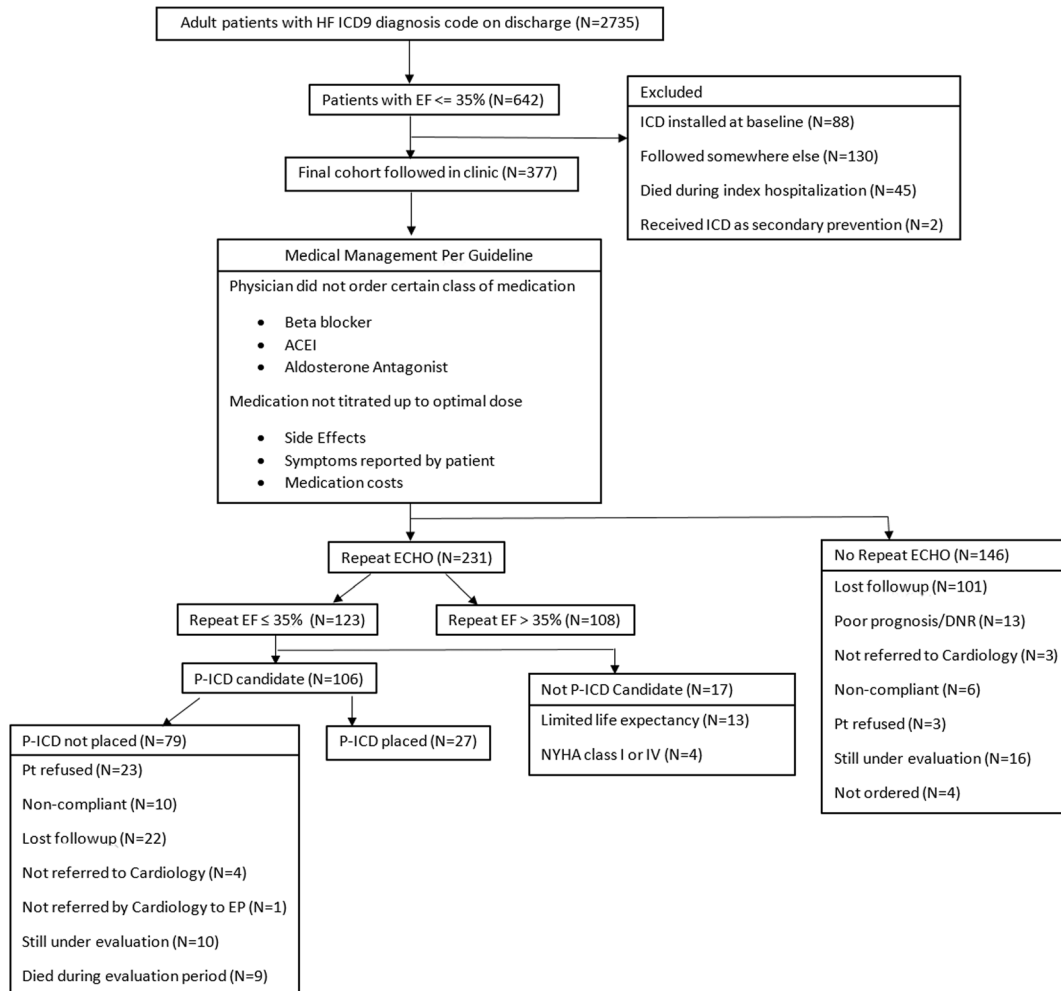

Figure 1 Patient selection flowchart. The *arrows* denote the level in which various factors led to the exclusion of patients. HF, heart failure; ICD9, *International Classification of Diseases*, Ninth Revision; ICD, implantable cardioverter-defibrillator; EF, ejection fraction; ACEI, angiotensin-converting-enzyme inhibitor; ECHO, echocardiogram; P-ICD, ICD for primary prophylaxis; NYHA, New York Heart Association.

population, there were significant barriers to having ICD placement, such as patient compliance, loss to follow-up, and patient refusal. Future studies should investigate methods to improve ICD implantation rate and reduce the delay. Given that nearly all patients eligible for ICD placement were given referrals to cardiologists, future research should focus on overcoming the barriers in specialty clinics and the facilitation of such consultations in primary care clinics.

Our study has its limitations: it was a single-center study conducted in an underserved patient population in an inner-city public municipal teaching hospital, and thus the results may not be generalizable to other settings.

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Compliance with Ethical Standards:

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