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ORIGINAL ARTICLE

Characteristics and in-hospital outcomes of hospitalisations with heart failure with reduced or preserved ejection fraction undergoing percutaneous coronary intervention

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Abstract

Background Studies comparing characteristics and in-hospital outcomes for heart failure with reduced ejection fraction (HFrEF) and heart failure with preserved ejection fraction (HFpEF) for hospitalisations undergoing percutaneous coronary intervention (PCI) for ST-segment elevated myocardial infarction (STEMI) remain limited.

Aim This sought to investigate characteristics and in-hospital outcomes for HFpEF and HFpEF hospitalisations undergoing STEMI-PCI.

Methods The National inpatient sample database from years 2012 to 2014 was queried and appropriate *International Classification of Disease, Ninth Revision, Clinical Modification* codes were utilised to identify study cohorts. A total of 400,590 hospitalisations underwent STEMI-PCI, of which, 31,180 presented with acute heart failure (89.3% with acute HFrEF and 10.7% with acute HFpEF). The HFpEF cohort was older (65.6 vs. 69.9 years), consisted of more females (35% vs. 48.7%), and presented with significantly higher comorbidities as demonstrated by higher Charlson's Comorbidity Index ≥ 3 (59.6 vs. 68%) ($P < 0.001$ for all). However, lower in-hospital mortality (9.2% vs. 8.0%, $P = 0.04$) was observed with HFpEF hospitalisations, which accompanied by lower mechanical circulatory support (MCS) device (20.3 vs. 12.3%, $P < 0.001$) use after propensity score matching. These translated to lower median hospitalisation cost ($28,116 vs. $27,823, $P < 0.001$) with HFpEF without significant change in median length of hospitalisation stay (6 vs. 6 days, $P = 0.08$).

Conclusions This study highlights the distinct risk profile for hospitalisations with HFpEF undergoing STEMI-PCI. HFpEF hospitalisations are associated with the lesser need for MCS, lower in-hospital mortality, and ultimately lower hospitalisation cost compared to HFrEF.

Keywords Heart failure with preserved ejection fraction · Heart failure with reduced ejection fraction · In-hospital outcomes · Percutaneous coronary intervention · ST-segment elevated myocardial infarction

Introduction

Heart failure with preserved ejection fraction (HFpEF) accounts for ~ 50% of overall HF hospitalisations and presents with clinical signs of heart failure (HF), an ejection fraction (EF) above 50% with diastolic abnormalities on the echocardiogram [1–4]. The prevalence of HFpEF is increasing possibly due to increased life expectancy, increased comorbidities, increased overall HF patients, increased awareness of diastolic dysfunction amongst physician, or from clinical recognition of the disease [5–7]. Few studies suggested better prognosis with HFpEF compared to heart failure with reduced ejection fraction (HFrEF), and others have suggested no difference between short-term and long-term outcomes [1, 2, 4, 8]. However, the state of venous congestion is thought to be the

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same in HFpEF and HFrEF with equal right ventricular and kidney dysfunction [9]. Recent advancements in the HF treatment have demonstrated improved outcomes for HF hospitalisations in the USA in a recent study [10]. HF is a significant predictor of adverse outcomes in patients undergoing Percutaneous Coronary Intervention (PCI) [11]. Additionally, Mamas et al. demonstrated patients with depressed EF undergoing PCI for ST-segment elevated myocardial infarction (STEMI) to have worse outcomes [12]. As the problem continues to rise in the USA, a national level analysis of characteristics and in-hospital outcomes of hospitalisations with acute HFpEF undergoing STEMI-PCI commands additional attention to develop strategies to reduce the healthcare burden. This study sought to investigate the prevalence, characteristics, and in-hospital outcomes of the HF hospitalisations with preserved or reduced EF who underwent STEMI-PCI.

Methods

The data was obtained using the National Inpatient Sample (NIS) database, which was developed for the Healthcare Cost and Utilization Project (HCUP). HCUP was developed through a Federal-State-Industry partnership sponsored by the Agency for Healthcare Research and Quality (AHRQ) [13]. NIS is the largest, all-payer, inpatient database in the USA and includes data from 48 states. NIS contains clinical and resource utilisation information from ~8 million discharges annually while protecting the privacy of individual patients, physicians, and hospitals. The NIS database after 2012 was constructed using a systemic sampling of 20% of discharges from all US hospitals and was stratified by the following variables: census division, ownership status, location (urban vs. rural), teaching status, bed size, admission month, and patient diagnosis-related group. Moreover, the discharge weights in the universe were redefined using the state inpatient database. This study was conducted following all the required practices recommended by AHRQ [14] (Supplementary Table 1). The NIS has been used to analyse trends in healthcare utilisation, hospitalisation frequency, quality, cost, and other outcomes [15, 16]. This study did not require Institutional Review Board approval as the database was obtained from NIS.

This is a retrospective observational cohort study using the NIS database from 2012 to 2014. The NIS database was restructured from 2012; therefore, this study cohort included data from 2012 to 2014 (Fig. 1). All hospitalisations (N = 550,825) with a diagnosis of STEMI were identified using validated *International Classification of Diseases, 9th Revision, Clinical Modification,* diagnosis codes 410.0-410.8 except 410.7 [17]. Then, hospitalisations who underwent PCI during their admission were identified with previously validated ICD-9-CM procedure codes 00.66, 36.06, 36.07 [18]. Next, hospitalisations < 18 years of age (N = 20) were excluded. Finally, to identify HFrEF, ICD 9 CM diagnostic codes 428.21 and 428.23 (acute systolic heart failure) were included with the exclusion of ICD 9 CM diagnostic codes for systolic and diastolic combined HF codes. Similarly, to identify HFpEF, ICD 9 CM diagnostic codes 428.31 and 428.33 (acute diastolic heart failure) were included with the exclusion of ICD 9 CM diagnostic codes for combined systolic and diastolic HF codes. Combined systolic and diastolic HF codes

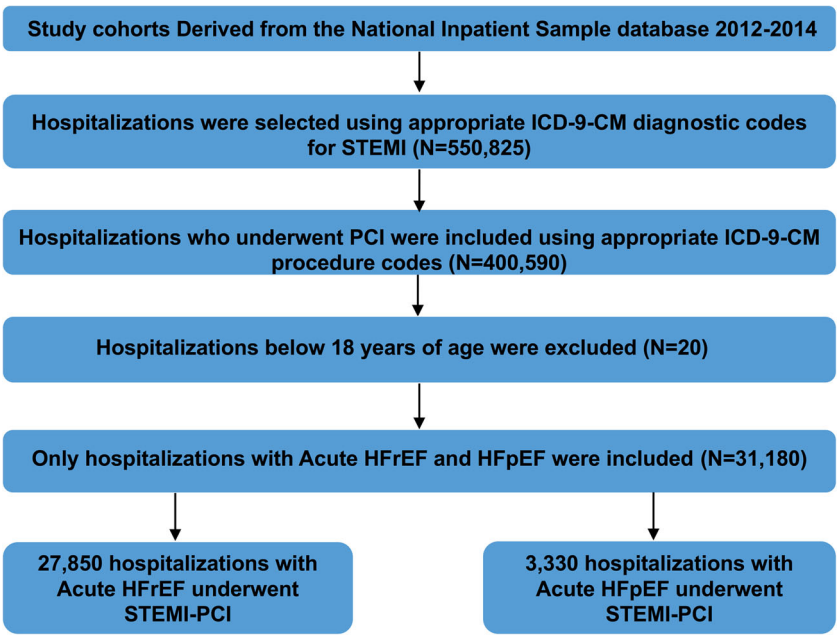

Fig. 1 Flowchart for selection of study cohorts with HFrEF and HFpEF undergoing STEMI-PCI. Abbreviations: ICD-9-CM, international classification of disease, Ninth revision, clinical modification; HFpEF, heart failure with preserved ejection fraction; HFrEF, heart failure with reduced ejection fraction; STEMI, ST-segment elevated myocardial infarction; PCI, percutaneous coronary intervention

were excluded to avoid selection bias. In his study, Goyal et al. used this method to select hospitalisations for HFrEF and HFpEF when using the NIS database [19]. This diagnosis of HFrEF and HFpEF was present on admission and possibly prior to PCI.

The patient level variables were studied directly from the NIS database and included the following: age, sex, race, primary payer, hospital location, and Elixhauser comorbidities. Other comorbidities included in this analysis were identified using appropriate ICD-9-CM codes (Supplementary Table 2). The severity of comorbid condition was measured using Charlson's Comorbidity index, which ranges between 0 and 33, with a higher score representing a greater severity of comorbid conditions [20] (Supplementary Table 3). The primary outcome of this study was in-hospital mortality and the secondary outcome was the requirement of MCS use (IABP, pLVAD, ECMO). Additionally, length of stay and median cost of hospitalisations were included, which reflects resource utilisation.

Continuous variables were reported as the mean ± standard deviation (SD) and were compared using the Student's *t* test. Categorical variables were reported as a frequency (with percentages) and compared using Chi-square tests. A trend test was performed using Jonckheere-Terpstra Test. The statistical analysis was performed using SAS 9.4 (SAS Institute Inc., Cary, NC). Statistical tests are two-sided and P values < 0.05 were considered statistically significant. To reduce the selection bias and to account for potential confounding factors, propensity score matching was performed. First, a multivariate logistic regression in a step-wise fashion was used to generate propensity scores. Then, a match was performed using the one-to-one scheme within the nearest neighbour matching method without replacement. This analysis included discharge weights along with age, sex, race, Elixhauser comorbidities, and other comorbidities. An absolute standardised difference was less than 10% for each variable analysed in the analysis after matching. This suggests minimal differences between the groups and is considered acceptable [21]. Finally, the primary and secondary outcomes were compared using McNemar test or paired *t* test [16]. The NIS database provides the total charges associated with each hospital stay and was converted to hospitalisation cost estimates using the group average all-payer in-hospital cost and charge information from the detailed reports by hospitals to the Centers for Medicare and Medicaid Services. The final cost was calculated by multiplying total cost with the cost-to-charge ratio.

Results

A total of 550,825 hospitalisations with a diagnosis of STEMI were identified, of which 400,590 underwent PCI. Later, 20 hospitalisations were excluded as being < 18 years of age. Finally, 31,180 hospitalisations were extracted having acute heart failure, and among them, 27,850 (89.3%) hospitalisations presented with acute HFrEF and 3330 (10.7%) with acute HFpEF. The trend of HFrEF hospitalisations increased from 8655 in 2012 to 10,075 in 2014; however, it remained stable for HFpEF hospitalisations, which was 1060 in 2012 and 1135 in 2014 ($P_{trend} = 0.05$) (Supplementary Fig. 1). Demographics and baseline characteristics are shown in Table 1. HFpEF hospitalisations were older (mean age 65.6 vs. 69.9 years, $P < 0.001$), and consisted of fewer males (65% vs. 51%, $P = < 0.001$) with equal gender contribution. More than one third of hospitalisations in both groups were Caucasians (72.8% vs. 76.9%, $P < 0.001$) with slightly higher Caucasians in the HFpEF cohort. Most common primary payer was Medicare/Medicaid (60.4% in HFpEF and 72.6% in HFrEF). Almost 95% of hospitalisations in both groups were treated in urban hospitals. The most common Elixhauser comorbidities in both groups included hypertension, diabetes mellitus, chronic pulmonary disease, and chronic renal failure. Additionally, hypertension, chronic pulmonary disease, liver disease, chronic renal failure, prior MI, prior PCI, prior CABG, and dyslipidemia were significantly higher in the HFpEF group, whereas smoking, cardiogenic shock, and family history of CAD were higher in the HFrEF cohort undergoing STEMI-PCI (Table 1). Moreover, CCI ≥ 3 was significantly higher in HFpEF (59.6% vs. 68%, $P < 0.001$) hospitalisations, thus indicating a higher pre-procedure risk profile.

A total of 3325 hospitalisations were included in each group after propensity score matching (Table 2). An absolute standardised difference between all matched variables was less than 10% (Fig. 2). The primary outcome of this study, in-hospital mortality, was significantly higher in the HFrEF cohort (9.2% vs. 8.0%, $P = 0.04$) (Table 3). The trend of in-hospital mortality was lower with HFpEF in 2012; however, it increased from 5.19% in 2012 to 9.25% in 2014 ($P_{trend} < 0.001$) In contrast, the trend of in-hospital mortality remained stable for HFrEF (Supplementary Fig. 2). Overall utilisation of MCS was significantly higher in the HFrEF hospitalisations (20.3% vs. 12.3%, $P < 0.001$) after propensity score matching. Furthermore, this utilisation of MCS in HFrEF hospitalisations increased significantly during the study period (2395 in 2012 to 2500 in 2014, $P_{trend} < 0.001$), whereas the utilisation of MCS in HFpEF hospitalisations remained stable (110 in 2012 to 140 in 2014, $P_{trend} = 0.18$) (Supplementary Fig. 3). IABP use was higher with HFrEF hospitalisations (18.7% vs. 12.0%, $P < 0.001$). Newer MCS, pLVAD use was also higher in the HFrEF group (2.3% vs. 0.8%, $P < 0.001$). The overall median length of hospitalisation stay was comparable between the group (6 vs. 6 days, $P = 0.08$) (Supplementary Fig. 4). However, overall median cost of hospitalisations was slightly higher with HFrEF hospitalisations ($28,116 vs. $27,823, $P < 0.001$). Median hospitalisation cost increased significantly for HFpEF ($25,212 in 2012 to $29,619 in 2014, $P_{trend} < 0.001$), whereas it remained stable for HFrEF ($27,101 in 2012 to $27,560 in 2014, $P_{trend} = 0.11$) (Supplementary Fig. 5).

Table 1 Demographics and baseline characteristics of patients with acute heart failure with reduced/preserved ejection fraction undergoing percutaneous coronary intervention for ST-segment elevated myocardial infarction (unmatched hospitalisations)

Variable names	HFrEF ($N = 27,850$)	HFpEF ($N = 3330$)	P value
Age, years	65.6 (13.4)	69.9 (13.1)	< 0.001
Male	18,090 (65.0)	1710 (51.3)	< 0.001
Race			
Caucasians[a]	20,270 (72.8)	2560 (76.9)	< 0.001
African-Americans	1890 (6.8)	205 (6.2)	
Other races	5685 (20.4)	565 (17.0)	
Primary payer			
Medicare/Medicaid	16,825 (60.4)	2415 (72.6)	< 0.001
Private insurance	7750 (27.8)	620 (18.7)	
Other	3270 (11.8)	290 (8.7)	
Median household income (percentile)			
0–25th	7720 (28.5)	840 (25.7)	< 0.001
26–50th	7850 (29.0)	920 (28.1)	
51–75th	6505 (24.0)	850 (26.0)	
76–100th	5005 (18.5)	665 (20.3)	
Hospital location			
Rural	1800 (6.5)	165 (5.0)	< 0.001
Urban, non-teaching	8330 (29.9)	1160 (34.8)	
Urban, teaching	17,720 (63.6)	2005 (60.2)	
Elixhauser comorbidities			
Hypertension	17,565 (63.1)	2395 (71.9)	< 0.001
Diabetes	8220 (29.5)	1035 (31.1)	0.061
Congestive heart failure	1315 (4.7)	175 (5.3)	0.17
Chronic pulmonary disease	5445 (19.6)	840 (25.2)	< 0.001
Coagulation disorder	2255 (8.1)	260 (7.8)	0.56
Liver disease	405 (1.5)	85 (2.6)	< 0.001
Chronic renal failure	4490 (16.1)	810 (24.3)	< 0.001
Other comorbidities			
Smoking	11,505 (41.3)	1250 (37.5)	< 0.001
Prior myocardial infarction	2470 (8.9)	365 (11.0)	< 0.001
Prior percutaneous coronary intervention	3190 (11.5)	425 (12.8)	0.026
Prior coronary artery bypass grafting	700 (2.5)	165 (5.0)	< 0.001
Family history of coronary artery disease	2425 (8.7)	230 (6.9)	< 0.001
Dyslipidemia	16,485 (59.2)	2060 (61.9)	0.003
Cardiogenic shock	8955 (32.1)	770 (23.1)	< 0.001
Charlson's comorbidity index			
≤ 2	11,260 (40.4)	1065 (32.0)	< 0.001
≥ 3	16,590 (59.6)	2265 (68.0)	

Frequencies are in numbers with percentages in the parenthesis or mean with standard deviation

HFpEF heart failure with preserved ejection fraction, *HFrEF* heart failure with reduced ejection fraction

[a] Missing values—5

Discussion

This analysis has highlighted important baseline characteristics and in-hospital outcomes of hospitalisations undergoing STEMI-PCI associated with acute HFpEF and acute HFrEF from national cohorts of more than 30,000 hospitalisations. Overall, HFpEF hospitalisations included only one tenth the number of HFrEF hospitalisations undergoing STEMI-PCI. Medicare/Medicaid was the primary payment method in two thirds of all hospitalisations. Hospitalisations for HFpEF were older, had a greater frequency of females, and presented with significantly higher comorbidities including hypertension, COPD, liver disease, and chronic renal disease. Taken together, HFpEF had a higher burden of comorbidities as demonstrated by higher CCI. Overall, in-hospital mortality in both groups was much higher than those hospitalisations without

Table 2 Demographics and baseline characteristics of patients with acute heart failure with reduced/preserved ejection fraction undergoing percutaneous coronary intervention for ST-segment elevated myocardial infarction (propensity score-matched hospitalisations)

Variable names	HFrEF ($N = 3325$)	HFpEF ($N = 3325$)	Absolute standardised difference in %
Age, years	70 (12.3)	70 (13.1)	3.9
Male	1730 (52.0)	1710 (51.4)	1.2
Race			
Caucasians	2410 (72.8)	2555 (76.8)	9.4
African-Americans	250 (7.5)	205 (6.2)	
Other races	655 (19.7)	565 (17.0)	
Elixhauser comorbidities			
Hypertension	2420 (72.8)	2390 (71.9)	2.0
Diabetes	1045 (31.4)	1030 (31.0)	1.0
Congestive heart failure	140 (4.2)	175 (5.3)	4.9
Chronic pulmonary disease	770 (23.2)	835 (25.1)	4.5
Coagulation disorder	235 (7.1)	260 (7.8)	2.9
Liver disease	65 (2.0)	85 (2.6)	4.0
Chronic renal failure	855 (25.7)	805 (24.2)	3.5
Other comorbidities			
Smoking	1260 (37.9)	1250 (37.6)	0.6
Prior myocardial infarction	365 (11.0)	365 (11.0)	0
Prior percutaneous coronary intervention	440 (13.2)	425 (12.8)	1.3
Prior coronary artery bypass grafting	145 (4.4)	160 (4.8)	2.1
Family history of coronary artery disease	265 (8.0)	230 (6.9)	8.5
Dyslipidemia	2045 (61.5)	2055 (61.8)	0.6
Cardiogenic shock	770 (23.2)	770 (23.2)	0

Frequencies are in numbers with percentages in the parenthesis or mean with standard deviation

HFpEF heart failure with preserved ejection fraction, *HFrEF* heart failure with reduced ejection fraction

acute HF. However, in-hospital mortality was significantly lower in hospitalisations with HFpEF. This observation was associated with lower MCS use and a lower cost of hospitalisation. However, the median cost of hospitalisations for HFpEF increased significantly during this study period.

A significantly reduced frequency of HFpEF hospitalisations undergoing STEMI-PCI was observed, suggesting that MI may constitute a major cause of HFrEF; however [1], several prior studies have demonstrated equal frequency for HFrEF and HFpEF in HF hospitalisations [1, 2, 19]. The reason for this

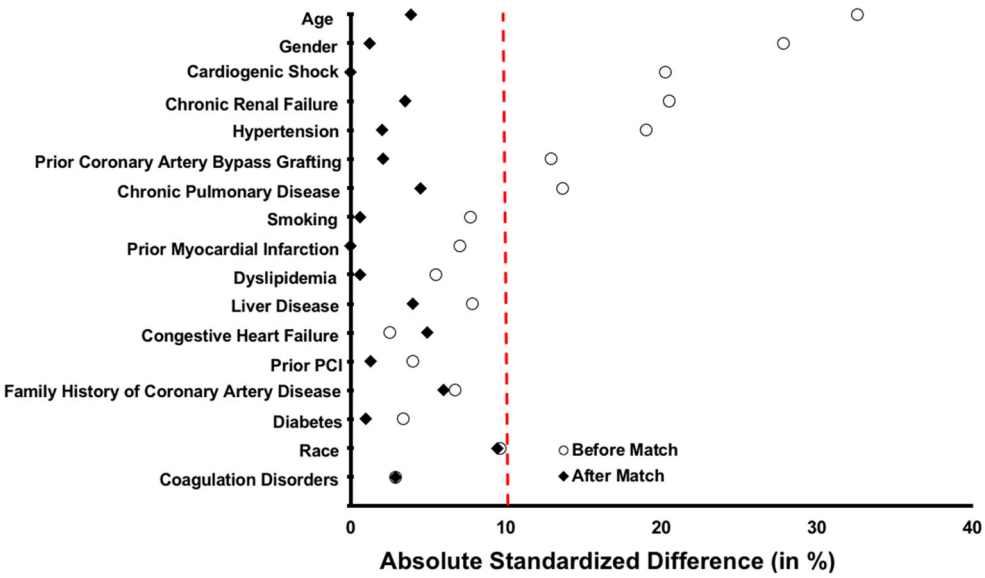

Fig. 2 Absolute standardised differences in % before and after propensity score matching comparing covariate values for hospitalisations with HFrEF and HFpEF. Abbreviations: HFpEF, heart failure with preserved ejection fraction; HFrEF, heart failure with reduced ejection fraction; PCI, percutaneous coronary intervention

Table 3 In-hospital outcomes for patients with acute heart failure with reduced/preserved ejection fraction undergoing percutaneous coronary intervention for ST-segment elevated myocardial infarction (propensity score-matched hospitalisations)

Variable names	HFrEF ($N = 3325$)	HFpEF ($N = 3325$)	Odds ratio (95% CI)	P value
In-hospital mortality	310 (9.2)	265 (8.0)	1.19 (1.01–1.41)	0.04
MCS use	675 (20.3)	410 (12.3)	1.81 (1.58–2.07)	< 0.001
IABP use	620 (18.7)	400 (12.0)	1.68 (1.46–1.92)	< 0.001
pLVAD use	75 (2.3)	25 (0.8)	3.05 (1.93–4.80)	< 0.001
ECMO use	5 (0.2)	10 (0.3)	0.50 (0.17–1.46)	0.20
Length of stay, median (IQR)	6 (4–9)	6 (3–10)	N/A	0.08
Cost, median (IQR)	$28,116 ($19,766–$45,030)	$27,823 ($19,827–$41,039)	N/A	< 0.001

Frequencies are in numbers with percentages in the parenthesis

CI confidence interval, *ECMO* extracorporeal membrane oxygenation, *HFpEF* heart failure with preserved ejection fraction, *HFrEF* heart failure with reduced ejection fraction, *IABP* intra-aortic balloon pump, *IQR* interquartile range, *MCS* Mechanical Circulatory Support, *pLVAD* percutaneous left ventricular assist device

reduced frequency is unknown; however, previous myocardial infarction with necrosis or stunning may contribute to it. Another reason for higher HFrEF includes prior history of ischemic cardiomyopathy; information on which was not available to us. Although this demonstrates an increasing prevalence of HFrEF and non-significantly increasing prevalence of HFpEF, it did not account for the diagnostic behaviour of the treating physician, which may have affected it. This study revealed HFpEF hospitalisations were associated with higher comorbidity burden, older age, and a greater frequency of females, which is consistent with previously published studies [1, 2, 19]. Collectively, this is demonstrated as higher CCI in the HFpEF cohort. Higher hypertension and chronic pulmonary disease observed with HFpEF hospitalisations are concurrent with previous studies as well [1, 7, 8]. It should also be noted that substantial heterogeneity in baseline risk was observed in previous studies, which is consistent with these study cohorts admitted for STEMI-PCI with acute HFpEF or HFrEF.

This study demonstrated higher overall mortality and longer length of stay irrespective of the type of HF undergoing STEMI-PCI. Congestive HF is an independent predictor of higher mortality in hospitalisations for PCI, which may have contributed to the higher mortality in both groups [22]. Taniguchi et al. demonstrated higher short-term all-cause mortality (14.8%) when STEMI-PCI admission is associated with HF [22]. Cheng et al. demonstrated that HFpEF is associated with lower mortality with higher all-cause readmission rates and comparable 1-year mortality in HFrEF and HFpEF [8]. Furthermore, in-hospital mortality was significantly higher with HFrEF as compared to HFpEF in this study. These results for those undergoing STEMI-PCI are concurrent with previous studies including a meta-analysis of clinical trials for only HFrEF and HFpEF hospitalisations without STEMI-PCI [23]. Higher utilisation of MCS with HFrEF hospitalisations might help explain this observation. Higher use of MCS may result from previous myocardial infarction with necrosis and/or stunning. There is a well-conceived association between MCS use and higher risk scores; however, this study lacks risk scores (SYNTAX-2). This is because MCS is used when there is portentous baseline risk profile [24, 25], and MCS use has also been associated with increased in-hospital mortality. This increasing use of MCS may have contributed to the higher median cost of hospitalisations with HFrEF in this study. Furthermore, trends of mortality were stable for HFrEF and increased for HFpEF undergoing STEMI-PCI, which is worrisome and may warrant a more effective treatment for HFpEF and HFrEF undergoing STEMI-PCI. Finally, Caucasians are associated with higher in-hospital mortality and this study has higher Caucasians in the HFpEF group which remained higher (absolute standardised difference, 9.4%) even after propensity score matching [26, 27]. Appropriate and timely device selection, such as newer MCS, which are associated with lower mortality risk, might help in reducing added mortality [25]. Additionally, completeness of revascularisations is shown to be associated with lower mortality [28].

This study has several important messages to convey to both interventionalists and HF specialists. We hope to inform cardiologists that both HFpEF and HFrEF are associated with significantly higher in-hospital mortality when undergoing STEMI-PCI. There has been a significant improvement in technology, which can help prevent this additional mortality associated with HFpEF and HFrEF. IABP use was significantly higher as compared to pLVAD use in this study. Additionally, the use of newer MCS, such as Impella, has increased over the past several years, which can further reduce the mortality [24]. Additionally, the relatively milder presentations of HFpEF New York Heart Association (NYHA) grading of HF was not available for this study. The diagnosis of HFpEF may have been associated with milder NYHA heart failure grading [7]. Physicians should recognise this problem in addition to the lack of appropriate treatment for HFpEF as

compared to many pharmacological and device-based treatments available for HFrEF [7, 29]. Finally, Medicare and Medicaid beneficiaries seeking STEMI-PCI may face stringent financial burden due to upcoming policy changes as Medicare/Medicaid was the primary payment method for more than two thirds hospitalisations in this study [30, 31]. Taken together, appropriate procedure and device selection, advance medical therapy in the early stage of HF [32], and pre-procedural risk stratification can help prevent additional mortality observed in this study.

Several limitations associated with any retrospective study are present in this study as well. Firstly, this study may not have represented the accurate frequency for HFrEF and HFpEF undergoing STEMI-PCI as the analysis excluded those hospitalisations with combined systolic and diastolic HF. Diagnosis of HFpEF can be challenging at times as traditional biomarkers are not significantly associated with HFpEF as much as HFrEF in addition to the variation of reporting of this clinical vignette [1, 33]. Also, this analysis lacks information on EF values measured with an echocardiogram, limited information on PCI characteristics and door-to-balloon timings. However, previously validated codes were used to identify hospitalisations for HFrEF and HFpEF [19]. Furthermore, this analysis lacks the history of atrial fibrillation, which is thought be a precipitant of acute decompensation in HFpEF [7]. This study may have included patients who developed HF post-PCI as they were not differentiable in the dataset. HFrEF hospitalisations included in this study may have higher unmeasured baseline risk, which is reflected by higher MCS use. Propensity score matching was performed to avoid possible selection bias; however, residual cofounders could not be excluded. Finally, the NIS database comprised of in-hospital stays only; therefore, outpatient procedures, long-term follow-up, and readmission information were absent. However, the use of the NIS database enabled the analysis of a much greater number of hospitalisations for HFpEF and HFrEF undergoing STEMI-PCI. Also, as there were no exclusion criteria, this study represents "real-world" HF hospitalisations undergoing STEMI-PCI.

Conclusions

HFpEF and HFrEF hospitalisations undergoing STEMI-PCI represents a substantial burden on the US healthcare system given the high associated in-hospital mortality. This study demonstrated a distinct risk profile with higher comorbidities, more females, and older age for HFpEF hospitalisations. Hospitalisations with HFrEF undergoing STEMI-PCI were associated with higher in-hospital mortality, translating with higher median hospitalisation cost compared to HFpEF. This study highlights the need for new treatment strategies and focused research on HFrEF and HFpEF hospitalisations undergoing STEMI-PCI.

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Compliance with ethical standards

Conflicts of interest The authors report no relationships that could be construed as a conflict of interest.

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