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Original Article

Management of Acute Decompensated Heart Failure in the Cardiac Intensive Care Unit: The Importance of Co-management With a Heart Failure Specialist

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ABSTRACT

Background: Heart failure (HF) is a common reason for admission to the cardiac intensive care unit. We sought to identify the role of an HF consultation service in improving the management of this patient population.

Methods: We identified all adult patients admitted to the cardiac intensive care unit (2014-2015) at the University Health Network with a diagnosis of acute decompensated HF ± cardiogenic shock (CS). Clinical characteristics and course were recorded. We calculated a propensity score–adjusted association between HF consultation and in-hospital mortality.

Results: A total of 285 unique patients were identified in our cohort. Of these, 82 (28.7%) died. A total of 150 patients (52.6%) were co-managed by an HF service, and 135 patients (47.3%) were not.

RÉSUMÉ

Contexte : L'insuffisance cardiaque (IC) est un motif fréquent d'admission à l'unité de soins intensifs de cardiologie. Cette étude visait à cerner le rôle d'un service de consultation spécialisé en IC dans l'amélioration de la prise en charge de la population de patients atteinte de cette affection.

Méthodologie : Un recensement de tous les patients adultes admis en 2014-2015 à l'unité de soins intensifs de cardiologie du Réseau universitaire de santé et ayant reçu un diagnostic d'IC aiguë décompensée avec ou sans choc cardiogénique a été effectué. Les caractéristiques cliniques et l'évolution de l'atteinte avaient été consignées pour ces patients. L'association, ajustée en fonction du score de propension, entre la consultation pour IC et la mortalité hospitalière a été calculée.

Heart failure (HF) affects more than 1 million Canadians each year, with approximately 600,000 newly diagnosed cases annually. Currently, 1 in 5 Canadians will have HF during their lifetime. It is estimated that it costs the Canadian healthcare system more than $2.8 billion dollars annually, with the highest economic burden seen in the last 6 months of life.[1] Economic analysis shows a marked increase in hospital costs during the final 2 years of life, especially in the last 6 months with longer days spent in hospital.[2] HF admissions account for the second highest number of days in hospital when compared with other chronic diseases and is projected to account for up to 80,000 admissions in Canada by 2025.[1,3]

Given the large number of patients admitted to the hospital with HF, they are often admitted to Internal Medicine or Cardiology services. Multiple studies have shown the benefit of general cardiologists' involvement in the management of these patients.[4-9] In one study, cardiology service discharge summaries were more likely to have details, which include reassessment of left ventricular ejection fraction (LVEF), inpatient study results (ie, laboratory work, imaging results), discharge weight and vital signs, and a discharge physical examination. Furthermore, multiple studies have shown that patients followed in a HF clinic at the time of hospital discharge had higher use of guideline-directed medical therapy (GDMT) and a reduction in hospitalizations and mortality.[4-8] Despite these benefits, a Canadian population-based study found that a cardiologist saw only 54.9% of patients with an index HF diagnosis in the subsequent 2.5 to 3.5 years.[9]

Despite the evidence that close cardiology follow-up improves clinical outcomes, there is currently no data examining the role of a dedicated HF specialist consultation alongside the cardiac intensive care unit (CICU) team. Most recently, there is new evidence that suggests a "team-based approach" in

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Patients who were managed by an HF team were younger (52.5 vs 68.0 years, $P < 0.0001$), were more likely to be admitted with CS (61.3 vs 41.5%, $P < 0.0009$), and had higher rates of vasoactive medications during their admission (69.3% vs 52.6%, $P < 0.005$). At discharge, there were higher rates of discharge to a HF clinic (52.0% vs 27.5%, $P < 0.0001$) and prescription of guideline-directed medical therapy. In-hospital mortality was lower in those co-managed by a HF team (16.7% vs 42.2%, $P < 0.0001$). HF consultation reduced the odds of readmission by 76% (odds ratio, 0.24; 95% confidence interval, 0.13-0.47).

Conclusions: Patients managed by a HF team were more likely to be in CS at admission, to survive to discharge from hospital, and to be initiated on guideline-directed medical therapy with HF follow-up.

Résultats : Au total, 285 patients uniques ont été recensés dans la cohorte. De ce nombre, 82 (28,7 %) patients sont décédés. Sur les 285 patients, 150 (52,6 %) avaient été pris en charge conjointement par un service spécialisé en IC, tandis que les 135 (47,3 %) autres ne l'avaient pas été. Les patients pris en charge par une équipe spécialisée en IC étaient plus jeunes (52,5 vs 68,0 ans, $p < 0,0001$), étaient plus susceptibles d'être en proie à un choc cardiogénique à l'admission (61,3 vs 41,5 %, $p < 0,0009$) et étaient plus nombreux à avoir reçu un agent vasoactif à l'admission (69,3 % vs 52,6 %, $p < 0,005$). Ils ont aussi été plus nombreux à être orientés vers une clinique spécialisée en IC à leur sortie de l'hôpital (52,0 % vs 27,5 %, $p < 0,0001$) et à se voir prescrire un traitement médical recommandé dans des lignes directrices. La mortalité hospitalière était plus faible chez les patients qui ont fait l'objet d'une prise en charge conjointe par une équipe spécialisée en IC (16,7 % vs 42,2 %, $p < 0,0001$). La consultation d'une équipe spécialisée en IC a en outre réduit le risque de réadmission de 76 % (rapport de cotes de 0,24; intervalle de confiance à 95 % : 0,13-0,47).

Conclusions : Les patients pris en charge par une équipe spécialisée en IC étaient plus susceptibles d'être en proie à un choc cardiogénique à l'admission, de survivre à leur sortie de l'hôpital, de se voir prescrire un traitement médical recommandé dans des lignes directrices et de faire l'objet d'un suivi dans une clinique spécialisée en IC.

patients with cardiogenic shock (CS) involving a shock team leads to increased 30-day survival rates.[10,11] In the present study, we aimed to compare patients admitted to the CICU with acute decompensated heart failure (ADHF) with or without CS who received a consultation with a dedicated HF team with patients who did not.

Methods

Study population

We retrospectively identified 329 consecutive adult patients from our CICU registry with a diagnosis of HF (with or without CS) who were admitted to the Peter Munk Cardiac Centre CICU, University Health Network (January 1, 2014, to December 31, 2015). The majority of the CICU attendings have expertise in interventional cardiology (n = 6), with 1 general cardiologist and 1 HF specialist. The HF specialist, once involved, would co-manage the patient with the CICU team (rounding daily) with continued involvement once discharged from the CICU. The University Health Network research ethics board review committee approved this study.

Patients in our population were admitted from an emergency department or our inpatient ward (medicine or cardiology services) or transferred from other hospitals for specialized care. The diagnosis of HF was made by the treating physician(s) and required documentation of their clinical presentation and physical examination. Findings included the presence of at least 1 symptom (dyspnea, orthopnea, abdominal bloating, or edema) and 1 sign (rales, peripheral edema, ascites, or pulmonary congestion on chest x-ray).[12] The diagnosis of CS was made if the patient had a systolic blood pressure of < 90 mmHg for ≥ 30 minutes or requirement for vasopressors or inotropes, evidence of end-organ hypoperfusion (urine output < 30 mL/h for 6 hours or lactate > 2), or hemodynamic criteria (from right heart catheterization, echocardiography, and clinical criteria of elevated jugular venous pressure, presence of S3 or rales).[13]

Patients were included in this study on the basis of HF diagnosis, which included preserved (defined as an LVEF $\geq$ 50%) or reduced LVEF (defined as an LVEF $<$ 50%).[14] Patients who received orthotopic heart transplant (OHT) or mechanical circulatory support (MCS) (ie, left ventricular assist device or extracorporeal membrane oxygenation), and those with established mixed shock were excluded (ie, confirmed septic shock). The former group was excluded because these modalities mandated a mandatory HF consultation. If a patient was admitted to the CICU on more than 1 occasion during a single admission to hospital, only the index admission was included in the analysis.

Clinical information including comorbid illnesses, admission medications, vitals, laboratory values, interventions received while in the CICU, discharge medications, and CICU and hospital length of stay (LOS) were extracted from the patient's electronic medical record. The presence of a consultation from a dedicated HF service and follow-up in a multidisciplinary clinic were recorded. Readmission rates (up to 90 days) were also tabulated.

Statistical analysis

Normal and nonparametric distributed continuous variables were presented as mean $\pm$ standard deviation. Categorical variables are shown as percentages. Student t test and Wilcoxon rank-sum test were used to compare normal and nonparametric continuous variables, and Fisher exact tests were used for categorical variables.

We calculated a propensity score for each patient by matching according to age, LVEF, hypertension, dyslipidemia, diabetes mellitus, cerebrovascular accident, peripheral vascular disease, heart rate, type of cardiomyopathy (ischemic vs nonischemic), admission for CS, and inotropic use and pulmonary artery catheterization at the time of admission. We

Table 1. Patient characteristics dichotomized to those receiving HF consultation vs those without subspecialty consultation

Characteristic	All patients (n = 285)	With HF consult (n = 150)	Without HF consult (n = 135)	*P* value
Age (y, mean ± SD)	59.9 ± 18.3	52.5 ± 16.3	68.0 ± 17.0	0.0001
Men, n (%)	196 (68.8)	102 (68)	94 (70.0)	0.8
LVEF at time of admission (mean ± SD)	31.3 ± 14.4	27.0 ± 12.4	35.7 ± 15.4	0.0001
LVEF ≥ 50% at time of admission (n, %)	55 (19.3)	15 (10)	40 (30)	0.0001
Comorbidities (n, %)				
Hypertension	127 (44.6)	57 (38)	70 (51.9)	0.023
Dyslipidemia	97 (34)	40 (26.7)	57 (42.2)	0.006
Diabetes mellitus	90 (31.6)	40 (26.7)	50 (37.0)	0.08
Previous myocardial infarction	86 (30.2)	35 (23.3)	51 (37.8)	0.001
Previous PCI	54 (18.8)	24 (16)	30 (22.2)	0.23
Previous CABG	43 (15.1)	18 (12)	25 (18.5)	0.14
Chronic kidney disease	78 (27.3)	36 (24)	42 (31.1)	0.19
Cerebrovascular accident	25 (8.7)	6 (4)	19 (14.1)	0.003
Peripheral vascular disease	24 (8.4)	7 (4.7)	17 (12.6)	0.02
Previous history of CHF	169 (59.3)	90 (60)	79 (58.5)	0.81
Previous history of VF/VT	26 (9.1)	20 (13.3)	6 (4.4)	0.01
Previous history of atrial fibrillation	120 (42)	54 (36)	66 (48.9)	0.03
Presence of permanent pacemaker	20 (6.9)	4 (2.7)	16 (11.9)	0.004
Presence of ICD	41 (44.4)	28 (18.7)	13 (9.6)	0.04
Presence of CRT-D	30 (10.4)	19 (12.7)	11 (8.1)	0.249
Chronic obstructive pulmonary disease	25 (8.7)	13 (8.7)	12 (8.9)	0.56
Current smoker	25 (8.7)	19 (12.7)	6 (4.4)	0.02
Previous smoker	52 (18.2)	28 (18.7)	24 (17.8)	0.88
Previous history of mental health	26 (9.1)	20 (13.3)	6 (4.4)	0.01
ACHD	11 (3.8)	5 (3.3)	6 (4.4)	0.76
Admission medications				
ASA	96 (33.7)	46 (30.7)	50 (37.0)	0.26
Thienoypridine	41 (14.4)	12 (8)	29 (21.5)	0.001
Beta-blocker	176 (61.7)	89 (59.3)	87 (64.4)	0.39
ACEi/ARB	111 (38.9)	62 (41.3)	49 (36.3)	0.40
ARNI	1 (0.4)	1 (0.7)	0 (0)	1.0
Aldosterone antagonist	85 (29.8)	55 (36.7)	30 (22.2)	0.009
CCB	22 (7.7)	9 (6)	13 (9.6)	0.30
Loop diuretic	186 (65)	89 (59.3)	97 (71.8)	0.03
Hydralazine	25 (8.8)	12 (8)	13 (9.6)	0.68
Nitrates	21 (7.4)	11 (7.3)	10 (7.4)	1.0
Digoxin	67 (23.5)	47 (31.3)	20 (14.8)	0.001
Statin	133 (46.6)	65 (43.3)	68 (50.3)	0.24
Insulin	34 (11.8)	15 (10)	19 (14.1)	0.36
Anticoagulation	73 (25.6)	43 (28.7)	30 (22.2)	0.22
Admission vitals (mean ± SD)				
Heart rate	88.7 ± 23.1	91.7 ± 23.4	85.4 ± 22.6	0.02
Respiratory rate	19.9 ± 4.4	19.8 ± 4.6	20 ± 4.2	0.70
Mean arterial pressure	74.8 ± 16.4	76.2 ± 16.4	73.4 ± 16.4	0.15
Systolic blood pressure	105.3 ± 20.3	105.2 ± 17.3	105.4 ± 23.3	0.93
Diastolic blood pressure	61.1 ± 12.5	63.1 ± 13.6	59 ± 10.8	0.005
Admission laboratory values (mean ± SD)				
Hemoglobin (g/L)	117.3 ± 25.8	122.0 ± 27.9	112.8 ± 22.9	0.003
Sodium (mmol/L)	133.5 ± 16.4	132.7 ± 18.9	134.2 ± 13.0	0.46
Creatinine (μmol/L)	180.6 ± 127.4	172.5 ± 129.5	190.4 ± 124.9	0.29
Serum lactate (mmol/L)	3.3 ± 3.2	3.2 ± 2.9	3.5 ± 3.5	0.43
Admission diagnosis (n, %)				
Etiology of CHF				
Ischemic	98 (34.4)	42 (28)	56 (41.5)	0.02
Nonischemic	187 (65.6)	108 (72)	79 (58.5)	
CICU admission for CS	148 (51.9)	92 (61.3)	56 (41.5)	0.0009
Admission with concurrent:				
ACS	4 (1.4)	0 (0)	4 (3.0)	0.05
Arrhythmia	4 (1.4)	3 (2)	1 (0.7)	0.62
Post−cardiac arrest	4 (1.4)	3 (2)	1 (0.7)	0.62
Interventions at time of CICU admission (n, %)				
Inotrope/vasopressor use	175 (61.4)	104 (69.3)	71 (52.6)	0.005
Mechanical ventilation	57 (20)	32 (21.3)	25 (18.5)	0.66
BIPAP	20 (7)	6 (4)	14 (10.4)	0.04
IABP	10 (3.5)	4 (2.7)	6 (4.4)	0.52
Impella (Abiomed, Danvers, MA)	7 (2.5)	3 (2)	4 (3.0)	0.71
Use of pulmonary artery catheter	99 (34.7)	60 (40)	39 (28.9)	0.06
IHD	26 (9.1)	16 (10.7)	15 (11.1)	1.00

Continued

Table 1. Continued.

Characteristic	All patients (n = 285)	With HF consult (n = 150)	Without HF consult (n = 135)	*P* value
Discharge parameters				
In-hospital mortality	82 (28.7)	25 (16.7)	57 (42.2)	0.0001
LOS (d, mean ± SD)				
CICU length of stay	6.5 ± 8.13	6.4 ± 6.1	6.8 ± 10.0	0.68
Hospital length of stay	23.9 ± 27.6	20.8 ± 19.5	25.4 ± 34.4	0.16

ACEi, angiotensin-converting enzyme inhibitor; ACS, acute coronary syndrome; ARB, angiotensin II receptor blocker; ARNI, angiotensin receptor-neprilysin inhibitor; ASA, acetylsalicylic acid; BIPAP, bilevel positive airway pressure; CABG, coronary artery bypass grafting; CHF, congestive heart failure; CICU, cardiac intensive care unit; CRT-D, cardiac resynchronization therapy-defibrillator; CS, cardiogenic shock; HF, heart failure; IABP, intra-aortic balloon pump; ICD, implantable cardioverter-defibrillator; IHD, intermittent hemodialysis; LOS, length of stay; LVEF, left ventricular ejection fraction; PCI, percutaneous coronary intervention; VF, ventricular fibrillation; VT, ventricular tachycardia.

conducted our propensity score matching by using the nearest neighbour matching method.

All statistical tests were 2 sided, and a P value of < 0.05 was set to be statistically significant. All statistical analyses were performed using SAS version 9.4 (SAS Institute, Inc., Cary, NC) and STATA version 15.1.

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Results

Patient characteristics

During the study period, 2378 patients were admitted to the CICU at the Peter Munk Cardiac Centre, with 329 unique patients admitted with a diagnosis of HF with or without CS. Of these patients, 44 (13.4%) received OHT or MCS during their hospitalization and were excluded. Of the remaining 285 patients, the mean age was 59.9 years, 68.8% (n = 196) were male, and 19.3% (n = 55) had heart failure preserved ejection fraction (HFpEF). Eighty-two patients (28.8%) died during their hospital stay. A total of 150 patients (52.6%) had an HF specialist consultation during their hospital stay, whereas 135 patients (47.4%) did not (Table 1 and Fig. 1). The HF consult was most often done on the same day as the CICU admission (median 0 [0-1] days). Patients who received an HF consultation were younger (52.5 ± 16.3 years vs 68.0 ± 17.0 years, $P < 0.0001$), had lower LVEF during their admission (27.0% ± 12.4% vs 35.7% ± 15.4%, $P < 0.0001$), were less likely to have an ischemic etiology for their HF (28.0% vs 41.5%, $P < 0.02$), and had less reported rates comorbid illnesses (including hypertension, dyslipidemia, diabetes, previous myocardial infarction and cerebrovascular accident, peripheral vascular disease, and atrial fibrillation). Upon presentation to the CICU, those receiving an HF consultation were more likely to be in CS (61.3% vs 41.5%, $P < 0.009$) and require inotropes or vasopressors (69.3% vs 52.6%, $P < 0.005$). At admission to CICU, they also had a higher heart rate (91.7 ± 24 vs 85.4 ± 22.1, $P < 0.02$) and diastolic blood pressure (63.1 ± 13.6 vs 59.0 ± 10.8, $P < 0.005$). There were no significant differences between the groups with respect to the need for mechanical ventilation, intra-aortic balloon pump, or Impella (Abiomed, Danvers, MA) insertion, as well as pulmonary artery catheterization for tailored hemodynamics. Admission blood work (hemoglobin, sodium, creatinine, and lactate) was also not significant different.

At the time of discharge, patients who received an HF consultation during their hospitalization were more likely to be seen in follow-up in the HF clinic (52.0% vs 27.5%, $P < 0.0001$) and to be on GDMT (Table 2). These findings remain consistent even after excluding patients with HFpEF (Table 3). In-hospital mortality was lower in those co-managed by an HF consultation service (16.7% vs 42.2%, < 0.0001). After propensity score matching, HF consultation was associated with lower odds of in-hospital mortality (odds ratio, 0.24; 95% confidence interval, 0.13-0.47). Hospital and CICU LOS were not statistically significant. There was no significant difference between readmission rates (19.3% vs 14.1%, $P = 0.27$).

Discussion

In this retrospective study, we found that patients admitted with HF with or without CS to the CICU who were co-managed with a dedicated HF consultation service were more likely to survive to discharge despite increased acuity and illness severity at time of CICU admission (ie, higher rates of presentation with CS and vasopressor use). In addition, our study revealed that those seen by an HF consultant were also more likely to leave hospital on GDMT if they had heart failure reduced ejection fraction (HFrEF).

Upon looking at these 2 groups, there are clear differences in baseline characteristics. Those seen by an HF team were younger, more likely to have a nonischemic cause of HF, and more likely to have HFrEF and a previous diagnosis of HFrEF. In addition, they were also more likely to be in CS on admission to the CICU, requiring more aggressive medical therapy.

Those patients not co-managed by an HF team were older and more likely to have HFpEF and comorbid illness. In this clinical scenario, an HF consultation may not have been sought because older patients or those with HFpEF were presumed ineligible for advanced therapies. It is also possible that there is a perception that HF expertise is not necessary because HFpEF does not benefit from conventional HF therapy. However, this subgroup is difficult to treat, and because the prognosis is similar to that of patients with HFrEF,[15-17] an argument could be made for specialist consultation. Because there are currently no studies looking at the role of a specialized HF consultant in the management of the HFpEF population, further research is needed to assess whether HF consultation provides an incremental benefit in the inpatient setting. Although there are significant differences between both groups (ie, age, severity of illness,

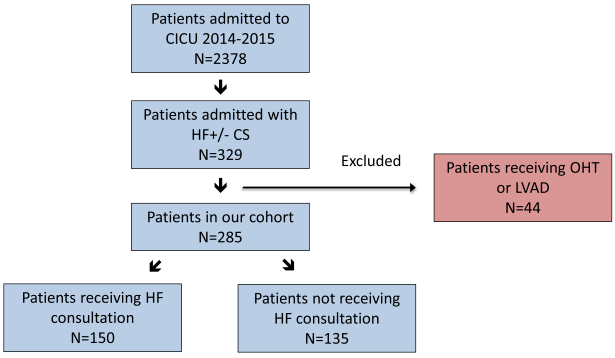

Figure 1. Flow diagram of patients admitted to the cardiac intensive care unit (CICU) from 2014 to 2015 at our institution. CS, cardiogenic shock; HF, heart failure; LVAD, left ventricular assist device; OHT, orthotopic heart transplantation.

comorbidities), these differences may be a result of existing referral patterns within our institution. These results could be explained by the fact that the Peter Munk Cardiac Centre is a quaternary care center that offers OHT and MCS that necessitates earlier involvement by an HF team to ensure that the window for accessibility to these resources is timely. Critically ill young patients likely prompt earlier HF referral.

In-hospital mortality was lower in those co-managed by a dedicated HF team, despite higher rates of CS at time of admission. Because ADHF with organ impairment is clinically challenging to manage, expertise and specialized training in advanced HF and cardiac critical care may allow earlier identification of illness severity, more aggressive decongestive therapies, and more rapid initiation and withdrawal of inotropes/vasopressors, which may potentially explain the lower rates of in-hospital mortality. A larger change in weight loss during hospitalization was seen in the group followed by an HF team (7.7 ± 8.9 kg vs 4.8 ± 4.8 kg, $P = 0.004$) compared with those who were not. Although weight loss could be also due to loss of muscle mass in light of acute illness, the CICU and hospital LOS were similar between both groups.

This study also demonstrates that patients with HFrEF seen by an HF consultant were more likely to be discharged on GDMT (Tables 2 and 3). Although the introduction of beta-blockers and diuretics were not statistically different between both groups, the use of vasodilators, aldosterone antagonists, and digoxin were higher in patients co-managed by an HF team. Possible reasons for a lack of GDMT at the time of discharge include the lack of knowledge of timing of initiating these therapies or the avoidance of polypharmacy in the elderly population, it remains unclear why this discrepancy exists. Multiple guidelines, based on robust data, encourage early introduction of these therapies.[14,18,19] However, further studies are needed to identify gaps in applying guidelines into clinical practice.

Table 2. Medications at time of discharge for survivors dichotomized to those receiving HF consultation vs those without subspecialty consultation

Discharge medications	Patients with HF consultation (n = 125)	Patients without HF consultation (n = 78)	*P* value
ACE/ARB or ARNI	69 (55.2)	27 (34.6)	0.01
Beta-blocker	87 (69.6)	45 (57.6)	0.19
Aldosterone antagonists	78 (62.4)	22 (28.2)	0.0001
ISDN/hydralazine	38 (30.4)	12 (15.4)	0.029
Digoxin	61 (48.8)	10 (12.8)	0.0001
Lasix	83 (66.4)	53 (67.9)	0.66

ACE, angiotensin converting enzyme inhibitor; ARB, angiotensin II receptor blocker; ARNI, angiotensin receptor-neprilysin inhibitor; HF, heart failure; ISDN, isosorbide dinitrate.

Table 3. Medications at time of discharge for survivors with LVEF < 50%, dichotomized to those receiving HF consultation vs those without subspecialty consultation

Discharge medications	Patients with HF consultation (n = 114)	Patients without HF consultation (n = 57)	*P* value
ACE/ARB or ARNI	66 (57.8)	22 (39.0)	0.02
Beta-blocker	76 (66.7)	33 (57.9)	0.3
Aldosterone antagonists	74 (64.9)	19 (33.3)	0.0002
ISDN/hydralazine	37 (32.5)	11 (19.3)	0.08
Digoxin	58 (50.9)	9 (15.8)	0.0001
Lasix	76 (66.7)	37 (64.9)	0.87

ACE, angiotensin-converting enzyme inhibitor; ARB, angiotensin II receptor blocker; ARNI, angiotensin receptor-neprilysin inhibitor; HF, heart failure; ISDN, isosorbide dinitrate.

In addition, patients with HF consultation were more likely to be seen in follow-up at a multidisciplinary HF clinic (63.4% vs 27.5%, $P < 0.0001$). Access to timely follow-up in a multidisciplinary HF clinic has been shown to reduce hospital readmissions at 6 months and subsequent visits to the emergency department, as well as an improvement in quality of life.[20,21] Although multiple studies have shown reduced mortality in patients discharged from hospital with ADHF with follow-up with a cardiologist compared with a noncardiologist (ie, family practice),[6,7] there are no studies examining whether mortality rates differ among cardiac specialties (ie, HF specialist vs general cardiologist). Further investigations are needed to examine this particular clinical question.

As the incidence of HF in our population continues to increase, there will undoubtedly continue to be a varied group of front-line providers (with varying degrees of training) who manage this patient population in the inpatient and outpatient settings. Although there is significant evidence showing that management of these patients by cardiologists leads to a reduction in emergency department use and an improvement in quality of life, this is the first study that demonstrates the added benefit of subspecialized training in advanced HF and transplant cardiology in reducing in-hospital mortality and improving rates of initiation of GDMT while in the hospital. Most recently, the Accreditation Council for Graduate Medical Education has issued an American Board of Internal Medicine added qualification designation for advanced HF and transplant cardiology, with clear published training requirements that include the management of critically ill patients with CS, MCS, and OHT.[22] With more than 80 training programs in North America (74 in the United States and 6 in Canada) currently, the growth of a critical mass of specialty-trained providers, alongside primary care providers

and general internists, will be needed to tackle the growing HF epidemic. In addition, the delivery of care that is currently available mostly at specialty centers appears to be unsustainable over the next decade. New guidelines have suggested the role of a spoke-hub-and-node model, where patient complexity dictates where they are best managed.[23] As patients fluidly move between functional states, it may not be simple to rely solely on functional status to stratify patients because accompanying comorbid illness and frailty add an extra layer of complexity in their management. System-wide planning to tackle the significant burden of HF will be needed to address this growing public health concern.

The present study highlights the need for HF consultation for patients admitted to the CICU setting. Despite the fact that the subset of patients co-managed by an HF specialist were more likely in CS necessitating vasopressor or inotrope therapy, we have shown that these patients are managed more aggressively with decongestive therapies leading to a larger net weight loss during their hospital stay. In addition, this subgroup was more likely to survive to discharge with higher rates of GDMT use and with follow-up in a multidisciplinary HF clinic. This study reiterates the need for specialist HF consultation as suggested by the National Institute for Health and Care Excellence.[24]

Limitations

There are several limitations to address in this study. First, this study is from a single academic institution whose focus is on advanced HF therapies. This may make it difficult to generalize these findings to other hospital sites. In addition, because our hospital services many community sites, we were not able to capture readmission rates or deaths at other hospitals. Our dataset also does not focus on emergency department use within our institution or our community partners. Finally, our data set did not evaluate the degree of complexity or severity of comorbid illnesses that may have contributed to each patient's hospital trajectory.

Conclusion

A dedicated HF consultation service is an integral component of managing the critically ill population of patients admitted to the hospital with a diagnosis of HF or CS. Although patients managed by an HF team were more likely to be in CS with higher rates of use of vasoactive agents, they had a lower rate of in-hospital mortality and were more likely to be discharged on GDMT with follow-up in an HF clinic compared with those managed exclusively by their primary team. As such, this study highlights the importance of involving a HF specialty consultation service for patients admitted to the CICU with HF to reduce mortality and to optimize medical therapy at time of discharge.

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Disclosures

The authors have no conflicts of interest or financial ties to disclose.

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