

Association Between The Discharge Process And Post-Discharge Events In Patients With Heart Failure

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Research Article

Keywords: Heart Failure, Transitional Care, Caregivers, Health Education, Patient Discharge

Posted Date: January 5th, 2022

DOI: <https://doi.org/10.21203/rs.3.rs-1176130/v1>

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Abstract

Background: HF is a burden on healthcare resources due to the high cost of frequent readmissions. Predictive models have been reported for the post-discharge prognosis of HF. However, these models mostly included non-modifiable factors and their predictive accuracy was limited. This implies that potentially modifiable factors are needed, which could be attributed to the discharge process. This study aimed to explore the relationship between the discharge process and post-discharge events in patients with HF.

Methods: Medical records were reviewed to identify patients who were admitted for HF exacerbation. Information related to the discharge process included post-discharge clinic appointments, educational contents before discharge, and family participation during patient education. HF-related events were defined as a composite of events, including emergency department visits, readmissions, or death. A multivariable Cox proportional hazards regression model was used to explore the association between the discharge process and HF-related events.

Results: Of 201 patients, 41 had at least one HF-related event. Post-discharge clinic appointments were scheduled 8 days after discharge. Patients received their discharge education on average of one topic, and approximately the families of 70% of the patients participated in this educational activity. In the Cox regression model, family participation during education was independently associated with a longer time to HF events (hazard ratio: 2.105). However, and post-discharge follow-up appointments and the number of educational contents received were not associated with the time to HF events.

Conclusion: We found that family participation during education is a protective factor for adverse prognosis in patients with HF. Our results highlight the importance of family engagement in HF management.

Background

The estimated prevalence of heart failure (HF) is 64.3 million people worldwide, and this number is expected to increase due to the aging of the population and advances in medical treatment [1, 2]. Despite improvements in HF therapy, HF-related events such as rates of readmission, and emergency department (ED) visits remain high [3], with the short-term readmission rate ranging from 20–25% [4]. Because of the cost of repeated hospitalization, HF is considered a great burden on healthcare resources [2, 5].

Researchers have investigated factors related to poor prognosis (e.g., readmission) in patients with HF. According to a recent systematic review of models for predicting the risk of readmission in patients with HF, predictors included in the predictive models for readmission for HF were grouped into three categories: clinical (e.g., laboratory values and vital signs), administrative (e.g., demographic variables), and psychosocial predictors (e.g., psychiatric comorbidities and substance abuse) [6]. However, the predictive accuracy of these models ranged from poor to acceptable. It should be noted that factors included in the predictive models were non-modifiable. Thus, this finding implies that additional

modifiable factors should be considered to improve the predictive power for prognosis of patients with HF who are discharged from the hospital.

The intervention designed to prevent readmission among patients from one care setting to another is often called transitional care [7]. Potential factors, including transitional care that can be modifiable, could be found in the discharge process, such as discharge education and post-discharge clinic appointments. Transitioning between inpatient and outpatient settings is critical for improving patient outcomes, such as reducing HF-related events [3]. Therefore, the purpose of this study was to explore the relationship between factors related to the discharge process and prognosis among patients who were admitted to the hospital due to HF exacerbation. In this study, prognosis was defined as the composite end point of death, rehospitalization, or ED visits due to HF (i.e., HF event-free survival).

Methods

Study design and sample

A retrospective chart review was conducted using the data of patients discharged with a diagnosis of HF (International Classification of Disease-10 codes 150.1–150.4, 150.9) from an academic medical center in Korea between January 2014 and March 2017. Eligible patients were admitted due to HF exacerbation and were discharged alive. We initially screened 818 records and excluded 516 because their primary reason for the index hospitalization was not related to HF or because they died during the index hospitalization. Of the 302 records retained, 101 were excluded as they did not include data on variables of interest (e.g., living status, post-discharge clinic appointments). As a result, 201 records were included in the study.

Data collection

Electronic medical records were reviewed to abstract the following information from the index hospitalization: demographic and clinical information and information related to the discharge process. To identify patients' prognosis, their electronic medical records were reviewed for a median of 699 days (interquartile range: 441–789) after the index hospitalization. A data collection protocol was developed to consistently abstract the data. Any ambiguity among the research nurses was discussed by a principal investigator.

Information related to the discharge process. The discharge process factors included in this study were post-discharge clinic appointments, patient education for HF self-care, and family participation in patient education. According to a scientific statement from the American Heart Association (AHA), systematic implementation of the principles of transitional care programs to prevent rehospitalizations was recommended for at-risk patients with HF [8]. The suggested components of the transition of care include medication reconciliation, early post-discharge contact and communication with patients and/or clinicians, patient education related to self-care, interdisciplinary care coordination, and communication of patient health information to patients and their post-discharge healthcare provider [8]. However, the

systematic approach for the transition of care (e.g., care coordination) had not been implemented in Korea, including in the facility where this study was conducted. At the clinic, patients saw the same clinicians who evaluated them during the index hospitalization, and medication reconciliation was performed before discharge for all patients in Korea. Of the suggested components listed in the AHA scientific statement, information about scheduling post-discharge clinic appointments and patient education on self-care was available in the medical records. The days of the patient's first clinic visit after discharge were computed. The educational contents about HF before discharge were also abstracted from the medical records and categorized as follows: pathophysiology, medication, low sodium diet, symptom management, and exercise.

The significant role of caregivers in the self-care of patients with HF is well-known [9, 10], and the American Association of Heart Failure Nurses' position paper clearly states the importance of family involvement in educating patients [11]. Therefore, information about the participation of family caregivers in patient education is also included as one of the discharge process factors. Patients with medical records indicating the participation of family members during patient education were considered to have the participation of family caregivers in their education.

HF event-free survival. The outcome of this study was defined as the composite end point of time to the first HF-related event, which was composed of HF-related death, rehospitalization, or ED visit due to HF exacerbation over 2 years after the index hospitalization. This information was abstracted from patients' electronic medical records after the index hospitalization was reviewed for up to 2 years.

Demographic and clinical information. For the demographic information, age, sex, education level, and living arrangement (living alone vs. living with others) were collected. For the clinical information, data on left ventricular ejection fraction, etiology of HF, changes in weight between admission and discharge, the number and names of the discharge medications, and comorbid conditions were collected. Comorbidity burden was measured using the Charlson comorbidity index (CCI) [12].

Data analysis

To compare the patients' demographic and clinical information and information related to the discharge process between patients with and without HF-related events, an independent t-test or chi-square test was conducted, as appropriate.

Multivariable Cox proportional hazards regression was used to examine whether HF event-free survival was predicted by discharge process factors (i.e., days of post-discharge clinic appointment, the number of educational contents about HF before discharge in which the patients received, and the participation of family members during patient education). Covariates included in the multivariable Cox proportional hazards regression model were age, education level, living arrangement, comorbidity burden measured with the CCI, and changes in weight between admission and discharge. All statistical analyses were performed using SPSS, version 20.0, software (IBM SPSS). Statistical significance was set at $p < 0.05$.

Results

Sample characteristics

A total of 201 patients were included, with more women than men. The mean age was 70.8 years (SD= 13.6), and the majority had below high school education (67.2%) and lived with others (86.1%). The majority of the patients had a non-ischemic HF etiology with a reduced ejection fraction. Patients stayed on an average of 8.6 days (Table 1). When comparing the characteristics between patients with and without HF-related events, patients with HF-related events were more likely to be older and have higher CCI scores than those without HF-related events ($p < 0.05$).

Table 1
Sample characteristics (N=201)

Characteristics		Total (n=201)	HF-related events		p-value
			Yes (n =41)	No (n =160)	
Mean (SD) or Frequency (%)					
Age (years)		70.79 (13.64)	75.93 (11.40)	69.48 (13.88)	0.007
Sex	Male	99 (49.3%)	25 (61.0%)	74 (46.3%)	0.092
	Female	102 (50.7%)	16 (39.0%)	86 (53.8%)	
Education level	Below high school graduate education	135 (67.2%)	29 (70.7%)	106 (66.3%)	0.586
	≥High school graduate	66 (32.8%)	12 (29.3%)	54 (33.8%)	
Living arrangement	Living alone	28 (13.9%)	3 (7.3%)	25 (15.6%)	0.212
	Others	173 (86.1%)	38 (92.7%)	135 (84.4%)	
Charlson comorbidity index		2.86 (1.76)	3.80 (2.24)	2.61 (1.53)	<0.001
Left ventricular ejection fraction (n=190)	<40	89 (46.8%)	22 (59.5%)	67 (43.8%)	0.087
	≥40	101 (53.2%)	15 (40.5%)	86 (56.2%)	
Etiology of heart failure	Ischemic	75 (37.3%)	11 (26.8%)	64 (40.0%)	0.120
	Non-ischemic	126 (62.7%)	30 (73.2%)	96 (60.0%)	
NT-pro BNP on admission [†] (n=174)		6979.5 (8542.0)	8742.5 (9264.8)	6566.8 (8345.1)	0.189

NT-pro BNP, N-terminal pro-brain natriuretic peptide; ACEi/ARB, angiotensin-converting enzyme inhibitor/angiotensin II receptor blocker

†=The distribution was skewed, and *p*-values were obtained based on log-transformed values.

* The changes in weight between admission and discharge were computed by subtracting admission weights from discharge weights.

Characteristics	Total (n=201)	HF-related events		
		Yes (n =41)	No (n =160)	p-value
Changes in weight between admission and discharge (kg)*	1.90 (3.43)	1.52 (2.58)	2.00 (3.61)	0.423
Number of discharge medications	7.21 (3.04)	7.41 (3.05)	7.16 (3.05)	0.637
ACEi/ARB (n=200)	153 (76.5%)	29 (72.5%)	124 (77.5%)	0.505
Beta blockers (n=200)	179 (89.5%)	37 (92.5%)	142 (88.8%)	0.773
Diuretics (n=200)	183 (91.5%)	38 (95.0%)	145 (90.6%)	0.533
Length of stay during the index hospitalization (days)	8.64 (16.33)	8.50 (5.70)	8.66 (17.74)	0.957
NT-pro BNP, N-terminal pro-brain natriuretic peptide; ACEi/ARB, angiotensin-converting enzyme inhibitor/angiotensin II receptor blocker				
†=The distribution was skewed, and <i>p</i> -values were obtained based on log-transformed values.				
* The changes in weight between admission and discharge were computed by subtracting admission weights from discharge weights.				

Discharge process factors

On average, the post-discharge clinic appointments were scheduled for approximately 8 days (SD= 2.9) after discharge (Table 2). Approximately 60% of the patients were scheduled for post-discharge clinic appointments within one week of discharge. Almost all patients (99%) were scheduled within two weeks of discharge. All patients received HF education before discharge, except for 10 patients (5%). The HF educational content that was most frequently covered was related to medications (94.0%), followed by symptom management (41.8%), exercise (15.4%), low sodium diet (12.9%), and pathophysiology (1.5%). More than two-thirds of the patients (69.7%) were educated with their family members. When comparing the discharge process factors between patients with and without HF-related events, there were no differences, except that the patients with HF-related events received education about pathophysiology (Table 2).

Table 2
Factors related to the discharge process

		Total (n=201)	HF-related events		p-value
			Yes (n =41)	No (n =160)	
		Mean (SD) or Frequency (%)			
Post-discharge clinic appointment (days)		8.11 (2.92)	8.54 (3.85)	8.01 (2.64)	0.301
The number of educational contents about HF before discharge		1.66 (1.04)	1.66 (0.94)	1.66 (1.06)	0.990
The contents of the education	Pathophysiology	3 (1.5%)	3 (7.3%)	0 (0.0%)	0.008
	Medications	189 (94.0%)	40 (97.6%)	149 (93.1%)	0.466
	Low sodium diet	26 (12.9%)	4 (9.8%)	22 (13.8%)	0.609
	Symptom management	84 (41.8%)	15 (36.6%)	69 (43.1%)	0.449
	Exercise	31 (15.4%)	6 (14.6%)	25 (15.6%)	0.875
Participation of family during the education	Yes	140 (69.7%)	27 (65.9%)	113 (70.6%)	0.553
	No	61 (30.3%)	14 (34.1%)	47 (29.4%)	

HF event-free survival

During the follow-up period (a median of 699 days), one patient died due to HF-related reasons, and 40 patients had at least one of the following HF-related events: HF-related ED visits or readmissions.

In the Cox regression model, after adjustments were made for covariates, patients without family presence during the education were 2.1 times more likely to have a shorter length of HF event-free survival (hazard ratio, 2.105; 95% confidence interval, 1.004–4.412). Age and CCI were predictive of HF event-free survival among the covariates included in the Cox regression model. Older age and higher CCI were associated with an increased risk of HF-related events (Table 3).

Table 3
Multivariate Cox regression analysis for heart failure-related events* (N=201)

Variables	Hazard ratio	p-value	95% confidence interval
Age (years)	1.049	0.005	1.014–1.085
Education level [ref: \geq High school graduate]	1.186	0.654	0.562–2.503
Living arrangement [ref: living with others]	2.372	0.160	0.71–7.922
Charlson comorbidity index	1.310	0.001	1.122–1.53
Changes in weight between admission and discharge	1.104	0.128	0.972–1.253
Post-discharge clinic appointment (days)	1.060	0.244	0.961–1.169
The number of heart failure educational contents received before discharge	1.166	0.360	0.839-1.621
No presence of family during the education [ref: Yes]	2.105	0.049	1.004–4.412
* Heart failure-related events: death, readmission, and emergency department visit			

Discussion

This study examined whether discharge process factors were associated with HF event-free survival. We found that the participation of families in patient education was related to HF event-free survival, but not in either the days of post-discharge clinic appointments or the number of educational contents about HF before discharge. This result implies that learning more about HF and its management is helpful for family members to help patients manage HF, which can contribute to preventing adverse prognosis.

The immediate post-discharge period has been termed as the “vulnerable phase” of hospitalization for HF [13]. A successful discharge process for this period as part of a transitional care program can help patients avoid preventable rehospitalization. In the United States, the Centers for Medicare and Medicaid Services have implemented several programs to decrease avoidable readmissions by improving the quality of care transitions when patients are discharged from the hospital [14]. One of the important quality measures for care transition is patient discharge education. According to a systematic review and meta-analysis by Fischer et al., the overall effect of providing HF discharge instructions on time during repeated hospitalizations in patients with HF was not significant. Similarly, in our study, the number of educational contents about HF before discharge was not associated with the time to HF-related events [15]. However, these results from our study and the study by Fischer and colleagues need to be cautiously interpreted. First, only three studies were included to estimate the pooled effect of discharge instructions in the study by Fischer et al. Second, the academic medical center where the data were collected for our study did not provide any guidelines to nurses on how to provide education for patients and with what contents. Nurses are in an ideal position to contribute to outcomes in the discharge process, especially in discharge education [3]. However, due to the lack of guidelines, patients in our study received HF

education verbally in an inconsistent manner from their nurses. Previous studies have suggested the importance of a comprehensive understanding of HF, its symptoms, and self-care when providing patient education [16, 17]. Therefore, the lack of a relationship between the number of educational contents and HF-related events in our study may be due to the poor quality of discharge education to patients.

The inclusion of families in discharge education and planning is required in some US states [18]. Investigators have described the important role of social support in HF management [9, 10] and suggest the inclusion of informal caregivers in patient discharge education [11]. This claim is further supported by our finding that family members participate in patient discharge education. Living with others was not associated with event-free survival in our study. This finding appears to contradict the positive effect of family participation and HF management in that living with someone is often considered a proxy for social support. However, informal caregivers' negative effects on patients' self-care have been described when informal caregivers are not knowledgeable about HF management [19]. Therefore, our findings further highlight the importance of family involvement in patient education for family members to adequately support patients' HF management after discharge.

An early post-discharge clinic appointment within the first week of discharge is recommended according to a scientific statement from the AHA [8]. Most of the patients in our study were scheduled to see their cardiologists within one week, and there were no differences in days to post-discharge clinic appointments between patients with and without HF-related events. This may have led to the non-significant association between days to post-discharge clinic appointments after discharge and HF-related events in our study.

This study has some limitations. Data were collected by reviewing medical records. Because information in the medical records depend on clinicians' documentation, certain information may not be available or incomplete. For example, information about the participation of family members during discharge education was available; however, their relationship with the patients was unavailable. This study was conducted in a single academic medical center, which may limit the generalizability of our findings.

Conclusion

Our results suggest that family involvement in patient discharge education is important for improving the prognosis after discharge from the hospital. Family members may not be able to physically present during patient education, especially when a family is employed. To address this issue, nurses can create innovative strategies to promote family members' participation in patient education, such as using an online platform for video conferencing. Our results also showed that there was no relationship between the number of educational contents covered and patient prognosis. However, this result should be cautiously interpreted as the education given to patients is not evidence-based or guideline-based. Therefore, it is important to develop strategies for improving the quality of discharge education for patients with HF in Korea, where no system level supports (e.g., reimbursement) are available.

Abbreviations

AHA: American heart association; CCI: Charlson comorbidity index; ED: Emergency department; HF: Heart failure;

Declarations

Authors' contributions

Conceptualization: KSL; Data curation: KSL, HL; Formal analysis: KSL, HL; Funding acquisition: KSL; Investigation: KSL, NEM, J-HP; Methodology: KSL; Project administration: KSL, HL, NEM, J-HP; Resources: KSL, J-HP; Software: KSL, HL; Supervision: KSL; Validation: KSL, HL, NEM; Writing–original draft: KSL, HL; Writing–review & editing: all authors.

Funding

This research was supported by the following fundings: (1) National Research Foundation of Korea grant funded by the Korean government (MEST; grant number: 2016R1A2B4008495); (2) the BK21 four project (Center for Human-Caring Nurse Leaders for the Future) funded by the Ministry of Education (MOE, Sejong, Korea) and National Research Foundation of Korea (NRF).

Availability of data and materials

The datasets generated and/or analysed during the current study are not publicly available due to privacy/ethical restrictions but are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

This study was a retrospective chart review and was exempted from approval by the Institutional Review Board (IRB) of Chungnam National University Hospital. The study was carried out according to the Helsinki Declaration.

Consent for publication

Not applicable

Competing interests

The authors declare that there are no conflicts of interest.

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