Original Article

Association between Stasis Dermatitis and Length of Stay in Heart Failure Hospitalizations

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Abstract

Background: Stasis dermatitis (SD) is caused by venous hypertension that can be associated with peripheral congestion due to heart failure (HF). Length of stay (LOS) is the primary driver of HF hospitalization costs. Therefore, it is important to determine those patients who will have longer LOS. We aimed to investigate the relationship between the SD and LOS in HF patients. **Methods:** A total of 308 patients, who were hospitalized between January 2012 and January 2014 due to acute decompensated HF (ADHF) in our center, were evaluated in this retrospective observational cohort study. Patients' baseline clinical characteristics and presence of SD diagnosis within the past 3 months prior the HF hospitalization were assessed by a review of cardiology and dermatology clinics medical records. **Results:** A total of 237, acutely decompensated, HF patients were enrolled in the study. The median LOS was 5 days, and the mean LOS was 5.4 ± 2 days. Prolonged LOS was defined as LOS >5 days, and the patients were classified into two groups: Those with LOS ≤5 days (Group I) and those with LOS >5 days (Group II, longer LOS). The presence of SD diagnosis was higher in Group II compared to patients in Group I (22% vs. 46%, $P < 0.001$). In the multivariate logistic regression model, presence of SD diagnosis, presence of moderate-to-severe tricuspid regurgitation, presence of atrial fibrillation, left atrial diameter, creatinine level, sodium level remained associated with longer LOS after adjustment for age, gender and for the variables found to be statistically significant in univariate analysis and correlated with LOS. **Conclusions:** This was the first time in the literature that a study demonstrated that the presence of SD was associated with an increased the risk of prolonged hospitalization independent of other factors in patients with reduced ejection fraction heart failure admitted for ADHF.

Keywords: Acute heart failure, congestion, length of stay, stasis dermatitis

Introduction

Acute decompensated heart failure (ADHF), that can be defined as the sudden initiation or rapid worsening of heart failure (HF) symptoms and results, is a complex clinical syndrome with high mortality and morbidity.[1] Length of stay (LOS) of patients who hospitalized due to acute HF has been shown to be affected by many factors such as patient compliance with treatment, accompanying comorbidities, HF stages, functional capacities, and etiology of HF.[2-4] It is important to establish the factors related to prolonged LOS in patients with HF since prolonged LOS pose additional risks to the patient and lead to increases in health expense.[5]

Stasis dermatitis (SD) is characterized by poorly demarcated erythematous and eczematous patches and plaques of the lower legs, classically involving the medial malleolus. SD is caused by venous hypertension (HT) that can be associated with only venous insufficiency or concomitant peripheral congestion due

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to HF.[6] We thought that SD, which is a pathology that we see quite often during our daily clinical practice in patients with stasis in their lower extremities and is thought to develop as a result of venous HT, may be associated with prolonged LOS, and for the first time in the literature, we aimed to evaluate the relationship of SD, which we think may be an indicator of venous HT, with LOS of HF patients.

Methods

A total of 308 patients, who were hospitalized between January 2012 and January 2014 due to ADHF in our center, were evaluated in this retrospective observational cohort study. Patients' age; gender; comorbidities, such as diabetes mellitus (DM), HT, atrial fibrillation (AF); laboratory and echocardiographic results, previous medications and presence of SD diagnosis within the past 3 months prior the HF hospitalization were assessed by a review of hospital medical records. Four patients with previous diagnoses of malignancies, four patients with previous diagnoses of cirrhotic hepatic disease, 17 patients with acute coronary syndrome (ACS), nine patients with acute de novo HF (first attack), 14 patients with cardiogenic shock requiring intravenous inotrope, 15 patients with known lower extremity venous insufficiency, eight patients with a different diagnosis of dermatitis other than SD with lower extremity involvement [Figure 1]. The study was approved by the local ethics committee.

Decompensations were diagnosed based on a combination of the presence of a recent deterioration of symptoms and signs of HF, as suggested in guidelines.[7,8] LOS was calculated as an overall in-hospital stay.

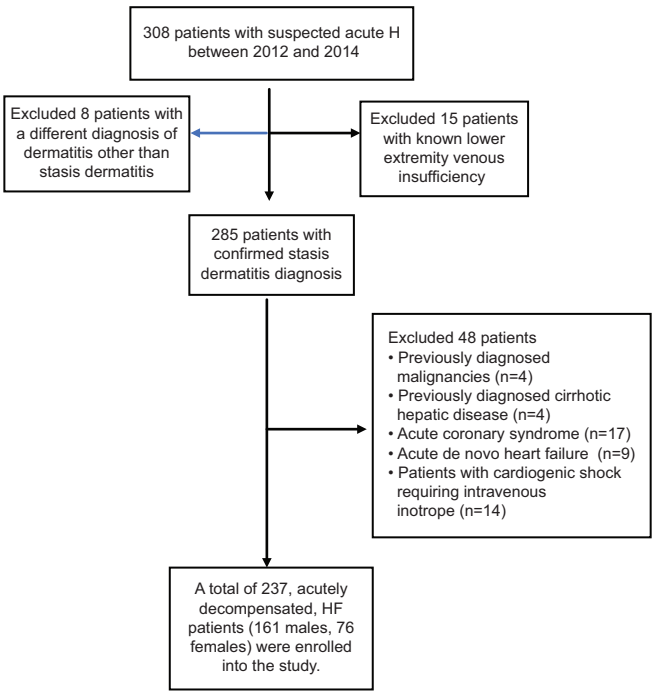

Figure 1: Patient flow chart

SD was diagnosed and recorded on hospital files by a dermatologist. The presence of characteristic dermatologic changes includes bilateral erythematous, scaly, and slightly discolored papules and plaques on the lower legs were used for diagnosis.[9]

Echocardiographic examinations were undertaken by experienced echocardiographers through the Vivid 7 system (GE Medical System) with 2.5–5 Mhz probes. The ejection fraction (EF) was calculated using the Modified Simpson method, in line with the most recent guidelines.[10] Chamber sizes were defined according to recent guidelines.[10] Systolic pulmonary artery pressure (SPAP) was calculated using the peak velocity of tricuspid regurgitation (TR) and estimated right atrial pressure. Valvular regurgitations were graded into two categories (moderate to severe or not moderate to severe) through a combination of color flow jet Doppler signal intensity, vena contracta width according to guideline recommendations.[11]

Statistical analysis

The Kolmogorov–Smirnov test was used to verify the normality of the distribution of continuous variables. Continuous variables were expressed as mean ± standard deviation or median (minimum–maximum) in the presence of abnormal distribution, and categorical variables as percentages. Independent parameters were compared through an independent sample *t*-test, and if there was no normal distribution, through Mann–Whitney U-test with median. Categorical data were evaluated by the Chi-square test as appropriate. Correlation was evaluated using the Spearman correlation test. We used a univariate analysis to quantify the association of variables with prolonged LOS. Variables that were statistically significant in the univariate analysis and potential other confounders were used in a multivariate logistic regression model with forward stepwise method to determine the independent prognostic factors for prolonged LOS. All statistical procedures were performed using SPSS software version 14.0 (SPSS Inc., Chicago, IL, USA). A $P = 0.05$ was considered as statistically significant.

Results

A total of 237, acutely decompensated, HF patients (161 males and 76 females) were enrolled in the study. The median LOS was 5 days, and the mean LOS was 5.4 ± 2 days, ranging from 2 to 15 days. Prolonged LOS was defined as LOS >5 days, and the patients were classified into two groups: Those with LOS ≤S5 days (Group I) and those with LOS >5 days (Group II, longer LOS). The mean age was 68 ± 11 years, and mean EF was 32% ± 7%. Table 1 presents the baseline clinical characteristics of the patients in terms of their LOS. Patients in Group II had higher left atrial (LA) diameter, SPAP, blood urea nitrogen (BUN), creatinine levels and they had lower hemoglobin and sodium levels than the patients in Group I. The presence of SD diagnosis was higher in Group II compared to patients in Group I (46% vs. 22%,

Table 1: Baseline clinical characteristics, laboratory, and echocardiographic parameters and preadmission medications of the patients in terms of their length of stay

Characteristics	LOS ≤5 days (Group I) (*n*=135), *n* (%)	LOS >5 days (Group II) (*n*=102), *n* (%)	*P*
Age (years)	68±11	69±11	0.231
Female	44 (33)	32 (31)	0.842
Hypertension	76 (56)	55(53)	0.716
Diabetes mellitus	33 (24)	36 (35)	0.069
Atrial fibrillation	40 (30)	56 (55)	<0.001
Laboratory parameters			
BUN (mg/dl)	21 (8-103)	30 (6-114)	<0.001
Creatinine (mg/dl)	1.2 (0.5-5.7)	1.7 (0.5-6.3)	<0.001
Sodium (mmol/L)	134±3	131±5	<0.001
Potassium (mmol/L)	4.5 (3.3-6.4)	4.5 (3.1-6.4)	0.927
Hemoglobin (g/dl)	13±2	12±2	0.010
BNP (pg/ml)	1452 (1000-4256)	1456 (1054-8898)	0.075
Echocardiographic parameters			
LA diameter (mm)	44±7	48±8	<0.001
LV diastolic diameter (mm)	53±8	54±8	0.540
EF (%)	33±7	31±8	0.116
RV dilatation	43 (32)	54 (53)	0.001
SPAP (mmHg)	36±14	43±14	<0.001
Moderate-to-severe TR	38 (28)	64 (63)	<0.001
Moderate-to-severe MR	28 (21)	44 (43)	<0.001
Preadmission medications			
Usage of ACEI/ARB	111 (82)	85 (83)	0.960
Usage of MRA	48 (36)	37 (36)	0.909
Usage of beta blocker	117 (87)	85 (83)	0.591
Usage of diuretics	107 (79)	82 (80)	0.830
Presence of stasis dermatitis diagnosis	29 (22)	47 (46)	<0.001

BUN: Blood urea nitrogen, LOS: Length of stay, BNP: B-type natriuretic peptide, SPAP: Systolic pulmonary artery pressure, LA: Left atrium, LV: Left ventricle, RV: Right ventricle, MR: Mitral regurgitation, TR: Tricuspid regurgitation, ACEI: Angiotensinogen converting enzyme inhibitor, ARB: Angiotensin receptor blocker, MRA: Mineralocorticoid receptor antagonist, EF: Ejection fraction

$P < 0.001$) and the ratios of patients with AF, patients with right ventricle (RV) dilatation, patients with moderate-to-severe TR and mitral regurgitation (MR) were higher in Group II than Group I [Table 1]. LOS was positively correlated with SPAP, LA diameter, BUN, creatinine, and B-type natriuretic peptide (BNP) levels and associated with the presence of SD diagnosis, AF, moderate-to-severe TR and moderate-to-severe MR. LOS was negatively correlated with the hemoglobin, sodium levels, and EF [Table 2].

The results of the univariate and multivariate logistic regression analyses for the prolonged LOS are summarized in Table 3. According to univariate analysis, older age, presence of SD diagnosis, presence of AF, presence of moderate-to-severe MR, presence of moderate-to-severe TR, higher BUN levels, higher creatinine levels, higher BNP levels, higher SPAP, higher LA diameter, lower hemoglobin, and lower sodium levels were significantly associated with an increased risk of prolonged LOS. In the multivariate logistic regression model, presence of SD diagnosis (odds ratio [OR] = 23.832, 95% confidence interval [CI]: 7.217–78.696, $P < 0.001$), presence of moderate to severe TR (OR = 4.413, 95% CI: 1.361–14.314, $P = 0.013$), presence of AF (OR = 3.215, 95% CI: 1.123–9.204, $P = 0.030$), LA diameter (OR = 1.089, 95% CI: 1.016–1.168, $P = 0.016$),

Table 2: Spearman correlation coefficients for the length of stay

LOS	*r*	*P*
Presence of stasis dermatitis diagnosis	0.291	<0.001
BNP	0.174	0.015
Presence of atrial fibrillation	0.354	<0.001
SPAP	0.248	<0.001
EF	−0.210	0.001
Presence of moderate-to-severe TR	0.405	<0.001
Presence of moderate-to-severe MR	0.320	<0.001
Left atrial diameter	0.324	<0.001
BUN	0.282	<0.001
Creatinine	0.405	<0.001
Hemoglobin	−0.194	0.003
Sodium	−0.430	<0.001

BUN: Blood urea nitrogen, LOS: Length of stay, BNP: B-type natriuretic peptide, SPAP: Systolic pulmonary artery pressure, MR: Mitral regurgitation, TR: Tricuspid regurgitation, EF: Ejection fraction

creatinine level (OR = 2.658, 95% CI: 1.409–5.014, $P = 0.003$), sodium level (OR = 0.839, 95% CI: 0.745–0.946, $P = 0.004$) remained associated with longer LOS after adjustment for age, gender and for the variables found to be statistically significant in univariate analysis and correlated with LOS.

Table 3: Univariate and Multivariate logistic regression analysis for predicting prolonged length of stay

Variables	Univariate			Multivariate		
	P	OR	95% CI	*P*	OR	95% CI
Presence of stasis dermatitis diagnosis	<0.001	8.585	4.476-16.466	<0.001	23.832	7.217-78.696
Presence of moderate-to-severe TR	<0.001	4.450	2.383-8.307	0.013	4.413	1.361-14.314
Presence of atrial fibrillation	<0.001	5.210	2.778-9.730	0.030	3.215	1.123-9.204
LA diameter	<0.001	1.114	1.067-1.1164	0.016	1.089	1.016-1.168
Creatinine levels	0.001	2.035	1.330-3.113	0.003	2.658	1.409-5.014
Sodium levels	<0.001	0.813	0.747-0.884	0.004	0.839	0.745-0.946
Age	0.017	1.037	1.007-1.067			
Presence of moderate-to-severe MR	0.004	2.452	1.338-4.493			
BUN levels	<0.001	1.027	1.014-1.041			
BNP levels	0.002	1.002	1.001-1.004			
SPAP	0.011	1.028	1.006-1.051			
Hemoglobin levels	0.001	0.795	0.693-0.911			

All the variables from Table 1 were examined, and only those significant at $P<0.05$ level and correlated with LOS are shown in univarite analysis. Multivariate logistic regression, including all the variables in univariate analysis with forward stepwise method. CI: Confidence interval, OR: Odds ratio, BUN: Blood urea nitrogen, LOS: Length of stay, BNP: B-type natriuretic peptide, SPAP: Systolic pulmonary artery pressure, MR: Mitral regurgitation, TR: Tricuspid regurgitation, LA: Left atrial

Discussion

To the best of our knowledge, for the first time in the literature, we illustrated that the presence of SD diagnosis is independently associated with prolonged LOS in patients hospitalized with ADHF.

Hospitalizations related to HF, which are increasing worldwide, pose a significant burden in terms of health expenditures. During hospitalizations due to HF, the rise of LOS due to various reasons increases additional clinical problems such as hyponatremia, hypokalemia, anemia, embolic and hemorrhagic complications, hospital infections in patients, and these clinical problems also lead to longer LOS. It creates a vicious cycle, leading to both an increase in morbidity and mortality rates in patients and a further increase in health-care costs.[12-16] Determining the factors associated with prolonged LOS in HF patients may contribute to the solution of this problem, which causes both clinical and economic problems.

To date, it has been determined that many different parameters have been associated with LOS in studies conducted at different centers which evaluated the factors associated with the LOS in HF patients. It has been shown that chronic kidney disease (CKD), chronic obstructive pulmonary disease, DM, severe MR, the presence of AF, low systolic blood pressure, high pulse rate, low hemoglobin, low sodium, high creatinine, and higher BN*P* values are associated with longer LOS.[17-20] In our study, the presence of AF, higher creatinine, and lower sodium values were associated with prolonged LOS independently of other variables, which are overlapping with the other studies.[13,20] Higher BNP, higher BUN, lower hemoglobin value, and severe MR, which were found significant in other studies through multivariate analysis, were determined significant in the univariate analysis of our study, while it lost its significance in the multivariate analysis.[13,18] In addition, in the subgroup analysis of the recently published multicenter study Journey HF-TR, New York Heart Association functional capacity, CKD, ACS-related HF, right HF, cardiogenic shock, invasive and noninvasive ventilation, and hemodynamic monitorization were found independently associated with prolonged LOS.[4] In our study, unlike Sinan *et al*., HF patients associated with ACS and cardiogenic shock patients, who are thought to have long LOS due to their clinical condition, were not included in the study. Although the right HF patients are also not specified in our study, the presence of moderate-severe TR, which we can consider as an echocardiographic parameter that is indirectly associated with right heart functions, was found to be independently associated with prolonged LOS. Again, in our study, higher creatinine values were found to be independently associated with prolonged LOS, which is in line with the Journey HF TR study.[4]

With the increase of venous pressure in the lower extremities in the SD, venous valves in these veins remain insufficient, resulting in reflux current in the direction of gravity leading to accumulation in the lower extremity; thus, it is thought that the inflation caused by increased hydrostatic pressure in these veins of the region leads to changes in the skin.[21] The venous pressure increase in these veins may be caused by the insufficiency of primary valves of veins or the insufficiency of valves due to trauma, deep vein thrombosis, as well as can also be caused by venous valves, which become insufficient due to increased hydrostatic pressure in lower extremities depending on the increased right heart pressures caused by HF, especially right HF.[21,22] Thus, the patients with venous insufficiency or deep vein thrombosis were excluded from the study.

It has been known long ago that venous congestion has an effect on renal function. Decreased transrenal pressure gradient as a result of increased venous pressure in HF patients has been shown to be associated with impaired renal function and inadequate response to diuretic therapy.[23-25] In a study of the left and right heart pressures in hospitalized HF patients,

central venous pressure (CVP) was shown to be the most important predictor of worsening renal function.[26] The clinical indication of renal venous pressure increase can be considered as the development of peripheral edema and CVP increase. In a study covering 12,778 patients, Chen *et al*. showed that the increase in peripheral edema and CVP was associated with the severity of impaired renal function.[27] The congestion, which is the most important cause of recurrent hospitalization in HF patients, has been shown to shorten the length of time to the rehospitalization and increase mortality when it does not decline sufficiently during hospitalization.[28-30] In our study, when the development pathogenesis of SD is considered, venous HT, which leads to the development of SD and developed as a result of venous congestion, can be associated with increased CVP and decreased transrenal pressure gradient. Impaired renal functions due to renal venous congestion and increased CV*P* values, as well as decreased diuretic response, can be considered a valid reason for prolonged LOS in HF patients with SD.[23-30]

AF, moderate-severe TR, higher LA diameter and lower sodium values, which were found in this study to be associated with prolonged LOS except for SD and impaired renal functions, were also shown in previous studies to be associated with congestive HF.[31-35] In addition, AF and lower sodium values from these parameters are independently associated with prolonged LOS, which is consistent with previous study results.[13,20]

Conclusion

The incidence rate of SD which is thought to develop as a result of venous congestion and is a common impairment encountered in hospitalized HF patients, and the relationship of SD with LOS were evaluated for the first time in the literature by our study, and the presence of SD diagnosis was found to be associated with prolonged LOS. If our study is supported by more extensive and prospective studies, it may contribute to reducing LOS and, therefore, hospital costs by formerly identifying patients with resistant congestion and associated prolonged LOS periods and by arranging appropriate treatment strategy from the outset.

Our study has several limitations

First of all, our study is a retrospective and single-centered study, and information about patients was obtained from hospital registries. Hence, unfortunately, some data are not available. Although the drugs used by the patients prior to admission are known, the treatment during hospitalization and especially the fact that the diuretic dose could not be included in the study are also important limitations. In addition, the absence of TAPSE data for the evaluation of the right heart function can also be considered among the major limitations.

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Conflicts of interest

There are no conflicts of interest.

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