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Characterizing pain leading to emergency medical services activation in heart failure

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Abstract

Background—Pain is a common but understudied symptom among patients with heart failure (HF) transported by emergency medical services (EMS). The aims were to determine explanatory factors of a primary complaint of pain and pain severity, and characterize pain among patients with HF transported by EMS.

Methods—Data from electronic health records of patients with HF transported by EMS within a midwestern United States county from 2009-2017 were analyzed. Descriptive statistics, Chi-square, analysis of variance, and logistic and multiple linear regression analyses were used.

Results—The sample (n = 4,663) was predominantly women (58.1%) with self-reported race as Black (57.7%). The mean age was 64.2 ± 14.3 years. Pain was the primary complaint in 22.2% of the sample, with an average pain score of 6.8 ± 3.1 out of 10. The most common pain complaint was chest pain (68.1%). Factors associated with a primary pain complaint were younger age (OR = 0.97, CI = 0.96 – 0.97), history of myocardial infarction (OR = 1.96, CI = 1.55 – 2.49), and the absence of shortness of breath (OR = 0.67, CI = 0.58 – 0.77). Factors associated with higher pain severity were younger age (b = −0.05, SE = 0.013), being a woman (b = 1.17, SE = 0.357), and White race (b = −1.11, SE = 0.349).

Conclusions—Clinical and demographic factors need consideration in understanding pain in HF during EMS transport. Additional research is needed to examine these factors in order to improve pain management and reduce transports due to pain.

Background

Heart failure (HF) is a common and serious chronic condition and is the leading cause of hospitalization among adults age 65 and older.[1-3] Patients with HF have high hospital readmission rates, frequently requiring emergency medical services (EMS) for transportation.[2,4] Patients with HF often present with several debilitating symptoms.[5-7] Although dyspnea and fatigue are the hallmark symptoms of HF and have been well

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studied,[8] many patients report acute and chronic pain as a major distressing symptom.[9,10] In the biopsychosocial model of pain, pain is defined as a multidimensional experience influenced by biological (e.g., age, HF stage) and demographic (e.g., gender, race, health literacy, social support) factors, including individual response to pain.[11-13] Previous conceptualizations of factors influencing pain in HF have also included neurohormonal imbalances (e.g., cytokines), impaired blood circulation, affective conditions (e.g., anxiety, depression), and physical disability.[13,14]

Pain in HF is commonly reported in both inpatient and outpatient settings. In a recent meta-analysis of 19 studies of 4,592 patients with HF, the prevalence of pain ranged from 23% to 85%.[13] Common sites of pain included the lower extremities,[10] chest,[15,16] and back.[15,17] These locations of pain are often driven by unique pathologies. For example, chest pain among patients with HF is thought to be caused by periods of prolonged high cardiac filling and ischemia, which subsequently damage myocardial tissue.[18] Pain in other locations among patients with HF has been linked to musculoskeletal, neuropathic, and visceral conditions due to inflammation, edema, and impaired circulation.[13,17,19]

The complexity of pain locations, etiologies, and contributing factors in HF is partially driven by comorbid conditions, co-occurring symptoms, medical devices, and cardiac procedures. A systematic review of symptom clusters among patients with HF reported frequent co-occurrence of functional decline with emotional distress and cognitive impairment, all of which may influence pain.[20] Authors of other studies have reported a relationship among pain with fatigue, depression, anxiety, and cognitive dysfunction.[21,22] Patients with HF often present with multiple comorbidities including diabetes, hypertension, atrial fibrillation, and obesity, which can increase prevalence of pain.[7,23] Additionally, patients with HF often have a history of myocardial infarction, a leading cause of pain that is associated with life-threatening complications and mortality.[24] These comorbid conditions produce considerable symptom burden and often have complex and prolonged treatment trajectories.[7] Patients with HF undergo a substantial number of cardiac procedures, and may be recipients of cardiac devices such as pacemakers or implantable cardioverter-defibrillators, which can contribute to chronic chest pain through inappropriate discharges and nerve stimulation.[1,25-27]

Patients with HF are frequently transported by EMS, often with significant pain as the primary complaint.[28] Although pain has been studied within general HF populations, the characteristics of pain among patients with HF transported by EMS remain unknown. Characterizing pain that is severe enough to lead to activating EMS may improve future preventative treatment. Pain in patients with HF has been associated with all-cause mortality.[15] Subsequently, preventative pain management in HF is important to reduce risk of adverse outcomes.[15,16] However, most interventions have focused on other symptoms (e.g., dyspnea, fatigue, cognitive dysfunction, depression, and sleep disordered breathing),[29,30] and have not addressed acute or chronic pain. As such, determining the characteristics of patients with pain who are transported by EMS may improve overall care and reduce rates of death and hospital readmission.[28]

The aims in this study of patients with HF who were transported by EMS were to: 1) evaluate demographic (i.e., gender, age, race) and clinical status (i.e., medical diagnoses, vital signs, medications, cardiac devices) variables as explanatory factors for having a primary complaint of pain; 2) evaluate demographic and clinical status variables as explanatory factors of pain severity among those with a primary complaint of pain; and 3) characterize differences in pain severity by demographics and locations (i.e., chest pain, abdominal pain, generalized pain, and back pain) among the patients with a primary complaint of pain.

Methods

Design and Data Source

A retrospective cross-sectional design was used. This current study was designed as a follow up to a parent study which characterized primary complaints among patients with HF who activated EMS.[28] This current study was conducted because a high percentage of patients in the parent study had a primary complaint of pain, but explanatory factors and pain characteristics were not explored.[28] The details of data collection were described in the previous publication.[28] Briefly, the data were obtained from electronic health records of an EMS system in a large Midwestern county in Indiana, United States, which performs approximately 100,000 transports per year to 3 acute care centers in a large metropolitan area. The original sample was comprised of 6,582 community-dwelling HF patients with a total of 16,905 transports over 8 years (June 2009 to June 2017). This current study analyzed the initial (index) transport for each patient. The study protocol was approved by the university institutional review board.

Sample

Patients from the parent study were included if they met the following inclusion criteria: (1) diagnosis of HF in the EMS electronic health record; (2) age 21 years and older; and (3) transported by EMS to 1 of the 3 acute-care hospitals.[28] Exclusion criteria were patients with incomplete data for the analyses. These criteria led to a sample of 4,663 patients.

Measures

All data collected during transport were entered into pre-specified fields in the electronic medical record by emergency services personnel. The medical record conformed with the National EMS Information System standard.[28] A self-report HF diagnosis was obtained from either the patient or family member and entered into the EMS medical record by a paramedic. A primary complaint (e.g., chest pain, respiratory problems, diabetic emergency) was recorded by EMS personnel in the medical record for each patient at the index transport.[28] The dependent variable for aim 1 was a primary complaint of pain. The dependent variable for aim 2 was pain severity scores. Patients were asked to rate their pain severity on a scale of 0-10 by either the paramedic or emergency medical technicians (EMT). A score of 0 is classified as no pain, 1-3 as mild pain, 4-6 as moderate pain, and 7-10 as severe pain.[31] For aim 3, primary complaints of pain were documented by location (i.e., abdominal, back, chest, or generalized).

Factors associated with a primary pain complaint (aim 1) and pain severity (aim 2) were either obtained from patients or family members by EMT or EMS personnel. Demographic variables included age, gender, race, and ethnicity. Clinical status variables were assessed by the paramedic or EMT and documented in the medical record. These included vital signs (blood pressure, heart rate, respiratory rate), oxygen (O_2) saturation, number of medications, cardiac devices (i.e., pacemaker, implantable cardioverter-defibrillator), history of comorbid conditions (i.e., angina, arrhythmias, hypertension, coronary artery disease, myocardial infarction, atrial fibrillation, coronary artery bypass graft, sudden cardiac arrest), presence of shortness of breath, and Glasgow Coma Scale (GCS). Previous studies have classified a score of 13-15 on the GCS as mild injury, with 9-12 indicating moderate injury.[32]

Statistical Analyses

Sociodemographic characteristics were summarized using descriptive statistics. All variables were examined prior to analysis to identify outliers and verify distribution. For the first aim, demographic characteristics were compared between patients with and without a primary complaint of pain using independent samples t-tests and Chi-square tests. Binomial logistic regression was used to evaluate variables associated with presenting with a primary complaint of pain. Variables included in the logistic regression analyses were age, self-reported gender (woman, man), self-reported race (White, Black, Other), shortness of breath, number of comorbid conditions, number of medications, history of coronary artery disease, atrial fibrillation, coronary artery bypass graft, or myocardial infarction, and presence of a pacemaker or implantable cardioverter-defibrillator.[7,11,13,20,22-28,33-35] Ethnicity and history of sudden cardiac arrest were excluded from the regression analysis because of small sample sizes ($n < 50$ per group). Due to small sample sizes, Pacific Islander, Native American, and Asian race were collapsed into one category (Other).

For the second aim, multiple linear regression was used to evaluate explanatory variables associated with pain severity among the subset with a primary complaint of pain. The variables that were analyzed in the multiple linear regression were age, gender, race, systolic blood pressure, heart rate, respiratory rate, oxygenation, number of comorbid conditions, number of medications, shortness of breath, history of coronary artery disease, atrial fibrillation, coronary artery bypass graft, or myocardial infarction, and presence of a pacemaker or implantable cardioverter-defibrillator. Systolic blood pressure was analyzed rather than diastolic blood pressure given that elevated systolic blood pressure tends to play a larger role in adverse cardiovascular outcomes.[36] All variables were entered simultaneously in both the logistic and linear regressions. Heteroskedasticity and multicollinearity/tolerance were assessed after conducting the multiple linear regression analysis.[37,38]

For the third aim, locations of pain as well as pain severity scores by location were examined among the subset with a primary complaint of pain. Independent samples t-tests were used to compare pain scores across three defined groups associated with pain: age (< 65 and ≥ 65 years), gender (man, woman), and race (Black, White).[13,22,39] Chi-square tests were used to evaluate if the percentage of primary pain complaint locations significantly differed by gender, age, and race. Two-way analysis of variance (ANOVA) was conducted to compare if

pain severity scores differed by demographics and the four pain locations. All analyses were conducted using Stata 16. A significance level of 0.05 was adopted for all analyses.

Results

Clinical and sociodemographic characteristics are presented in Table 1 for the 4,663 patients who were transported by EMS. The mean age was 64.16 ± 14.26 years. More than half of the sample were women, 57.7% of the sample was Black race, and 99.2% of the sample was non-Hispanic ethnicity. In the sample, 75.3% had a history of hypertension, 18.1% had a history of a myocardial infarction, and 11.2% had a history of coronary artery disease. The mean vital signs were: systolic blood pressure, 148.69 mmHg; heart rate, 92.57 beats per minute; and respiratory rate, 20.6 breaths per minute.

Of the 4,663 patients, 1,034 (22.2%) had a primary complaint of pain during EMS transport. Compared with patients who activated EMS with other primary complaints, patients with a primary complaint of pain were significantly younger, had significantly higher diastolic blood pressure and O_2 saturation, and significantly slower heart rate and respiratory rate. Patients with a primary complaint of pain had a significantly greater number of comorbid conditions, and a significantly higher frequency of a history of coronary artery disease, coronary artery bypass graft, sudden cardiac arrest, and myocardial infarction. Patients with a primary complaint of pain had significantly higher GCS scores, indicating better mental status, although mean scores in both groups and the total sample were above 14. A significantly higher percentage of patients who presented with a primary complaint of pain had a pacemaker, or an implantable cardioverter-defibrillator.

The logistic regression model results are presented in Table 2. The odds of presenting to EMS with a primary complaint of pain were 96% higher for those with a history of myocardial infarction ($P < .001$). Conversely, the odds of presenting to EMS with a primary complaint of pain were 3% lower for every one year decrease in age ($P < .001$), and 33% lower for those with shortness of breath ($P < .001$). From the Chi-square analysis (Table 3), men had a higher percentage of chest pain complaints, while women more frequently presented with other pain complaints. Similarly, patients younger than 65 years of age more frequently presented with chest pain as a primary complaint, while those aged 65 years and older more frequently presented with other pain complaints.

Of the 1,034 patients with a primary complaint of pain, 312 (30.2%) had a pain score documented. Pain scores were statistically significantly higher in women (mean 7.18 ± 2.83) compared to men (mean 6.29 ± 3.28), $P = .0123$. Pain scores were significantly higher among patients who self-reported race as White (mean 7.36 ± 2.37) compared to Black (mean 6.38 ± 3.29), $P = .004$. There was no difference in pain scores among patients younger than 65 (mean 6.93 ± 2.93) compared to older than 65 (mean 6.48 ± 3.37), $P = .266$ (data not shown). In the linear regression model (Table 4), factors associated with higher pain severity included being a woman ($b = 1.17$, $P = .001$), and higher systolic blood pressure ($b = 0.013$, $P = .012$). Factors associated with decreased pain severity included younger age ($b = −0.05$, $P < .001$), and Black race compared to White race ($b = −1.11$, $P = .002$). In the results of the ANOVA (Table 5), pain severity scores were significantly

different by gender and race, but not age. There were significant differences in pain severity scores by pain locations. However, there were not significant interactions between gender, age, and race with these four pain locations.

The locations and severity scores among patients with a primary complaint of pain are presented in Table 6 and Figure 1. The most common primary pain complaint was chest pain (68.1%, n = 704), followed by abdominal pain (17.7%, n = 183), generalized pain, (9.2%, n = 95), and back pain (5%, n = 52). Severity scores of pain were 6.79 ± 3.06, indicating moderate to severe pain, and 34.9% had severity scores of a 9 or 10/10. Average pain severity scores among the individual pain locations were 7.33 ± 3.4 among abdominal pain, 8.22 ± 1.8 among back pain, 6.44 ± 2.99 among chest pain, and 8.73 ± 2.05 among generalized pain.

Discussion

This analysis of a community-dwelling sample of patients with HF aimed to identify explanatory factors of activating EMS for a primary complaint of pain, identify explanatory factors of pain severity, and characterize pain locations and severity. Significant explanatory factors of activating EMS for a primary complaint of pain included younger age, absence of shortness of breath, and a previous history of myocardial infarction (see Table 2). History of myocardial infarction was the largest explanatory factor of presenting with pain. Significant explanatory factors of higher pain severity included younger age, being a woman, White race compared with Black race, and higher systolic blood pressure among patients who activated EMS for a primary complaint of pain (see Table 4). Chest pain was the most common pain location at 68.1% (see Figure 1). The percentage of patients with severe chest pain (60.4%) in this study was higher than other studies of patients with HF (28.6%)[10], possibly because these patients were seeking EMS services for pain. However, pain severity scores in the entire sample were the lowest for chest pain, while generalized pain scores were the highest. This study is novel because little literature has examined pain in patients with HF who activated EMS. Identifying and managing pain among patients who are transported by EMS is essential to reduce the risk of death and subsequent rehospitalization. Symptom management in HF is especially important given that as high as 62% of hospital readmissions may be attributable to other comorbid conditions and symptoms.[40]

These results reinforce findings from previous studies that pain is a common symptom in HF.[7,13,41] Pain has been reported in 23 - 85% of patients in both inpatient and community-dwelling samples.[13] Other studies have reported that 37 - 68.9% of hospitalized patients with HF experience either moderate or severe pain.[5,39,42] We found that 22.2% of the sample, or more than 1 in 5 patients, experienced life-threatening or urgent pain resulting in activation of EMS. Furthermore, 34.9% of patients presenting with a primary complaint of pain had scores of 9 or 10/10. Pain was the most severe among patients with a primary complaint of back or generalized pain, which further highlights the alarming level of pain severity experienced in this population (see Table 6).

The number of primary complaints of chest pain and other locations of pain were examined. In previous research, chest pain accounted for 13 - 42% of pain symptoms experienced

by outpatients with HF.[10,17,22] In the parent study, 65% of patients reported chest pain on index transport, independent of having a primary complaint of pain (22.2%).[28] In another study of over 10,000 hospitalized patients with HF, 64% experienced chest pain.[43] The largest predictor of presenting with a primary complaint of pain in this study was a history of myocardial infarction, which is an important finding given the high co-occurrence of myocardial infarction and HF,[24] and may explain why 68.1% of primary complaints of pain were chest pain. History of cardiac conditions and high blood pressure have been associated with presentation of chest pain in previous studies.[16] Outside of chest pain, 32% of patients had a primary complaint of pain in other locations. Previous findings have reported that as high as 60% of patients with HF report pain in the back, shoulders, and upper/lower extremities.[7,39,44] It is unclear whether the other locations of pain observed in this sample were driven by HF pathology or by other musculoskeletal or inflammatory conditions (i.e. arthritis, osteoporosis, herniated discs)[45-47] However, these results highlight that both cardiac and non-cardiac forms of pain are prevalent and may lead to activation of EMS. This may indicate the need for targeted interventions based on etiology, type, or location of pain in this population.

In our analysis, being a woman was associated with worsened pain severity by 1.17 on a scale of 0-10 (see Table 4). This may constitute a clinically meaningful increase based on previous minimally clinically important difference studies of 0-10 pain severity scales among patients with chronic pain.[48] The results build on previous findings that women tend to have higher pain severity.[7,22] A higher percentage of women also presented with a primary complaint of pain compared to men, but the difference was not statistically significant. These results are congruent with some previous studies of patients with HF which found no strong relationship between gender with pain presence,[5,10,39,42,49] though there is still a lack of consensus.[6,15,16] Few studies have examined differences in pain severity between men and women seeking care from EMS. Generally, women remain underrepresented in HF studies, and further research is needed to better understand the differences in pain characteristics between men and women.

In the current study, the patients with a primary complaint of pain were significantly younger than those without a primary complaint of pain by 5.7 years (see Table 1). Moreover, younger age was associated with higher pain severity scores and an increased likelihood of presenting with pain. The majority of studies in HF populations have found no significant relationships between age and pain,[5,10,16,21,22,42,49] although some studies have reported both negative[39] and positive[6] associations between age and pain. Patients with HF tend to be older, and as such have a higher number of comorbid conditions which increase symptom burden.[1] Interestingly, while studies do report high pain prevalence rates among older patients with HF, pain severity appears to be similar between older and younger patients.[12,22,23] Our findings may be driven by sample differences, as our sample included only patients who activated EMS. Overall, the relationship between pain and age in HF requires additional research.

This study found a negative relationship between shortness of breath and presentation with a primary complaint of pain, but not with pain severity (see Tables 2 and 4). This finding contrasts with previous literature in both HF and older populations.[10,50] Pain in HF

may result from impaired oxygenation and circulation which induces demand ischemia.[14] Importantly, respiratory problems were the most common primary complaint in the parent study (28.8%), which meant those patients were not included in the subset with a primary complaint of pain.[28] This may explain why shortness of breath was negatively associated with presenting with a primary complaint of pain, yet a similar relationship was not observed for pain severity. Another possible reason for this unexpected finding may be the younger age of the sample with pain, who may have less general deconditioning, or from medical treatments received during the index transport (i.e., oxygen, nitroglycerin). Additional research is needed to explore the relationship between pain and shortness of breath among patients with HF who activate EMS.

One interesting finding was that self-reported White race was associated with increased pain severity despite Black patients presenting with a primary complaint of pain more frequently (see Tables 2, and 4). National studies have identified that Black patients are more likely than White patients to use emergency departments for routine care of ongoing health conditions, and are less likely to have a primary care provider.[51] This disparity may explain why a higher percentage of Black patients were transported for a primary complaint of pain in our study, yet had lower average pain scores. This may reflect the ongoing challenge created by lack of access to high-quality care among vulnerable racial groups, and should be studied further in regards to pain among HF populations.[52] Previous literature has documented that pain disproportionally affects vulnerable racial and ethnic populations, who have more severe pain, higher limitations, increased psychologic distress, and limited access to healthcare services.[53,54] Additional research is needed to examine the relationships between race and pain in patients with HF in both emergency and non-emergency healthcare settings.

Patients with HF frequently suffer from other comorbid conditions and symptoms that increase symptom burden, including pain.[7,41,55] We found that only a history of myocardial infarction was associated with pain. However, this study analyzed primarily comorbid cardiac conditions, and there are additional chronic conditions (e.g. depression, diabetes) that could be examined further.[56] Effective pain management in the context of other complex symptoms and conditions is essential to promote optimal recovery among patients with HF.[7] Pain in patients with HF has been associated with all-cause mortality, myocardial infarction, and hospitalization,[15] though other studies have not found such a relationship.[10] As such, it remains unclear what survival trends will occur with patients transported by EMS with complaints of chest pain compared to other locations of pain, which may be driven by differences in pathophysiology.[28]

Strengths and Limitations

The strengths of this study include an understudied yet important prehospital sample of patients who are being transported by EMS with HF and pain. Additionally, the study analyzed a large dataset with a high percentage of patients who were women and Black. There are some limitations to this work. First, this sample consisted of patients with HF seeking care from EMS in one metropolitan area and may not be representative of a general HF population, in particular rural patients. Second, the data were not available for

echocardiographic validation of an HF diagnosis, which is a common limitation of point-of-care data originating from an emergency field setting without access to such diagnostic tests. Relatedly, we did not have access to hospital admission or discharge diagnoses, which may have provided additional clarity regarding the origin of the pain complaint expressed by the patient. Fourth, there are additional factors that contribute to pain that were not available in the dataset, including depressive symptoms and anxiety. Additionally, our data set only collected data on cardiac comorbidities, and so there are additional non-cardiac comorbid conditions that could be controlled for in subsequent studies, such as diabetes or chronic obstructive pulmonary disease.

Implications for Future Research

From these study findings, additional research is needed. First, future studies should prospectively examine affective symptoms and other comorbid conditions that were not captured in this dataset but could be associated with a primary complaint of pain. Examination of all factors associated with pain presence and severity is crucial to improve pain management and prevent EMS transport due to pain. Second, prospective longitudinal research is needed to explore if these factors can predict a primary utilization of EMS for a complaint of pain, and pain severity. Longitudinal research can also determine if pain is associated with multiple transports as well as other hospital outcomes, including discharge status and disposition. Third, additional research is needed regarding triaging of patients with HF and pain as urgent vs. emergent within emergency care settings and its subsequent relationship with hospital outcomes. Fourth, the underlying mechanisms of pain in HF need to be examined further, including genetic influences.[12] However, biologic mechanisms underlying pain should be studied alongside patient reported outcomes given that pain is both a sensory and emotional experience.[11]

Our study findings highlight several implications for nursing. Nurses play a crucial role in pain management education among patients suffering with chronic illness, including HF.[42] Although some research has found that older (≥ 65 years) hospitalized patients with HF may not receive appropriate education on pain management and monitoring prior to discharge,[42] less research has been conducted on how younger hospitalized patients with HF and pain are educated by nurses. Nurses should recognize both the presence of multiple pain conditions experienced by patients with HF as well as its prognostic implications for survival and quality of life, particularly when conducting health assessments.[18] This is important because documentation of pain and other co-occurring symptoms by homecare nurses for patients with HF has been associated with a higher risk of emergency department visits.[57] As such, education of patients and family members about strategies to manage pain and when to seek treatment is crucial to improve outcomes.[28,30]

Conclusion

Results revealed that more than 1 in 5 patients with HF presented to EMS with a primary complaint of pain. Patient characteristics associated with increased odds of presenting with a primary complaint of pain included younger age, having a history of myocardial infarction, and absence of shortness of breath. Additionally, factors associated with more severe pain

were younger age, being a woman, higher systolic blood pressure, and self-reported White race compared with Black race. This study emphasizes the prevalence and severity of pain among patients with HF leading to activation of EMS, indicating the need for better pain management strategies in this population.

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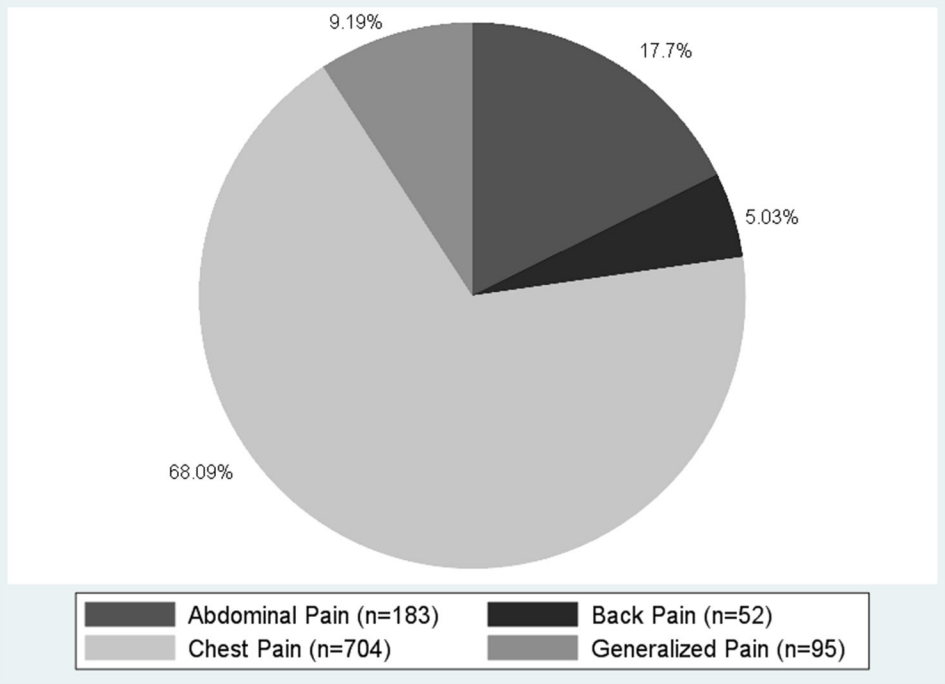

Figure 1 –.
Pie chart of primary complaints of pain by location (n=1,034)

Table 1 –

Demographics of patients with heart failure during emergency medical services transport (N=4,663)

Variable	Total sample (n=4,663)	No complaint of pain (n=3,629)	Complaint of pain (n=1,034)	p-value
Age in years	64.16 ± 14.26	65.42 ± 14.09	59.73 ± 13.97	< .001
Gender				.262
Women	2,709 (58.1%)	2,124 (58.5%)	585 (56.6%)	
Men	1,954 (41.9%)	1,505 (41.5%)	449 (43.4%)	
Race				.733
White	1,934 (41.5%)	1,500 (41.3%)	434 (42.0%)	
Black	2,689 (57.7%)	2,099 (57.8%)	590 (57.1%)	
Other	40 (0.9%)	30 (0.8%)	10 (1%)	
Ethnicity (n=4,612)				.030
Not Hispanic/Latino	4,574 (99.2%)	3,563 (99.3%)	1,011 (98.6%)	
Hispanic/Latino	38 (0.8%)	24 (0.7%)	14 (1.4%)	
Vital signs				
Systolic BP in mmHg	148.69 ± 38.91	148.95 ± 40.29	147.75 ± 33.65	.334
Diastolic BP in mmHg (n=3,954)	83.45 ± 21.67	83.07 ± 22.20	84.75 ± 19.72	.030
Heart rate in BPM	92.57 ± 24.48	93.00 ± 24.30	91.03 ± 25.03	.025
Respiratory rate	20.60 ± 6.75	21.06 ± 7.20	18.97 ± 4.51	< .001
O_2 saturation in %	94.78 ± 8.16	94.18 ± 8.93	96.89 ± 3.87	< .001
Glasgow Coma Scale (n=4,363)	14.58 ± 1.71	14.47 ± 1.92	14.97 ± 0.36	< .001
Shortness of breath	2,241 (48.1%)	1,817 (50.1%)	424 (41.0%)	< .001
Number of medications	6.44 ± 5.26	6.42 ± 5.25	6.50 ± 5.30	.670
Number of comorbid conditions	1.26 ± 0.92	1.20 ± 0.88	1.45 ± 1.02	< .001
Comorbid conditions				
Coronary artery disease	522 (11.2%)	374 (10.3%)	148 (14.3%)	< .001
Atrial fibrillation	488 (10.5%)	384 (10.6%)	104 (10.1%)	.628
Hypertension	3,511 (75.3%)	2,732 (75.3%)	779 (75.3%)	.971
Coronary artery bypass graft	252 (5.4%)	173 (4.8%)	79 (7.6%)	< .001
Myocardial infarction	846 (18.1%)	544 (15.0%)	302 (29.2%)	< .001
Sudden cardiac arrest	40 (0.9%)	23 (0.6%)	17 (1.6%)	.002
Devices				
Pacemaker	311 (6.7%)	220 (6.1%)	91 (8.8%)	.002
ICD	182 (3.9%)	117 (3.2%)	65 (6.3%)	< .001

Actual sample size is provided when total sample does not equal 4,663 due to missing data.

Abbreviations: BP, blood pressure; BPM, beats per minute; SD, standard deviation; ICD, implantable cardioverter-defibrillator

Table 2 –

Logistic regression of associations between patient characteristics and presenting with a primary complaint of pain (N=4,663)

Variable	Odds (95% CI)	P-value
Age	0.97 (0.96 – 0.97)	< .001
Gender (reference level = Men)		
Women	1.11 (0.96 – 1.28)	.173
Race (reference level = White)		
Black	1.05 (0.91 – 1.22)	.497
Other	1.22 (0.57 – 2.60)	.608
Shortness of breath	0.67 (0.58 – 0.77)	< .001
Number of medications	1.00 (0.99 – 1.02)	.860
Number of comorbid conditions	1.13 (0.97 – 1.31)	.105
Comorbid conditions		
Coronary artery disease	1.15 (0.87 – 1.53)	.315
Atrial fibrillation	0.96 (0.72 – 1.28)	.786
Coronary artery bypass graft	1.13 (0.81 – 1.58)	.480
Myocardial infarction	1.96 (1.55 – 2.49)	< .001
Devices		
Pacemaker	1.30 (0.96 – 1.77)	.093
Implantable cardioverter-defibrillator	1.45 (1.00 – 2.10)	.050

Table 3 –

Chi-square of locations of primary complaints of pain by gender, age, and race (n=1,034)

Variable	Abdominal (N=183)	Back (N=52)	Chest (N=704)	Generalized (N=95)	Chi2	P-value
Gender					9.912	.019
Women (n=585)	116 (19.8%)	34 (5.8%)	375 (64.1%)	60 (10.3%)		
Men (n=449)	67 (14.9%)	18 (4.0%)	329 (73.3%)	35 (7.8%)		
Age					13.950	.003
<65 years (n=695)	106 (15.3%)	31 (4.5%)	499 (71.8%)	59 (8.5%)		
≥65 years (n=339)	77 (22.7%)	21 (6.2%)	205 (60.5%)	36 (10.6%)		
Race (n=1,024) *					1.153	.764
White (n=434)	74 (17.1%)	22 (5.1%)	302 (69.6%)	36 (8.3%)		
Black (n=590)	108 (18.3%)	30 (5.1%)	394 (66.8%)	58 (9.8%)		

* Race calculated with only self-reported White and Black patients due to sample size

Percentages are calculated across locations for each age, gender, and racial group

Table 4 –

Multiple linear regression of associations between patient characteristics and pain severity (n=312)

Variable	Coef. ± Std. Error	t	P-value
Age	−0.05 ± 0.013	−3.69	< .001
Gender (reference level = Men)			
Women	1.17 ± 0.357	3.27	.001
Race (reference level = White)			
Black	−1.11 ± 0.349	−3.19	.002
Other	−1.72 ± 1.546	−1.11	.268
Vital signs			
Systolic blood pressure	0.013 ± 0.005	2.53	.012
Heart rate	−0.011 ± 0.008	−1.52	.129
Respiratory rate	0.09 ± 0.046	1.86	.064
O_2 saturation	−0.09 ± 0.053	−1.60	.111
Shortness of breath	−0.23 ± 0.353	−0.65	.515
Number of medications	0.04 ± 0.032	1.33	.185
Number of comorbid conditions	0.24 ± 0.327	0.74	.458
Comorbid conditions			
Coronary artery disease	−0.55 ± 0.604	−0.90	.368
Atrial fibrillation	−0.63 ± 0.632	−1.00	.320
Coronary artery bypass graft	−0.51 ± 0.728	−0.70	.485
Myocardial infarction	0.11 ± 0.516	0.22	.829
Devices			
Pacemaker	0.15 ± 0.727	0.21	.837
Implantable cardioverter-defibrillator	0.23 ± 0.948	0.25	.805

Table 5 –

Two-way ANOVA of pain severity by pain location and by gender, age, and race (n=312)

Source	F	df	*P*
Gender	4.67	1, 307	.031
Location	4.88	3, 307	.003
Gender X Location	0.42	3, 304	.742
Age	2.49	1, 307	.116
Location	5.92	3, 307	.001
Age X Location	1.23	3, 304	.298
Race (n=308) *	8.62	1, 303	.004
Location (n=308) *	5.51	3, 303	.001
Race X Location (n=308) *	0.69	3, 300	.558

* Race calculated with only self-reported White and Black patients due to sample size

Table 6 –

Pain severity by location of primary pain complaints and by gender, age, and race (n=312)

Variable	All Complaints	Abdominal (n=40)	Back (n=18)	Chest (n=297)	Generalized (n=19)
Total Sample	6.79 (3.06)	7.33 (3.41)	8.22 (1.80)	6.44 (3.05)	8.73 (2.05)
Gender					
Women (n=177)	7.18 (2.83)	7.77 (3.04)	8.43 (1.79)	6.79 (2.85)	8.50 (2.35)
Men (n=135)	6.29 (3.28)	6.50 (4.01)	7.50 (1.91)	6.04 (3.24)	9.14 (1.46)
Age					
<65 years (n=220)	6.93 (2.93)	8.12 (2.57)	8.08 (1.88)	6.53 (2.98)	9.09 (1.64)
≥65 years (n=92)	6.48 (3.37)	5.86 (4.33)	8.50 (1.76)	6.20 (3.25)	8.25 (2.55)
Race (n=308) *					
White (n=140)	7.36 (2.37)	8.09 (3.18)	7.83 (1.83)	6.98 (2.54)	9.67 (0.71)
Black (n=168)	6.38 (3.29)	6.39 (3.55)	8.42 (1.83)	6.06 (3.34)	7.90 (2.51)

* Race calculated with only self-reported White and Black patients due to sample size