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Non-Cardiac Chest Pain After Acute Myocardial Infarction: Frequency and Association with Health Status Outcomes

Mohammed Qintar, MD^{a,b}, John A. Spertus, MD, MPH^{a,b}, Yuanyuan Tang, PhD^a, Donna M. Buchanan, PhD^{a,b}, Paul S. Chan, MD, MSc^{a,b}, Amit P. Amin, MD, MSc^c, and Adam C. Salisbury, MD, MSc^{a,b}

^aSaint Luke's Mid America Heart Institute

^bUniversity of Missouri-Kansas City, Kansas City, MO

^cWashington University School of Medicine, Saint Louis, MO

Abstract

Background—The frequency of non-cardiac chest pain (CP) hospitalization after acute myocardial infarction (AMI) is unknown, and its significance from patients' perspectives is not studied.

Objectives—To assess the frequency of non-cardiac CP admissions after AMI and its association with patients' self-reported health status.

Methods—We identified cardiac and non-cardiac CP hospitalizations in the year after AMI from the 24-center TRIUMPH registry. Hierarchical repeated measures regression was used to identify the association of these hospitalizations with patients' self-reported health status using the Seattle Angina Questionnaire Quality of Life domain (SAQ QoL) and Short Form 12 (SF-12) physical (PCS) and mental (MCS) component summary scores.

Results—Of 3099 patients, 318 (10.3%) were hospitalized with CP, of whom 92 (28.9%) were hospitalized for non-cardiac CP. Compared with patients not hospitalized with CP, non-cardiac CP hospitalization was associated with poorer health status (SAQ QoL adjusted differences: −8.9 points [95% CI −12.1, −5.6]; SF-12 PCS: −2.5 points [95% CI −4.2, −0.8] and SF-12 MCS: −3.5 points [95% CI −5.1, −1.9]). SAQ QoL for patients hospitalized with non-cardiac CP was similar to patients hospitalized with cardiac CP (adjusted difference: 0.6 points [95% CI −3.2, 4.5]; SF-12

Corresponding author: Adam C. Salisbury, MD, MSc, 4401 Wornall Road, Kansas City, MO 64111. Phone: 816-751-8943, Fax: 816-932-5613, asalisbury@saint-lukes.org.

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Author Contributions:

Mohammed Qintar, MD: analysis of data, interpretation of data, drafting and revisions of manuscript.

Yuanyuan Tang, PhD: Statistical analyses, revisions of manuscript.

Donna M. Buchanan, PhD: interpretation of data, drafting and revisions of manuscript.

Paul S. Chan, MD, MSc: interpretation of data, drafting and revisions of manuscript.

Amit P. Amin, MD, MSc: interpretation of data, review and revisions of manuscript.

John A. Spertus, MD MPH: conception and design of study, funding of study, coordination of study, interpretation of data, drafting and revisions of manuscript.

Adam C. Salisbury, MD, MSc: conception and design of study, analysis of data, interpretation of data, drafting and revisions of manuscript.

PCS (0.9 points [95% CI −1.1, 2.9]), but was worse with regards to SF-12 MCS (adjusted difference: −2.0 points [95% CI −3.9, −0.2]).

Conclusions—Non-cardiac CP accounted for a third of CP hospitalizations within one year of AMI and was associated with similar disease-specific QoL as well general physical and mental health status impairment compared with cardiac CP hospitalization.

Keywords

chest pain; non-cardiac; angina; rehospitalization and health status outcomes

Prior studies have reported that 1 in 4 patients experience recurrent chest pain (CP) after acute myocardial infarction (AMI)^{1,2}. Although these patients may experience angina secondary to incomplete revascularization or recurrent ischemic events, others present with non-cardiac CP syndromes that can be difficult for them to distinguish from angina or a recurrent acute coronary syndrome^{3,4}. In fact, prior studies have indicated that 90% of patients diagnosed with non-cardiac CP in the general population continue to complain of chest pain at 2 years.⁵ This often leads to recurrent evaluations, which are associated with high resource utilization and cost^{3,6–8}. Although substantial effort has been directed toward protocols to efficiently risk stratify patients presenting to the hospital with CP^{9,10}, many of these patients are still hospitalized for further evaluation. Moreover, since the Centers for Medicare and Medicaid Services now reduce payments to hospitals with high readmission rates in the 30 days following AMI¹¹, understanding the frequency and impact of non-cardiac CP hospitalizations post AMI has become increasingly important.

Currently, the frequency of non-cardiac CP after AMI and its association with health-related quality of life is unknown. To identify the incidence of hospitalization with non-cardiac CP in the first year after AMI, and to determine its association with patients' health status, we analyzed data from the 24-center Translational Research Investigating Underlying Disparities in Acute Myocardial Infarction Patients' Health Status (TRIUMPH) study. TRIUMPH collected detailed data about patient characteristics and health status, as well as physician-adjudicated hospitalization data. To contextualize these results, we also examined the health status outcomes associated with cardiac CP hospitalization, and compared the impact of non-cardiac and cardiac CP hospitalization on health status outcomes. Finding a high frequency of non-cardiac CP admissions, and a strong association with health status, would underscore the importance of further studying and developing treatment strategies and protocols for this condition.

METHODS

TRIUMPH Study

A total of 4340 patients were enrolled in the TRIUMPH study between April 11, 2005 and December 31, 2008. Patients were ≥18 years of age, with elevated cardiac biomarkers (troponin or creatine kinase-MB fraction assessed within 24 hours of admission), and supporting evidence of an AMI (electrocardiographic ST-segment changes or prolonged ischemic signs/symptoms). Each patient underwent a standardized interview by research staff to document sociodemographic and clinical data, as previously described. Patients were

then contacted for follow-up interviews at 1, 6 and 12-months after AMI. All patients signed an informed consent after Institutional Review Board approval was obtained at each participating center. Funding support for the TRIUMPH Registry from the National Heart Lung and Blood Institute (P50 HL077113). The authors are solely responsible for the design and conduct of this study, all study analyses, the drafting and editing of the paper and its final contents.

A separate informed consent was obtained from TRIUMPH participants to collect their rehospitalization records for adjudication. During telephone interviews at 1, 6 and 12 months, patients were asked to report any admissions to any hospital. Any reported admissions led to retrieval of all hospital records over the year after AMI from the reported hospital. These documents were independently reviewed by at least two members of a physician adjudication panel to determine cause of hospitalization and document in-hospital processes of care. In the event that the initial two reviewers disagreed on the cause for hospitalization, a third reviewer independently reviewed the documents to ascertain the cause of hospitalization.

Study Population

Of the 4340 patients enrolled in TRIUMPH, 24 died before discharge from the index AMI hospitalization and 310 did not consent to release of medical records for the rehospitalization follow-up study. Among the remaining 4006 patients, 631 did not complete any follow-up interviews and 248 did not have physician-adjudicated hospitalization data, most often due to refusal of the admitting hospital to provide the medical records. We further excluded 28 patients who had only a hospitalization for staged percutaneous coronary intervention (PCI), yielding 3099 eligible patients participating in the follow-up rehospitalization study with complete follow-up data during the year after their AMI hospitalization.

Definitions and Adjudication Process

Each CP hospitalization was classified as non-cardiac or cardiac by the physician adjudication panel. Patients were classified as having a non-cardiac CP hospitalization if they were admitted with atypical or non-cardiac description of CP^{12,13} and the following conditions were absent: elevated cardiac biomarkers, evidence of myocardial ischemia on non-invasive stress tests, flow limiting epicardial coronary stenosis (>70%) or abnormal fractional flow reserve (<0.80). Specifically, patients with normal myocardial perfusion on stress myocardial perfusion imaging or normal wall motion on stress echocardiography who described atypical or non-cardiac chest pain were classified as having non-cardiac CP. The treating physician's diagnosis of non-cardiac CP was also used to identify non-cardiac CP hospitalizations. Cardiac CP was categorized according to standard definitions of stable angina, unstable angina, NSTEMI and STEMI after reviewing hospital records. The adjudicators specifically focused upon in-hospital testing, including cardiac biomarkers, ECG findings, stress testing and angiographic findings of severe epicardial stenoses or fractional flow reserve <0.80, and the treating physician's diagnoses. Specific cardiac chest pain definitions are listed in Supplementary Table 1. Any patient with no hospitalizations, cardiac hospitalizations unrelated to CP or with hospitalization for non-cardiac reasons in

the first year after AMI was categorized as not having had a CP hospitalization. Any patient admitted for both cardiac and non-cardiac chest pain during follow-up was classified in the cardiac chest pain group.

Outcome Measures

The primary outcome was disease-specific health status, which was evaluated using the quality of life domain of the disease-specific Seattle Angina Questionnaire (SAQ QoL). The SAQ is a 19-item self-administered instrument, with a 4-week recall period, that quantifies coronary artery disease-specific health status¹⁴. The SAQ is a 19-item self-administered instrument, with a 4-week recall period, that quantifies coronary artery disease-specific health status¹⁴. At each follow-up telephone interview, the SAQ and the SF-12 were administered by trained study nurses to record patients self-reported health status. The SAQ has well-established validity, reliability and is more sensitive to clinical change than generic health status measures. SAQ scores are also independently associated with costs, morbidity and mortality among CAD patients^{15–17}. Scores range from 0–100, where higher scores indicate better function, fewer symptoms and better quality of life. The SAQ asks patients to report CP, tightness or angina, but does not specifically distinguish between pain of an anginal character and other causes of CP. Accordingly, it is likely to effectively quantify the health status impact of CP regardless of its etiology.

As a secondary outcome, we also evaluated general health status using the generic Short Form 12 (SF-12)¹⁸. The SF-12 consists of 12 questions assessing two domains, the physical component (PCS) and the mental component (MCS) scores, which provide an assessment of patients' overall physical and mental function. A score of 50 is normalized to the mean health status of the US population and each 10 points represents 1 standard deviation from that mean. The lower the score, the worse the patient perceives his or her generic health status, and lower scores have been shown to correlate with a greater likelihood for admissions due to cardiac causes and death^{19–21}.

Statistical Analyses

We compared the baseline demographics, clinical characteristics and treatments of patients with non-cardiac CP hospitalization, cardiac CP hospitalization and those with no CP hospitalizations during the follow-up period. Continuous variables were reported as the mean $\pm$ standard deviation and differences were compared using one way analysis of variance. Categorical variables were compared using chi-square tests.

To understand the association between CP hospitalization and patients' health status (comparing patients hospitalized with non-cardiac CP vs. no CP hospitalizations, and those with cardiac CP hospitalization vs. no CP hospitalizations; Figure 1), we then fit 3 hierarchical repeated measure linear models to assess the association between CP hospitalization and each of the three health status outcomes: the disease-specific SAQ QoL and the generic SF-12 PCS and MCS domains. This repeated measures approach included all follow-up health status assessments (1, 6 and 12 months). In order to compare the relative health status impact of non-cardiac versus cardiac CP, we also directly compared the difference in health status scores among patients hospitalized with cardiac vs. non-cardiac

CP. All models adjusted for important potential confounders that were identified based upon either clinical judgment or a statistically significant difference between groups ($p < 0.05$) in univariate analyses. Patients' baseline health status scores were included in each analysis examining that same health status outcome, along with age, race, sex, smoking status, prior coronary artery bypass grafting (CABG), peripheral arterial disease, diabetes mellitus, insurance status (insurance vs. no insurance), Patient Health Questionnaire-9 depression scale score^{22,23}, Perceived Stress Scale-4 score²⁴, working status, marital status, in-hospital revascularization during index admission (percutaneous coronary intervention [PCI] vs. none, CABG vs. none), number of diseased vessels on coronary angiography during index hospitalization, ST-elevation MI (STEMI) vs. non ST-elevation MI (NSTEMI) and cardiac rehabilitation during follow-up. Finally, to contextualize the association of non-cardiac CP with health status outcomes, we used the same multivariable modeling to compare health status outcomes again between patients hospitalized with non-cardiac and cardiac CP.

In addition, we performed a time-to-rehospitalization analysis using the Kaplan-Maier method to and present these curves to show the timing of rehospitalization events among the different groups across the follow-up period. Finally, to identify additional independent predictors of health status in follow-up after AMI, we examined the relationship between covariates in the multivariable linear regression models and each health status outcome.

Sensitivity Analyses

We also evaluated for potential bias related to missing follow-up data. A total of 1189 patients with missing follow-up data over the 1-year follow-up period, who were not included in our primary analysis, were included in a sensitivity analysis along with the 3099 patients who had complete follow-up data. We generated a propensity score for likelihood of having complete follow-up data, including all baseline demographic, clinical and treatment variables in a non-parsimonious logistic regression model. Multivariable modeling for health status outcomes and predictors of non-cardiac CP hospitalization were then repeated to determine whether missing follow-up data influenced our results after weighting using the inverse of the propensity score to participate in follow-up. Essentially, this analysis assigns greater weight to the outcomes of a patient who had complete follow-up who was statistically most similar to a patient without complete follow-up, and less weighting to the outcomes of a patient with propensity score consistent with high likelihood of follow-up.

To study the association between timing of rehospitalizations, type (cardiac, non-cardiac and none), and health status we conducted further sensitivity analyses in which the patients were identified who were hospitalized for evaluation of chest pain symptoms within 1 month after the 30-day and 6 month assessments. These patients were categorized according to the type of chest pain and were compared to patients who were not hospitalized with chest pain over the follow-up period. Scores on each health status measure across these groups are presented in Supplementary Table 2, but across measures, health status was significantly worse among patients who were hospitalized with non-cardiac and cardiac chest pain within a month after assessment, in comparison to patients who had no hospitalizations for chest pain.

RESULTS

Patient characteristics

The baseline characteristics of patients with non-cardiac CP, cardiac CP and no CP hospitalizations are presented in Table 1. Briefly, compared to patients with no CP hospitalization and with non-cardiac chest pain hospitalization, patients with cardiac CP hospitalization were more likely to be non-white, to have cardiac comorbidities (including diabetes, hypertension, prior MI, prior PCI and prior CABG), to be depressed and less likely to work full or part time. Moreover, no differences were found in access to care metrics at baseline or at 6 or 12 months post AMI.

We report that cardiac catheterization was performed on 43% vs 5% vs 5% of patients with cardiac CP hospitalization, non-cardiac CP hospitalization and no chest pain hospitalizations, respectively. PCI during 1-year follow-up was performed on 31% of patients with cardiac CP hospitalization vs 7% in patients with no chest pain hospitalizations. None of the patients with non-cardiac CP hospitalization received PCI.

Frequency of non-cardiac chest pain hospitalization

In the year following an AMI admission, 318 of 3099 (10.3%) patients were hospitalized for evaluation and management of CP. Of these, 92 (28.9%) were admitted for non-cardiac CP and the remaining 226 patients were hospitalized with cardiac CP; 70 (31%) with recurrent AMI, 131 (58.0%) with unstable angina and 25 (11.0%) with stable angina. The timing of cardiac and non-cardiac chest pain hospitalizations over the follow-up period are presented in Figure 2 and Supplementary Figure 4.

Chest pain hospitalization and health status outcomes

Both non-cardiac CP and cardiac CP hospitalizations were associated with significantly worse disease-specific health status over the follow-up period as compared to patients without a CP hospitalization. After adjusting for patient characteristics, those hospitalized with non-cardiac CP had significantly lower SAQ QoL scores than those without a CP hospitalization (adjusted difference of -8.1 points, 95% CI -11.4, -4.8; Figure 3 and 4) similar to patients admitted with cardiac CP (adjusted difference of -9.5 points, 95% CI -11.7, -7.3) as compared with those without a CP hospitalization. The SAQ QoL scores over the year after AMI was similar between those with non-cardiac and cardiac CP admissions (difference in adjusted scores of 0.6 points, 95% CI -3.2, 4.5).

Similarly, general health status was worse among patients hospitalized with non-cardiac CP than those who were not hospitalized with CP (Figure 3 and 4). Patients presenting with non-cardiac CP (adjusted difference in SF-12 PCS scores of -2.5 points, 95% CI -4.2, -0.8) or cardiac CP (adjusted difference in SF-12 PCS scores of -3.4 points, 95% CI -4.5, -2.2) reported poorer physical functioning than those without hospitalization for with CP. There were no significant differences in the adjusted SF-12 PCS scores when comparing patients with non-cardiac CP hospitalizations and those who had cardiac CP hospitalizations (difference of 0.9 points, 95% CI -1.1, 2.9).

Mental health scores, as assessed by the adjusted SF-12 MCS, were lower in patients hospitalized with non-cardiac CP in comparison as compared with those who were not hospitalized with CP (difference -3.5 points, 95% CI -5.1, -1.9). Patients hospitalized with cardiac CP also had lower SF-12 MCS scores compared with to patients who had no CP hospitalizations (-1.4 points, 95% CI -2.5, -0.4). In contrast to the other health status measures, patients with non-cardiac CP hospitalization had worse mental health status over the follow-up period than patients hospitalized with cardiac CP (SF-12 MCS adjusted difference -2.0 points, 95% CI -3.9, -0.2).

We repeated the multivariable modeling process, using the same model structure and covariates, for each SAQ subscale and the SAQ Overall Summary Score (Supplementary Figure 1). These results were consistent with findings on the SAQ QoL scale indicating worse health status among patients with either cardiac or non-cardiac chest pain.

Other clinical characteristics independently associated with health status in recovery after AMI are presented in Supplementary Figures 2a, 2b and 2c. Older age, current work employment, being married and in-hospital revascularization during the index hospitalization were associated with better quality of life. However, smoking, presenting with STEMI, female gender, depression and stress, having no insurance and history of CABG prior to the index AMI were all associated with worse quality of life.

Sensitivity analyses

After adjusting our analyses for the inverse of the propensity to have complete follow-up data, we found no significant differences in our results, suggesting that there was little bias due to missing follow-up data.

Adjudication process

Initially, two physicians adjudicated each chart and in case of disagreement the chart was sent to a third physician for review (blinded to initial two reviews). In case of continued disagreement among the three reviewers, more reviewers (blinded to initial reviews) were invited to help with the adjudication. We report that the agreement between the initial two reviewers was high for all the three groups studied (75% vs 71% vs 85% for cardiac CP vs non-cardiac CP vs no CP hospitalizations, respectively). In cardiac CP hospitalization group, 21% needed a third reviewer and only 4% needed a fourth reviewer. In the non-cardiac CP hospitalization group, 23%, 3% and 2% needed a third, fourth and fifth reviewer, respectively.

Mortality

Mortality in the first two years after AMI was numerically lower in those with non-cardiac CP hospitalization (although with low event rates) but not significantly different compared to those with cardiac CP hospitalization and those without chest pain hospitalizations (2 [2.2%] vs. 18 [8.0%] vs. 188 [6.8%], respectively, $p=0.17$). Moreover, the 2-year mortality rates were also not significantly different between non-cardiac CP and cardiac CP groups (p value of 0.07).

Predictors of non-cardiac chest pain hospitalization

We identified several independent predictors of both non-cardiac CP and cardiac CP hospitalization. Compared with patients without a hospitalization for CP, patients with a greater burden of angina at the time of their index AMI, women and diabetics were more likely to be admitted with cardiac CP, but these patient factors were not associated with admission for non-cardiac CP (Supplementary Figure 3). Current smokers were less likely to present with non-cardiac CP, while there was no difference in the likelihood of hospitalization with cardiac CP in follow-up between smokers and non-smokers. Married patients were less frequently admitted to the hospital for evaluation of chest pain regardless of etiology, while those with prior CABG (before their index AMI) were more likely to be hospitalized with both cardiac CP and non-cardiac CP. Individuals treated with PCI during the index hospitalization were more likely to be hospitalized with cardiac CP than those who did not undergo revascularization.

DISCUSSION

In an era of increasing attention on post-AMI rehospitalization²⁵, understanding the frequency and types of CP hospitalization following AMI and the clinical significance of these CP hospitalizations is increasingly important. To our knowledge, there are no prior studies of the incidence and clinical implications of non-cardiac CP hospitalizations following AMI. We leveraged a multicenter AMI registry with carefully adjudicated data on all rehospitalizations in the first year after AMI to address this gap in knowledge. We found that hospitalization for CP within the first year after AMI occurred in 10% of patients, and that 1 in 3 patients hospitalized with CP presented with a non-cardiac etiology for their symptoms. Non-cardiac CP hospitalization was associated with poorer disease-specific and general health status throughout the first year of recovery as compared with those not admitted with recurrent CP and was associated with similar decrements in health status as compared with patients admitted for cardiac CP. In fact, although non-cardiac CP hospitalization was associated with slightly worse impairment of mental functioning than cardiac CP hospitalization, the difference was clinically modest and unlikely to be clinically significant.

Our study extends prior reports regarding the association of non-cardiac CP with patients' perceived quality of life. Prior studies have examined patients without known coronary artery disease, often identified in the Emergency Department or in outpatient clinics. These reports have suggested that patients with non-cardiac CP may have poor health status²⁶, and have similar or even greater levels of anxiety compared with those who have cardiac chest pain²⁷⁻²⁹. Importantly, it has been shown that many patients with non-cardiac CP are not reassured after being informed their chest pain is not of cardiac origin, often remaining anxious and seeking further medical evaluation⁸. Our report examines the relationship between non-cardiac CP and health status in a much higher risk population with recent AMI. Our data suggest a strong association between non-cardiac CP admissions and poorer health status in these patients with established CAD, indicating a clear need to better identify and treat the underlying causes of non-cardiac CP.

Non-cardiac CP has been shown to commonly occur with several conditions such as gastrointestinal, musculoskeletal and psychiatric disorders³⁰. Gastrointestinal diagnoses such as reflux disease, esophageal spasm, and cholelithiasis have been found to be important causes of symptoms in patients presenting with non-cardiac CP^{3,4,31}. In a small study of patients with coronary artery disease who had continued atypical CP despite medical therapy or revascularization, it was found that nearly two thirds had gastroesophageal reflux disease, and the majority of these patients experienced significant symptom relief with treatment⁴. Similarly, musculoskeletal CP is also a common, treatable cause of symptoms in a many patients with non-cardiac CP^{31–34}. Moreover, psychiatric conditions are prevalent among patients with non-cardiac CP and include panic, anxiety, and depressive disorders³⁵. Prior studies have shown that cognitive behavioral therapy is an effective treatment option for patients presenting with non-cardiac CP^{36,37}. To date, however, no systematic strategies to pro-actively evaluate these potential etiologies of non-cardiac CP have been developed or tested. Given that as many as a third of CP admissions are not cardiac in etiology, systematically seeking to identify and intervene in high-risk patients might be a cost-effective intervention that may also improve patients' health status recovery after an AMI. The use of prediction models on discharge to identify patients with high likelihood of rehospitalizations should be encouraged. Future studies should focus on developing protocols that aim to identify patients with non-cardiac chest pain that can be managed effectively in the outpatient setting to prevent extensive emergency room evaluations and admission to the hospital.

Several limitations of the present study should be considered in the interpretation of these data. First, we were not able to adjudicate the causes of patients' non-cardiac CP and angina secondary to small vessel disease or microvascular disease cannot be excluded in the non-cardiac CP group. However, our definition of non-cardiac CP was consistent with prior studies and represents some of the first insights into the frequency and clinical importance of these symptoms in patients with established coronary artery disease. Future studies are needed to determine the frequency of various non-cardiac CP syndromes, such as panic disorder, musculoskeletal pain, and gastroesophageal reflux disease, among others. Second, not all TRIUMPH patients participated in the follow-up rehospitalization study, and patients were also excluded who were not able to complete the follow-up process. Since these patients may differ from those who participated throughout the entire follow-up period, selection bias cannot be excluded. However, our results weighted for the inverse of the propensity to have complete follow-up suggested no significant bias was introduced into our analyses by missing data. The TRIUMPH rehospitalization sub-study did not collect detailed information for emergency department encounters that did not lead to inpatient admission. Accordingly, we were unable to examine variability in hospitalization rates among all-comers with chest pain symptoms, and were unable to examine either the association between outpatient emergency department evaluations and health status or the predictors of inpatient vs. outpatient evaluation." Moreover, follow-up health status assessments in TRIUMPH were conducted at 1-, 6- and 12-months after enrollment. Accordingly, for many hospitalizations there was no health status assessment in the month preceding hospital admission. Although our sensitivity analyses suggest an even stronger relationship between non-cardiac chest pain hospitalization and health status in the month before hospitalization,

greater granularity as to the exact temporal relationships between chest pain syndromes and health status cannot be obtained from this study and future efforts to collect patients' health status at more frequent interviews will be needed. TRIUMPH enrolled patients between 2005 and 2008 and thus the use of high sensitivity troponins and other advanced imaging modalities to risk stratify patients with chest pain might not reflect current practice. Finally, although we adjusted for potential confounders in the relationship between CP and health status outcomes, unmeasured and residual confounding cannot be excluded in this observational study.

CONCLUSIONS

We found that non-cardiac CP accounts for 1 in 3 CP hospitalizations in follow-up after AMI and is associated with impaired quality of life over the year after an AMI. Although the magnitude of the association of non-cardiac CP and cardiac CP with disease-specific quality of life and general physical functioning is similar, non-cardiac CP was associated with a slightly greater impairment in patients' mental health which was clinically modest and unlikely to be clinically significant. In light of the significant health status impairment associated with non-cardiac CP, better describing the causes, prevention and treatment of non-cardiac CP is an important area for future research.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Abbreviations

CP	Chest pain
SAQ	Seattle Angina Questionnaire
SF-12 PCS	Short Form 12 physical component summary scores
SF-12 MCS	Short Form 12 mental component summary scores
TRIUMPH Study	Translational Research Investigating Underlying Disparities in Acute Myocardial Infarction Patients' Health Status Study

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Figure 1. Patient population

The proportions of patients with complete follow-up who experienced hospitalization for non-cardiac CP, cardiac CP or had no CP hospitalizations are presented. The dotted lines demonstrate the comparisons of patients with: a) non-cardiac CP vs. CP hospitalization, b) cardiac CP vs. no CP hospitalization, and c) non-cardiac CP vs. cardiac CP hospitalization.

* a, b and c are the comparisons made between different rehospitalizations

Figure 2. Kaplan-Meier curve showing time-to-rehospitalization among patients with with cardiac chest pain hospitalization, non-cardiac chest pain hospitalization or no chest pain hospitalizations through 1 year of follow-up

Figure 3. Health status scores from baseline through 1 year of follow-up

Panel A shows SAQ Quality of Life scores at baseline, 1, 6 and 12 months for patients with non-cardiac CP, cardiac CP and no CP. Panel B shows baseline, 1, 6 and 12 month scores on the SF-12 PCS scale, and Panel C shows baseline, 1, 6 and 12 month scores on the SF-12 MCS scale.

Figure 4.

Association between cardiac or non-cardiac CP hospitalization and health status after acute myocardial infarction

Table 1

Patient characteristics

	Non-cardiac CP hospitalization (n = 92)	Cardiac CP hospitalization (n = 226)	No CP hospitalization (n = 2781)	P-Value
Age (years, mean $\pm$ SD)	58.2 $\pm$ 11.7	58.7 $\pm$ 11.7	59.4 $\pm$ 12.0	0.447
Male	55 (59.8%)	128 (56.6%)	1886 (67.8%)	< 0.001
White race	61 (66.3%)	142 (62.8%)	1955 (70.5%)	0.004
BMI (kg/m ² , mean $\pm$ SD)	29.1 $\pm$ 6.3	29.7 $\pm$ 7.0	29.6 $\pm$ 6.4	0.742
Socioeconomic Data				
College Education	48 (52.2%)	119 (53.1%)	1366 (49.4%)	0.497
Payor				0.002
Commercial/PPO	36 (40.4%)	80 (36.2%)	1184 (43.3%)	
HMO	3 (3.4%)	20 (9.0%)	304 (11.1%)	
Medicare	25 (28.1%)	40 (18.1%)	495 (18.1%)	
Medicaid	2 (2.2%)	19 (8.6%)	127 (4.6%)	
VA	0 (0.0%)	0 (0.0%)	37 (1.4%)	
Other	2 (2.2%)	9 (4.1%)	96 (3.5%)	
None/Self-Pay	21 (23.6%)	53 (24.0%)	489 (17.9%)	
Avoided Care Due to Costs in Past Year	21 (22.8%)	57 (25.9%)	657 (24.0%)	0.787
Financial Situation at the end of the month				< 0.001
Some money left over	38 (41.8%)	75 (33.5%)	1218 (44.5%)	
Just enough to make ends meet	30 (33.0%)	81 (36.2%)	1004 (36.7%)	
Not enough to make ends meet	23 (25.3%)	68 (30.4%)	514 (18.8%)	
Baseline ENRICHD Social Support Score (points, mean $\pm$ SD)	21.7 $\pm$ 4.8	21.3 $\pm$ 5.0	22.1 $\pm$ 4.3	0.015
Married or common law marriage	39 (42.9%)	95 (42.0%)	1541 (55.5%)	< 0.001
Work full or part time	49 (53.3%)	84 (37.5%)	1423 (51.7%)	< 0.001
Access to Care				
Difficultly obtaining an outpatient appointment (baseline)	4 (15.4%)	3 (30.0%)	73 (23.0%)	0.556
Difficultly obtaining care due to inability to find a physician (baseline)	1 (3.8%)	1 (10.0%)	59 (18.6%)	0.098
Currently Have a Doctor (6 months)	161 (91.0%)	67 (85.9%)	1758 (88.3%)	0.438
Currently Have a Doctor (12 months)	149 (87.1%)	67 (88.2%)	1784 (87.8%)	0.959
Past Medical History				
Diabetes	27 (29.3%)	92 (40.7%)	783 (28.2%)	< 0.001

	Non-cardiac CP hospitalization (n = 92)	Cardiac CP hospitalization (n = 226)	No CP hospitalization (n = 2781)	P-Value
Hypertension	63 (68.5%)	173 (76.5%)	1828 (65.7%)	0.004
Prior MI	20 (21.7%)	67 (29.6%)	534 (19.2%)	< 0.001
Prior PCI	15 (16.3%)	66 (29.2%)	522 (18.8%)	< 0.001
Prior CABG	14 (15.2%)	52 (23.0%)	275 (9.9%)	< 0.001
Dyslipidemia	47 (51.1%)	120 (53.1%)	1363 (49.0%)	0.471
Chronic Kidney Disease	2 (2.2%)	19 (8.4%)	182 (6.5%)	0.125
Current smoking	28 (30.4%)	95 (42.0%)	1076 (39.0%)	0.382
Chronic Heart Failure	9 (9.8%)	20 (8.8%)	182 (6.5%)	0.215
Peripheral Vascular Disease	2 (2.2%)	18 (8.0%)	126 (4.5%)	0.045
Prior stroke	7 (7.6%)	16 (7.1%)	119 (4.3%)	0.049
Health-Status Scores				
PHQ-9 Depression Score (points, mean $\pm$ SD)	5.8 $\pm$ 5.4	6.5 $\pm$ 5.7	5.0 $\pm$ 5.3	< 0.001
Perceived Stress Scale Score (points, mean $\pm$ SD)	5.2 $\pm$ 3.8	5.4 $\pm$ 4.2	4.4 $\pm$ 3.7	< 0.001
AMI Index Hospitalization Information				
STEMI	47 (51.1%)	89 (39.4%)	1224 (44.0%)	0.480
In-hospital Revascularization Procedure				0.064
None	19 (20.7%)	53 (23.5%)	680 (24.5%)	
PCI	68 (73.9%)	159 (70.4%)	1803 (64.8%)	
CABG	5 (5.4%)	14 (6.2%)	298 (10.7%)	
Killip Class on Arrival				0.168
I	86 (94.5%)	198 (89.2%)	2455 (89.3%)	
II	5 (5.5%)	24 (10.8%)	237 (8.6%)	
III	0 (0.0%)	0 (0.0%)	41 (1.5%)	
IV	0 (0.0%)	0 (0.0%)	17 (0.6%)	
In-Hospital Cardiogenic Shock	2 (2.2%)	5 (2.2%)	75 (2.7%)	0.955
Diseased Vessels				0.096
0	6 (6.8%)	9 (4.4%)	228 (8.7%)	
1	43 (48.9%)	77 (37.7%)	1127 (43.2%)	
2	20 (22.7%)	64 (31.4%)	668 (25.6%)	
3	19 (21.6%)	54 (26.5%)	583 (22.4%)	
LV Systolic Function				0.650
Normal	60 (65.2%)	140 (61.9%)	1744 (62.8%)	
Mild	19 (20.7%)	38 (16.8%)	549 (19.8%)	

	Non-cardiac CP hospitalization (n = 92)	Cardiac CP hospitalization (n = 226)	No CP hospitalization (n = 2781)	P-Value
Moderate	7 (7.6%)	31 (13.7%)	288 (10.4%)	
Severe	6 (6.5%)	17 (7.5%)	196 (7.1%)	
Medications at Discharge from Index Hospitalization				
Beta Blockers	81 (88.0%)	196 (86.7%)	2529 (90.9%)	0.081
Statins	75 (81.5%)	203 (89.8%)	2460 (88.5%)	0.097
Aspirin	89 (96.7%)	212 (93.8%)	2636 (94.8%)	0.621
Thienopyridine	72 (78.3%)	189 (83.6%)	2103 (75.6%)	0.022
ACE Inhibitor/ARB	68 (73.9%)	184 (81.4%)	2054 (73.9%)	0.043
Rehospitalization Information				
In-Hospital Cardiac Catheterization	5 (5.4%)	97 (42.9%)	9 (5.3%)	< 0.001
In-Hospital PCI	0 (0.0%)	71 (31.4%)	12 (7.1%)	< 0.001

Abbreviations: SD: standard deviation, BMI: Body mass index, MI: myocardial infarction, PCI: percutaneous coronary intervention, CABG: coronary artery bypass graft, STEMI: ST-Elevation myocardial infarction, ACE: Angiotensin converting enzyme and ARB: Angiotensin receptor blocker