

THE QUALITY OF SYMPTOMS IN WOMEN AND MEN PRESENTING TO THE EMERGENCY DEPARTMENT WITH SUSPECTED ACUTE CORONARY SYNDROME



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Contribution to Emergency Nursing Practice

- The current state of the scientific knowledge on the quality of symptoms in women and men presenting to emergency departments with suspected acute coronary syndrome (ACS) indicates that there are few sex differences in the symptoms of ACS and in reported symptom distress.
- The main finding of this paper was that symptom distress was significantly higher in patients ruled-in for ACS compared with those ruled-out, but there are few differences in the quality of symptoms between the 2 groups.
- Key implications for emergency nursing practice from this study are that the clinical presentation of symptoms of potential ACS are complex, and it is challenging for triage personnel to differentiate between those who will rule-in for ACS and those who will rule-out; therefore, a thorough cardiac evaluation is necessary for all patients with symptoms suggestive of ACS.

Abstract

Introduction: More than 5.5 million patients present to emergency departments in the United States annually for potential acute coronary syndrome (ACS); however, diagnosing ACS remains a challenge in emergency departments. Our aim was to describe the quality of symptoms (chest discomfort/

description of pain, location/radiation, and overall symptom distress) reported by women and men ruled-in and ruled-out for ACS in emergency departments.

Methods: The sample consisted of 1,064 patients presenting to emergency departments with symptoms that triggered cardiac workups. Trained research staff obtained data using the ACS Patient Information Questionnaire upon patient presentation to emergency departments.

Results: The sample ($n = 1,064$) included 474 (44.55%) patients ruled-in and 590 (55.45%) patients ruled-out for ACS. Symptom distress was significantly higher in patients ruled-in versus ruled-out for ACS (7.3 ± 2.6 vs. 6.8 ± 2.5 ; $P = 0.002$) and was a significant predictor for an ACS diagnosis in men (odds ratio [OR], 1.10; confidence interval [CI], 1.03-1.17; $P = 0.003$). Women also reported more chest pressure (51.75% vs. 44.65; $P = 0.02$) compared with men, and chest pressure was a significant predictor for a diagnosis of ACS (OR, 1.61; CI, 1.03-2.53; $P = 0.02$).

Discussion: Higher levels of symptom distress may help ED personnel in making a decision to evaluate a patient for ACS, and the presence of chest pressure may aid in making a differential diagnosis of ACS.

Key words: Acute coronary syndrome; Symptom quality; Sex differences; Symptom distress

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Each year, more than 5.5 million patients present to emergency departments in the United States to be evaluated for potential acute coronary syndrome (ACS); only 13.5% are ruled-in for ACS.¹ Diagnosing ACS, a time-sensitive condition, remains a diagnostic challenge because approximately 10% of all patients presenting to emergency departments complain of chest pain, but only approximately 10% of these patients will be diagnosed with acute myocardial infarction (AMI).²

Early identification and accurate interpretation of symptoms of ACS are crucial for appropriate diagnostic testing and administration of time-sensitive therapies to minimize myocardial damage.³ Delay in diagnosis and treatment is associated with increased morbidity and mortality.⁴ Previous researchers have reported sex differences in symptoms for patients presenting to emergency departments with potential ACS, with findings that women are more likely to experience a greater number and more diverse symptoms compared with men.⁵⁻⁷

Symptoms are often the first indicator of a change in health status. Symptoms often influence a person's decision to seek medical care. Yet the timely identification and accurate interpretation of symptoms of ACS can be difficult for patients, especially if symptoms deviate from what the patient believes is "normal," or symptoms are similar to those of other noncardiac conditions.⁸⁻¹⁰ Symptom incongruence, failure to recognize symptoms as serious, a mismatch between expected and actual symptoms, and experience with previous cardiac-related illness have been associated with a patient's decision to delay seeking medical attention during ACS.^{11,12}

Patient decision delay is responsible for the largest proportion of prehospital delay time.^{11,13} To have a positive influence on patients' treatment-seeking behavior, patients and clinicians need to have sufficient knowledge of the characteristics and severity of the symptoms during ACS.¹⁴ Studies show that women have longer prehospital delay times for symptoms suggestive of ACS compared with men.¹⁵⁻¹⁷ Clinical presentation and outcomes of ACS have been reported to vary between women and men, with more women presenting with non-ST segment elevation ACS (NSTEMI-ACS), suffering higher rates of complications, and experiencing higher in-hospital mortality.¹⁸ ST-elevation myocardial infarction (STEMI) and non-ST-elevation myocardial infarction (NSTEMI) often result in different outcomes and require different treatments.¹⁹

ACS consists of 3 clinical conditions: unstable angina (UA), NSTEMI, and STEMI. The clinical symptoms of UA and NSTEMI are similar; however, by definition, NSTEMI is associated with myocardial necrosis and has a worse prognosis.²⁰ Findings related to the quality of symptom experiences for women and men may provide evidence

for precise interventions to decrease prehospital delay and reduce total ischemic burden time.²¹

The aims of this study, therefore, were to (1) describe the quality of symptoms defined as chest discomfort/pain description, location, radiation, and overall symptom distress (symptom severity) reported by patients ruled-in and ruled-out for ACS in the emergency department and (2) to determine if there were sex differences in the quality of symptoms reported.

Methods

DESIGN, SAMPLE, AND SETTING

This is a secondary analysis of data from the Think Symptoms study, a large prospective multicenter study, the main aim of which was to investigate the influence of sex on symptoms suggestive of ACS. The study participants were drawn from 5 emergency departments in the Pacific Northwest, West, Southwest, and Midwest regions of the United States between January 2011, and December 2014. The study sites included 4 academic medical centers and 1 large regional referral hospital. The sample consisted of 1,064 women and men presenting to the emergency department with symptoms that triggered cardiac evaluation: that is, those who went on to be ruled-in or ruled-out for ACS. Patients were eligible for the study if they were ≥ 21 years old, could speak and understand English, and arrived by private transportation or emergency medical services. Exclusion criteria were heart failure (brain natriuretic peptide > 500 pg/mL), referred for dysrhythmia evaluation, transferred from dialysis centers, or cognitive impairment that precluded them from providing informed consent.

MEASURES

Trained research personnel assessed the quality of symptoms with the ACS Patient Information Questionnaire. A multidisciplinary Standardized Reporting Criteria Task Force designed the Questionnaire to measure standard data for patients presenting to emergency departments with potential ACS. The criteria were supported by the Society for Academic Medicine, American College of Emergency Physicians, American Heart Association, and American College of Cardiology.²² The questionnaire includes patient-reported information on demographic and symptom variables including type, location/radiation, and symptom distress. Patients were asked the following open-ended question: Where is the location/radiation of your pain?

DATA COLLECTION PROCEDURES

Enrollment occurred every day between 7 am and 11 pm. Patients who were considered stable by health care providers were approached by trained research staff for enrollment in the study. Once patients had been transferred to private examination rooms, the purpose of the study was explained, and informed consent was obtained. Data were then collected on individual and clinical characteristics by trained research personnel.

STATISTICAL ANALYSIS

Data analyses were performed using STATA statistical software, Version 14.2 (Release12, StataCorp LP, College Station, TX). Significance was set at $P \leq 0.05$ for all statistical procedures. Demographic characteristics, clinical history, and quality of symptoms were compared between those ruled-in and those ruled-out for ACS. Chi-square tests were conducted for categorical variables, and independent samples Students' *t*-tests were used to compare means for continuously measured variables. We conducted bivariate regression analyses to determine the association between diagnosis (ACS, non-ACS) and the quality (pressure, heavy, sharp) of symptoms, and each covariate (sex, age, type of ACS, family history of premature heart disease, diabetes status, and hypertension). Multiple logistic regression analyses were used to determine whether the quality of symptoms and symptom distress were predictive of diagnosis after adjusting for sex, age, type of ACS, family history of premature heart disease, diabetes status, and hypertension. We tested interactions using quality of symptoms (pressure, heavy, sharp) and overall symptom distress with the following variables: sex, age, family history, hypertension, and diabetes. Linktest was run after each regression model to test for specification errors. Linktest examines model specification after any single-equation estimation command such as logistic regression.²³ All covariates were entered into the model, regardless of whether they were statistically significant in the bivariate analysis, to account for the possibility of interactions with other variables in the model that may have changed the level of statistical significance in the regression models.

Results

DEMOGRAPHIC AND CLINICAL CHARACTERISTICS

Demographic and clinical variables were compared between patients ruled-in and ruled-out for ACS and between women and men (Tables 1 and 2). The sample

($n = 1,064$) included 474 (44.55%) patients ruled-in and 590 (55.45%) patients ruled-out for ACS. Patients were predominantly male (62.4%) and white (69.7%), with a mean age of 60.1 years (range 21 to 98). Participants ruled-in for ACS were older than those ruled-out (61.7 ± 12 years vs. 59 ± 15.4 years, $P = 0.002$), and women were more likely to be older (61.3 ± 14.6 years vs. 59.5 ± 13.6 years, $P = 0.03$). Men were more likely to have diagnoses of ACS (72.4% vs. 27.6%; $P \leq 0.001$) and were more likely to have NSTEMI-ACS (26.7% vs. 18.5%; $P \leq 0.001$) compared with women. A total of 28.7% of eligible patients refused to participate, citing fatigue, anxiety, or lack of interest.

QUALITY OF SYMPTOMS BY DIAGNOSIS AND SEX

The most frequently reported symptom was chest pressure, occurring in 503 (47%) of the patients. Table 3 shows the quality of symptoms between patients ruled-in and ruled-out for ACS and by sex. Overall symptom distress was significantly higher in patients ruled-in versus ruled-out for ACS (7.3 ± 2.6 vs. 6.8 ± 2.5 ; $P = 0.002$). There was no significant difference in the quality of chest pain descriptors, including pressure, heavy, and sharp (46.81% vs. 53.19% $P = 0.19$; 28.48% vs. 25.64% $P = 0.30$; 28.90% vs. 28.47% $P = 0.87$) between patients ruled-in and ruled-out for ACS, respectively. Women were more likely to have higher overall symptom distress (7.3 ± 2.4 vs. 6.8 ± 2.6 ; $P = 0.001$) compared with men. Women were also more likely than men to experience chest pressure (51.75% vs. 44.65%; $P = 0.02$).

There were no significant differences between women ruled-in and ruled-out for ACS in the quality of symptoms, whereas men ruled-in ACS had higher overall symptom distress (7.13 ± 2.6 vs. 6.46 ± 2.5 ; $P = 0.001$) compared with men ruled-out for ACS (Table 4). There was no significant difference between women and men with ACS in the quality of symptoms and overall symptom distress (Table 5).

Multiple logistic regression was used to determine whether quality of symptoms predicted diagnoses of ACS. We found that chest pressure and overall symptom distress were associated with ACS for both female and male patients when adjusting for demographic and clinical history (Table 6). Women with chest pressure were more likely to be diagnosed with ACS than men (odds ratio [OR], 1.61; confidence interval [CI], 1.03-2.53; $P = 0.02$). Overall symptoms distress was a significant predictor for diagnoses of ACS in men (OR, 1.10; CI, 1.03-1.17; $P = 0.003$) but not in women. We tested the quality of symptoms and overall symptom distress

TABLE 1

Demographic characteristic by diagnosis and sex

Characteristics	ACS (n = 474)		P	Non-ACS (n = 590)		P
	Male (343)	Female (131)		Male (321)	Female (269)	
Age, mean (SD)	60.5 (11.2)	64.7 (13.3)	< 0.001	58.4 (15.7)	59.7 (15.0)	0.30
	ACS (n = 474)	Non-ACS (n = 590)	P	Male (n = 664)	Female (n = 400)	P
Age, mean (SD)	61.7 (12.0)	59 (15.4)	0.002	59.5 (13.6)	61.3 (14.6)	0.037
Sex, n (%)						< 001
Female	131 (27.6)	269 (45.7)				
Male	343 (72.4)	321 (54.4)				
Race/ethnicity, n (%)			0.19			0.26
White	414 (70.2)	325 (69)		469 (70.6)	270 (67.5)	
Black	56 (11.9)	79 (13.4)		74 (11.1)	61 (15.2)	
Hispanic	45 (9.5)	36 (6.1)		52 (7.8)	29 (7.2)	
Other	45 (9.5)	59 (10)		67 (10.1)	37 (9.2)	
Missing						
Insurance			0.32			0.004
Private from employer	150 (31.6)	182 (31.0)		215 (32.4)	117 (29.2)	
Private paid by you	45 (9.5)	61 (10.3)		56 (8.4)	50 (12.5)	
Medicare	142 (30)	206 (35.0)		198 (30.0)	150 (37.5)	
Gov't insurance: other	55 (11.6)	66 (11.2)		84 (12.6)	37 (9.2)	
Not insured	71 (15.0)	68 (11.5)		97 (14.6)	42 (10.5)	
Education			0.52			0.54
<High school diploma	60 (12.7)	65 (11.2)		72 (10.8)	53 (13.2)	
High school diploma	112 (23.6)	123 (20.9)		146 (22.0)	89 (22.2)	
Some college	154 (32.5)	190 (32.2)		217 (32.7)	127 (32.0)	
College degree/grad	89 (18.8)	127 (21.5)		131 (20.0)	85 (21.2)	
Graduate degree	58 (12.2)	83 (14.7)		95 (14.3)	46 (11.5)	
Household income, n (%)			0.003			0.14
<\$20 000	121 (25.5)	195 (33.0)		183 (27.6)	133 (33.2)	
\$20 000-\$49 999	139 (29.3)	178 (30.2)		196 (29.5)	121 (30.2)	
\$50 000-\$99 999	103 (22.0)	86 (14.6)		123 (18.5)	66 (16.5)	
≥\$100 000	56 (11.8)	81 (14.0)		41 (14.5)	96 (10.2)	
Missing	55 (11.6)	50 (8.5)		66 (9.9)	39 (9.7)	
Marital status, n (%)			< 0.001			0.005
Single	107 (22.6)	170 (29.0)		173 (26.5)	104 (26)	
Married	255 (53.8)	242 (41.1)		327 (49.2)	170 (42.5)	
Separated	15 (3.2)	7 (1.2)		16 (2.4)	6 (1.5)	
Divorced	58 (12.2)	109 (18.5)		94 (14.2)	73 (18.3)	
Committed relationship	16 (3.4)	25 (4.2)		28 (4.2)	13 (3.3)	
Widowed	22 (4.7)	33 (5.6)		23 (3.5)	32 (8.0)	

continued

TABLE 1
Continued

	ACS (n = 474)	Non-ACS (n = 590)	P	Male (n = 664)	Female (n = 400)	P
Recruitment site			< 0.001			0.048
Midwest (n = 121)	55 (11.6)	66 (11.2)		72 (10.8)	49 (12.3)	
Northwest 1 (n = 439)	85 (18.0)	345 (60.0)		261 (39.3)	178 (44.5)	
Northwest 2 (n = 51)	46 (9.7)	5 (0.8)		41 (6.2)	10 (2.5)	
West (n = 270)	183 (38.6)	87 (14.7)		173 (26.1)	97 (24.3)	
Southwest (n = 183)	105 (22.2)	78 (13.2)		117 (17.6)	66 (16.5)	

Counts vary for income owing to missing data.

Bold treatment indicates statistical significance.

ACS, acute coronary syndrome; Grad, some graduate work.

for interactions with sex, age, diabetes, hypertension, and family history, and no significant interactions were found. Linktest was run after each regression model

to test for specification errors. The functional form for age adjustment was quadratic for men and linear for women.

TABLE 2
Clinical characteristics by diagnosis and sex

Characteristics	ACS	Non-ACS	P	Male	Female	P
Diagnosis, n (%)						< 0.001
Non-ACS				321 (48.3)	269 (67.3)	
Unstable angina				74 (11.1)	31 (7.8)	
NSTEMI				177 (26.7)	74 (18.5)	
STEMI				92 (13.9)	26 (6.5)	
Hypertension, n (%)			0.020			0.110
Yes	324 (68.7)	363 (62.0)		442 (66.8)	245 (61.0)	
No	147 (31.2)	222 (37.9)		219 (33.1)	150 (37.9)	
Diabetes, n (%)			0.49			0.367
Yes	142 (30.0)	165 (28.0)		198 (29.9)	109 (27.3)	
No	331 (70.0)	423 (71.9)		464 (70.1)	290 (72.7)	
Hypercholesterolemia, n (%)			< 0.001			0.875
Yes	292 (63.1)	276 (48.2)		350 (54.7)	218 (55.2)	
No	171 (37.0)	296 (51.7)		290 (45.3)	177 (44.8)	
BMI (mean; SD)	29.7 (6.5)	30.3 (7.7)	0.20	30.0 (6.6)	30.2 (8.2)	0.60
Smoking, n (%)			0.005			< 0.001
Never	228 (49.5)	339 (58.6)		325 (50.2)	242 (61.9)	
Former	119 (25.8)	137 (23.7)		166 (25.6)	90 (23.0)	
Current	114 (24.7)	102 (17.7)		157 (24.2)	59 (15.1)	
Cocaine use			0.013			< 0.001
Yes	35 (7.4)	23 (3.9)		48 (7.3)	10 (2.5)	
No	436 (92.6)	563 (96.1)		611 (92.7)	388 (97.5)	

Bold treatment indicates statistical significance.

ACS, acute coronary syndrome; BMI, body mass index; NSTEMI, non-ST-elevated myocardial infarction; SD, standard deviation; STEMI, ST-elevated myocardial infarction.

TABLE 3

Quality of symptoms by diagnosis and sex

Quality of symptoms	ACS n (%)	Non-ACS n (%)	P	Female	Male	P
Pressure	235 (46.81)	267 (53.19)	0.19	206 (51.75)	296 (44.65)	0.02
Heavy	135 (28.48)	151 (25.64)	0.30	121 (30.25)	164 (24.89)	0.057
Sharp	137 (28.90)	168 (28.47)	0.87	104 (26.00)	201 (30.27)	0.13
Symptoms distress (mean, SD)	7.3 (2.6)	6.8 (2.5)	0.002	7.3 (2.4)	6.8 (2.6)	0.001

Bold treatment indicates statistical significance.

ACS, acute coronary syndrome; SD, standard deviation.

LOCATION OF PAIN AND RADIATION BY DIAGNOSIS AND SEX

Participants described 25 locations for pain. The locations were organized into 9 locations: chest (middle, left, and general chest), epigastric area, arm and shoulder area (arm, shoulder, and arm and shoulder together), the jaw/neck/throat, and upper back region. Patients ruled-in for ACS were more likely to experience jaw/neck/throat pain ($n = 30, 6.34\%$ vs. $n = 11, 1.87\%$; $P = 0.001$), whereas patients ruled-out for ACS were more likely to experience upper back pain ($n = 190, 32.31\%$ vs. $n = 120, 25.37\%$; $P = 0.013$). Patients ruled-in for ACS were more likely to experience arm and shoulder pain simultaneously ($n = 124, 26.22\%$ vs. $n = 123, 20.99\%$; $P = 0.046$) compared with patients ruled-out for ACS.

Men ruled-in for ACS were more likely to report pain in the mid-chest ($n = 74, 21.64\%$ vs. $n = 16, 12.21\%$; $P = 0.019$) compared with women ruled-in for ACS. Women ruled-in for ACS were more likely to experience upper back pain ($n = 52, 39.69\%$ vs. $n = 68, 19.88\%$; $P < 0.001$) and jaw/neck/throat pain ($n = 17, 12.98\%$ vs. $n = 13, 3.80\%$; $P < 0.001$) compared with men ruled-in for ACS. There was no significant difference in radiation

of pain by diagnosis and sex between patients ruled-in and ruled-out for ACS.

Discussion

We compared chest discomfort, pain descriptors, location, radiation, and overall symptom distress in women and men presenting to emergency departments for potential ACS. Key findings were that overall symptom distress was significantly higher in patients ruled-in for ACS compared with ruled-out for ACS. Women with ACS were more likely to experience higher overall symptoms distress compared with men, but the difference was not statistically significant. Araújo et al²⁴ found a strong relationship between female gender and pain intensity greater than 8 (range 0 to 10) among women less than 65 years old. Our results may have differed because our sample includes women aged 21 to 98 years, and we asked about overall symptom distress, not simply pain intensity.

There were no significant differences in chest pain descriptors (pressure, heavy, and sharp) between patients ruled-in and ruled-out for ACS. Our results are similar to

TABLE 4

Diagnosis and symptom quality by sex

Quality of symptoms	Male (n = 664, 62.41%)		P	Female (n = 400, 37.59%)		P
	ACS	Non-ACS		ACS	Non-ACS	
Pressure	162 (47.23)	134 (41.88)	0.16	74 (56.49)	133 (49.44)	0.18
Heavy	91 (26.53)	74 (23.13)	0.31	44 (33.60)	77 (28.62)	0.31
Sharp	105 (30.61)	96 (29.91)	0.84	32 (24.43)	72 (26.77)	0.61
Overall distress	7.13 (2.6)	6.46 (2.5)	0.001	7.63 (2.5)	7.16 (2.4)	0.07

Bold treatment indicates statistical significance.

ACS, acute coronary syndrome.

TABLE 5

Sex and symptom quality by diagnosis

Quality of symptoms	ACS (n = 474)		P	Non-ACS (n = 590)		P
	Female	Male		Female	Male	
Pressure	74 (56.49)	162 (47.23)	0.07	133 (49.44)	134 (41.88)	0.06
Heavy	44 (33.59)	91 (26.53)	0.12	77 (28.62)	74 (23.13)	0.12
Sharp	32 (24.43)	105 (30.61)	0.18	72 (26.77)	96 (29.91)	0.40
Overall distress	7.63 (2.4)	7.13 (2.6)	0.06	7.16 (2.4)	6.46 (2.5)	< 0.001

Bold treatment indicates statistical significance.

those from a study conducted by Eslick et al.²⁵ The authors found that there was considerable overlap in patients with cardiac and noncardiac chest pain and advised clinicians to make provisional diagnoses based on the patient's location of pain. Similarly, in another study, researchers demonstrated that chest-pain characteristics had low accuracy for detecting AMI in both women and men.²⁶

Women—ruled-in and ruled-out for ACS—were more likely to report chest pressure compared with men, and chest pressure was a predictor of an ACS diagnosis in women. This finding is comparable with findings from Rubina et al,²⁷ who evaluated chest-pain characteristics among 796 women and 1,679 men presenting with acute chest pain in a large prospective international study. Women with AMI more often reported chest pressure compared with men. The authors suggested that coronary microvascular dysfunction influences the characteristics of chest pain that differ by sex; however, inconsistency exists among different studies.²⁸

There was no significant difference in chest pain locations in patients ruled-in and ruled-out for ACS; however, men ruled-in for ACS were more likely to have mid-chest pain compared with women with ACS. Similar to our findings, Mant et al, in a systematic review of acute chest pain, indicated that chest-pain localization had no predictive

value for a diagnosis of ACS.²⁹ Bosner et al³⁰ demonstrated that location of pain in patients with coronary heart disease (CHD) was similar to that of noncardiac chest pain, and there was no difference in location of chest pain between women and men with CHD. Similarly, in our study, there was no difference in chest-pain location between patients ruled-in and ruled-out for ACS. However, chest-pain location was significantly different in men compared with women ruled-in for ACS; men were more likely to experience mid-chest pain compared with women. Bosner et al did not find any differences in location of chest pain between women and men diagnosed with CHD, perhaps because of the nonacute diagnosis and the fact that chest pain was assessed in the primary-care setting.

Contrary to our findings, Malik et al (2013) indicated that chest-pain location gives an important clue to the diagnosis of ACS; pain that is located in the middle of chest is more likely to be ischemic compared with other locations of chest pain. The authors concluded that severe and prolonged precordial chest pain radiating to left shoulder, neck, and jaw in men between the ages of 41 and 70 years is highly suggestive of AMI.³¹ Similarly, we found that men ruled-in for ACS were more likely than women to experience mid-chest pain, but there was no significant difference in chest-pain location

TABLE 6

Prediction of diagnosis by quality of symptoms ACS (n = 474)

Quality of Symptoms	Male (n = 664) OR (CI)	P	Female (n = 400) OR (CI)	P
Pressure	1.18 (0.85-1.64)	0.53	1.61 (1.03-2.53)	0.02
Heavy	1.14 (0.78-1.65)	0.65	1.32 (0.77-4.44)	0.31
Sharp	1.09 (0.76-1.57)	0.83	1.03 (0.61-1.72)	0.67
Symptom distress	1.10 (1.03-1.17)	0.003	1.08 (0.99-1.19)	0.07

Bold treatment indicates statistical significance.

CI, confidence interval; OR, odds ratio.

between patients with and without ACS. Malik et al did not compare the symptoms of patients with AMI with noncardiac patients.³¹

In our study, patients ruled-in for ACS were more likely to experience jaw/neck/throat pain, and patients ruled-out for ACS were more likely to report upper back pain. Mackay et al³² assessed the symptoms during 2 minutes of balloon inflation (leading to ischemia) in women and men and demonstrated that female gender was a strong predictor of jaw/teeth/throat or neck discomfort (adjusted OR, 4.55; 95% CI, 2.31-8.98).

In our study, patients with ACS more often reported arm and shoulder pain (n = 124, 26.22% vs. n = 123, 20.99%; $P = 0.046$) compared with non-ACS patients. Pelter et al³³ found that patients with arm pain were almost twice as likely to rule-in for ACS yet found no differences in back/shoulder pain by gender. We assessed individual patient-reported symptoms, whereas Pelter et al reported a combination of symptoms. Of note, although we found statistically significant differences in jaw/neck/throat pain for patients for ACS, the symptoms were rarely reported, and therefore we believe they are not clinically relevant.

RADIATION OF PAIN

We also found a higher frequency of pain radiation to the jaw/neck/throat in female patients ruled-in for ACS; however, the difference in radiation of pain to the jaw/neck/throat did not differ between patients ruled-in and ruled-out for ACS. In a previous study, the most common site for radiation of pain during ACS was the left shoulder and arm. This might be because pain radiates along left-sided cervical nerve roots.³⁴ Solt et al³⁵ found a high prevalence of chest-pain radiation to the jaw, particularly in women.

LIMITATIONS

Our study had limitations. First, the variables of location/radiation are combined in the ACS Patient Information Questionnaire, so we were unable to determine exactly which variable the participant was responding to. Second, we combined the location/radiation of pain responses into 9 themes for analytic purposes because of the number of different responses and the small cell sizes. Third, patients who ruled-in for ACS and were not stable were excluded; thus, we do not know if characteristics of symptoms differ in patients who are unstable versus stable. Despite these limitations, our large heterogeneous sample suggests the generalizability of our findings.

Implications for Emergency Nurses

The clinical presentation of symptoms of potential ACS is complex, and it is challenging for triage personnel to differentiate between those who will rule-in for ACS and those who will rule-out. This necessitates a cardiac evaluation in nearly all patients suspicious for ACS. Our findings add knowledge of differences in the clinical presentation for women and men and those who rule-in for ACS compared with those who rule-out.

Conclusion

There were no significant differences in the quality of symptoms by diagnosis and sex in our study. Overall symptom distress was significantly higher in patients ruled-in for ACS, and the patients were more likely to experience jaw/neck/throat pain compared with patients ruled-out for ACS. Patients ruled-out for ACS were more likely to report upper back pain. Women with ACS were more likely to report radiation of pain to the jaw/neck/throat and to experience chest pressure, and chest pressure was a predictor of an ACS diagnosis in women. This is a noteworthy finding, as pressure may be interpreted as being less serious than chest pain and result in a delay in seeking treatment.

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REFERENCES

1. Bhuiya FA, Pitts SR, McCaig LF. Emergency department visits for chest pain and abdominal pain: United States, 1999-2008. *NCHS Data Brief*. 2010;(43):1-8.
2. Mockel M, Searle J, Muller R, et al. Chief complaints in medical emergencies: do they relate to underlying disease and outcome? The Charite Emergency Medicine Study (CHARITEM). *Eur J Emerg Med*. 2013;20(2):103-108.
3. Herlitz J, Wireklintundstrom B, Bang A, Berglund A, Svensson L, Blomstrand C. Early identification and delay to treatment in myocardial infarction and stroke: differences and similarities. *Scand J Trauma Resusc Emerg Med*. 2010;18:48.
4. Benjamin EJ, Blaha MJ, Chiuve SE, et al. Heart Disease and Stroke Statistics-2017 Update: a report from the American Heart Association. *Circulation*. 2017;135(10):e146-e603.
5. DeVon HA, Burke LA, Vuckovic KM, et al. Symptoms suggestive of acute coronary syndrome: when is sex important? *J Cardiovasc Nurs*. 2017;32(4):383-392.

6. Canto JG, Canto EA, Goldberg RJ. Time to standardize and broaden the criteria of acute coronary syndrome symptom presentations in women. *Can J Cardiol*. 2014;30(7):721-728.
7. O'Donnell S, McKee G, O'Brien F, Mooney M, Moser DK. Gendered symptom presentation in acute coronary syndrome: a cross sectional analysis. *Int J Nurs Stud*. 2012;49(11):1325-1332.
8. Rosamond W, Flegal K, Friday G, et al. Heart disease and stroke statistics—2007 update: a report from the American Heart Association Statistics Committee and Stroke Statistics Subcommittee. *Circulation*. 2007;115(5):e69-e171.
9. DeVon HA, Ryan CJ, Rankin SH, Cooper BA. Classifying subgroups of patients with symptoms of acute coronary syndromes: a cluster analysis. *Res Nurs Health*. 2010;33(5):386-397.
10. Pelletier R, Humphries KH, Shimony A, et al. Sex-related differences in access to care among patients with premature acute coronary syndrome. *CMAJ*. 2014;186(7):497-504.
11. Moser DK, Kimble LP, Alberts MJ, et al. Reducing delay in seeking treatment by patients with acute coronary syndrome and stroke: a scientific statement from the American Heart Association Council on Cardiovascular Nursing and Stroke Council. *J Cardiovasc Nurs*. 2007;22(4):326-343.
12. O'Donnell S, Moser DK. Slow-onset myocardial infarction and its influence on help-seeking behaviors. *J Cardiovasc Nurs*. 2012;27(4):334-344.
13. Riegel B, McKinley S, Moser DK, Meischke H, Doering L, Dracup K. Psychometric evaluation of the Acute Coronary Syndrome (ACS) Response Index. *Res Nurs Health*. 2007;30(6):584-594.
14. Thuresson M, Jarlov MB, Lindahl B, Svensson L, Zedigh C, Herlitz J. Symptoms and type of symptom onset in acute coronary syndrome in relation to ST elevation, sex, age, and a history of diabetes. *Am Heart J*. 2005;150(2):234-242.
15. Nguyen HL, Saczynski JS, Gore JM, Goldberg RJ. Age and sex differences in duration of prehospital delay in patients with acute myocardial infarction: a systematic review. *Circ Cardiovasc Qual Outcomes*. 2010;3(1):82-92.
16. Sederholm Lawesson S, Isaksson RM, Ericsson M, Angerud K, Thylen I, SymTime Study Group. Gender disparities in first medical contact and delay in ST-elevation myocardial infarction: a prospective multicentre Swedish survey study. *BMJ Open*. 2018;8(5), e020211.
17. Allana S, Khowaja K, Ali TS, Moser DK, Khan AH. Gender differences in factors associated with prehospital delay among acute coronary syndrome patients in Pakistan. *J Transcult Nurs*. 2015;26(5):480-490.
18. Mehta LS, Beckie TM, DeVon HA, et al. Acute myocardial infarction in women: a scientific statement from the American Heart Association. *Circulation*. 2016;133(9):916-947.
19. Garcia-Garcia C, Subirana I, Sala J, et al. Long-term prognosis of first myocardial infarction according to the electrocardiographic pattern (ST elevation myocardial infarction, non-ST elevation myocardial infarction and non-classified myocardial infarction) and revascularization procedures. *Am J Cardiol*. 2011;108(8):1061-1067.
20. Ruff CT, Braunwald E. The evolving epidemiology of acute coronary syndromes. *Nat Rev Cardiol*. 2011;8(3):140-147.
21. Hwang SY, Park EH, Shin ES, Jeong MH. Comparison of factors associated with atypical symptoms in younger and older patients with acute coronary syndromes. *J Korean Med Sci*. 2009;24(5):789-794.
22. Hollander JE, Blomkalns AL, Brogan GX, et al. Standardized reporting guidelines for studies evaluating risk stratification of ED patients with potential acute coronary syndromes. *Acad Emerg Med*. 2004;11(12):1331-1340.
23. Linktest: specification link test for single-equation models. <https://www.stata.com/manuals13/rlinktest.pdf>.
24. Araujo C, Laszczynska O, Viana M, et al. Sex differences in presenting symptoms of acute coronary syndrome: the EPIHeart cohort study. *BMJ Open*. 2018;8(2), e018798.
25. Eslick GD. Usefulness of chest pain character and location as diagnostic indicators of an acute coronary syndrome. *Am J Cardiol*. 2005;95(10):1228-1231.
26. Bates ER. Individual chest pain characteristics had low accuracy for detecting acute MI in both men and women. *Ann Intern Med*. 2014;160(6):JC11.
27. Rubini Gimenez M, Reiter M, Twerenbold R, et al. Sex-specific chest pain characteristics in the early diagnosis of acute myocardial infarction. *JAMA Intern Med*. 2014;174(2):241-249.
28. Arora G, Bittner V. Chest pain characteristics and gender in the early diagnosis of acute myocardial infarction. *Curr Cardiol Rep*. 2015;17(2):5.
29. Mant J, McManus RJ, Oakes RA, et al. Systematic review and modelling of the investigation of acute and chronic chest pain presenting in primary care. *Health Technol Assess*. 2004;8(2):iii, 1-158.
30. Bosner S, Bonisch K, Haasenritter J, Schlegel P, Hullermeier E, Donner-Banzhoff N. Chest pain in primary care: is the localization of pain diagnostically helpful in the critical evaluation of patients? A cross sectional study. *BMC Fam Pract*. 2013;14:154.
31. Malik MA, Alam Khan S, Safdar S, Taseer IU. Chest Pain as a presenting complaint in patients with acute myocardial infarction (AMI). *Pak J Med Sci*. 2013;29(2):565-568.
32. Mackay MH, Ratner PA, Johnson JL, Humphries KH, Buller CE. Gender differences in symptoms of myocardial ischaemia. *Eur Heart J*. 2011;32(24):3107-3114.
33. Pelter MM, Riegel B, McKinley S, et al. Are there symptom differences in patients with coronary artery disease presenting to the ED ultimately diagnosed with or without ACS? *Am J Emerg Med*. 2012;30(9):1822-1828.
34. Everts B, Karlson BW, Wahrborg P, Hedner T, Herlitz J. Localization of pain in suspected acute myocardial infarction in relation to final diagnosis, age and sex, and site and type of infarction. *Heart Lung*. 1996;25(6):430-437.
35. Solt K, Johansson JS. Binding of the active metabolite of chloral hydrate, 2,2,2-trichloroethanol, to serum albumin demonstrated using tryptophan fluorescence quenching. *Pharmacology*. 2002;64(3):152-159.