Article Type: Original research

Main Characteristics of Patients with Chest Pain in the Emergency Department.

Running Title: Chest Pain in the Emergency Department

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Declarations: I, the undersigned, declare that the work presented in this manuscript is original and has not been submitted or published elsewhere. All authors have read and approved the manuscript and have given their consent for submission and subsequent publication. We confirm that the manuscript adheres to the ethical guidelines of the journal and that all necessary permissions for the use of copyrighted material have been obtained.

Acknowledgment: We would like to express our sincere gratitude to Mr. Davis, responsible of The Cuban Hospital Emergency Department medical record and Mrs. Sinsiya, Project specialist from Medical Research Council of Hamad Medical Corporation, who have contributed to the completion of this research. Our sincere and endless gratitude is expressed also to the Open Access funding provided by The Qatar National Library.

Conflict of Interests: The authors declare no conflicts of interest.

Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Consent for participation: the informed consent was waived, because the research involved no more than minimal risk to the subject as it only entailed the review of existing medical records.

Consent for publication: All authors consent to the publication of this manuscript.

Ethical Approval: This study is part of a project approved by Qatar Medical Research Council under number MRC-01-23-845.

Abstract

Background

Chest pain is common among patients in emergency departments (EDs) worldwide, with significant implications for patient outcomes. This study aims to characterize patients presenting with non-cardiac and cardiac chest pain in the ED of The Cuban Hospital of Qatar.

Methods

We conducted a retrospective observational study from September 1 to October 31, 2023, involving 131 patients with chest pain, excluding 13, resulting in a final sample of 118 patients. We compared non-cardiac (109 patients) and cardiac (9 patients) chest pain across various demographic and clinical variables. Statistical analysis included Chi-square tests, odds ratios, and confidence intervals with a significance level of 95%.

Results

Males constituted 78% of the study population, with a significant proportion (49.2%) under age 40. Cardiac chest pain was more common in the 40 to 60-year-old age group (88.9%) and among Southeast Asians (66.7%). Obesity (28.8%) and hypertension (27.1%) were the most common risk factors. Non-cardiac chest pain predominated in cases without electrocardiogram (ECG) abnormalities (93.6%), while inverted T waves were most frequent in cardiac chest pain (55.6%). Most patients (93.2%) were discharged, with a higher admission rate for cardiac chest pain (44.4%).

Conclusion

Patients with cardiac chest pain were likely to be male, older, of Southeast Asian origin, and to have more risk factors, ischemic ECG changes, and elevated highly sensitive troponin T levels. Despite low-risk HEART (History, ECG, Age, Risk factors, and Troponin)/MACE (Major Adverse Cardiac Events) scores, these patients were admitted at higher rates. Current risk assessment tools may need adjustment to better identify cardiac chest pain patients requiring hospital admission despite low-risk scores.

Keywords: Chest Pain, Risk Factors, Electrocardiography, Biomarkers

Introduction

Chest pain is one of the most common concerns received by the Emergency Department (ED) [1]. Acute chest pain accounts for approximately 5% to 10% of ED attendances and 10% of emergency medical services calls, with more than 7 million presentations annually in the United States [2]. Half of the patients with chest pain in the ED have cardiac-related causes, most commonly ischemic heart disease, while the remainder have other cardiac-related causes [3]. A study conducted among hospitalized patients with chest pain and coronary heart disease in 14 Arab countries in the Middle East reported that over half of these patients had low incomes, limited healthcare coverage, limited education, and a higher incidence of coronary risk factors [4].

In Sub-Saharan Africa, less than 2% of patients with non-traumatic chest pain presenting to the ED are female, with a median age of 45 years. Two-thirds of these patients undergo an electrocardiogram (ECG) and troponin testing in the ED [5]. Other studies have shown a

predominance of patients aged 50 to 59 years and male sex among those with acute chest pain in the ED [6]. Proper history, physical examination, ECG, and highly sensitive troponin T (hs-cTn) testing can reliably aid in diagnosis and risk stratification [7]. Identifying cardiac chest pain is crucial in the ED because acute coronary syndrome requires immediate anti-ischemic therapy and coronary intervention to prevent further complications and mortality [8].

Few medical publications characterize patients with cardiac and non-cardiac chest pain in the ED of Qatar's hospitals. However, recent research shows that patients with coronary heart disease have a higher incidence of coronary risk factors, present at a younger age, and have a worse prognosis in women [9]. Many risk factors remain underrecognized, undertreated, and uncontrolled.

It is important to characterize patients presenting with non-cardiac and cardiac chest pain in the ED according to age, gender, region of origin, coronary risk factors, ECG findings, HEART (History, ECG, Age, Risk factors, and Troponin)/MACE (Major Adverse Cardiac Events) score, and final disposition. Therefore, this study aims to characterize patients presenting with non-cardiac and cardiac chest pain in the ED of The Cuban Hospital of Qatar to equip healthcare providers with more effective tools for managing chest pain in the ED.

Material and Methods

We conducted a retrospective observational analytic study in the ED of The Cuban Hospital of Qatar from September 1 to October 31, 2023. Inclusion criteria were male and female patients, aged 14 years and older, presenting to the ED with chest pain of any clinical characteristic during the specified period, and for whom ECG, hs-cTn, and NT-pro-BNP testing were performed or not.

Exclusion criteria included patients who did not meet the inclusion criteria or whose chest pain was caused by traumatic events.

We assessed 131 patients with chest pain, excluding 13, resulting in a sample of 118 patients: 109 with non-cardiac and 9 with cardiac chest pain, aged 14 years or older. This case-control study considered chest pain as an event and presentation in the ED as a condition. Our main objective was to compare non-cardiac and cardiac chest pain according to the following variables: age, gender, region of origin, coronary risk factors, ECG findings, hs-cTn, Pro B-type Natriuretic Peptide (NT-pro-BNP) levels, HEART/MACE score, and final disposition. Data were collected from the Hospital's Medical Record Department by the study authors.

This study is part of a project approved by the Qatar Medical Research Council under number MRC-01-23-845. Informed consent was waived as all data were retrospectively recorded, and no risk procedures, treatments, or interventions were performed on any patient. Patient confidentiality was respected, and the information obtained will be used only for guidance and the development of health systems.

Methodology

A 12-lead ECG was performed using an automatic machine at a speed of 25 millimeters per second and was either digitally or paper printed. Two investigators conducted ECG interpretation independently, which was later validated by the principal investigator. Hs-cTn and NT-pro-BNP were considered elevated if levels exceeded the reference values set by the hospital's clinical laboratory.

Statistical analysis was performed using IBM SPSS Statistics for Windows, Version 26.0. (IBM Corp., Armonk, NY, USA). We analyzed relative and absolute frequencies for all variables and performed Chi-square analysis for nominal and categorical variables, applying the Fisher exact test. We also calculated odds ratios with confidence intervals. We considered an alpha significance level of 95%.

Results

Table 1 presents the demographic data regarding age and gender. Male patients were more frequent (n=92, 78%) than female patients (n=26, 22%). The Chi-square analysis did not show a statistically significant relationship between chest pain and gender. Patients under age 40 years were prevalent (n=58, 49.2%), with non-cardiac pain predominating in this group (n=57, 52.3%). Patients with cardiac chest pain were more frequent in the 40 to 60-year-old group (n=8, 88.9%). The Chi-square analysis showed a statistically significant relationship between chest pain and age group.

Table 1 Distribution of chest pain regarding gender and age.

Demographic Data		Group		Total
		Non-cardiac	Cardiac	
		N (%)	N (%)	N (%)
Gender	Male	85 (78%)	7 (77.8%)	92 (78%)
	Female	24 (22%)	2 (22.2%)	26 (22%)
Age in Years*	< 40 Years	57 (52.3%)	1 (11.1%)	58 (49.2%)
	40 to 60 Years	40 (36.7%)	8 (88.9%)	48 (40.7%)
	>60 Years	12 (11%)	0	12 (10.2%)
Total		109 (92%)	9 (8%)	118 (100%)

*($p < 0.05$; CI 95%)

Table 2 presents the location distribution of the study participants. Southeast Asia was the region with the most representation (n=47, 39.8%), with cardiac chest pain prevalent among these patients (n=6, 66.7%). Qatari nationals were the second-largest group (n=23, 19.5%), with non-cardiac chest pain more frequent in this group (n=23, 21.1%). The Chi-square analysis did not show a statistically significant relationship between chest pain and the region of origin.

Table 2 Distribution of chest pain regarding the region of origin.

Region of Origin	Group		Total
	Non-cardiac	Cardiac	
	N (%)	N (%)	N (%)
Southeast Asia	41 (37.6%)	6 (66.7%)	47 (39.8%)
Qatari	23 (21.1%)	0	23 (19.5%)
Africa	20 (18.3%)	1 (11.1%)	21 (17.8%)
Arab Non-Qatari	11 (10.1%)	0	11 (9.3%)
Asia	6 (5.5%)	2 (22.2%)	8 (6.8%)
American	6 (5.5%)	0	6 (5.1%)
Europe	2 (1.8%)	0	2 (1.7%)

Obesity was the most prevalent risk factor (n=34, 28.8%), followed by hypertension (n=32, 27.1%), both of which were more common in patients with cardiac chest pain. Table 3 provides the distribution and incidence of risk factors among the study participants. The Chi-square analysis showed a statistically significant relationship between risk factors and chest pain. Hyperlipidemia was closely associated with cardiac chest pain, as indicated by the odds ratio analysis.

Table 3 Chest pain regarding coronary risk factors

Risks*	Group		Total	OR	95% CI
	Non-cardiac	Cardiac			
	N (%)	N (%)	N (%)		
Obesity	30 (27.5%)	4 (44.4%)	34 (28.8%)	0.47	0.12-1.9
Hypertension	28 (25.7%)	4 (44.4%)	32 (27.1%)	2.3	0.6-9.2
Smoke	19 (17.4%)	1 (11.1%)	20 (16.9%)	0.6	0.07-5.01
Hyperlipidemia**	16 (14.7%)	4 (44.4%)	20 (16.9%)	4.6	1.13-19.2
Type 2 Diabetes	14 (12.8%)	1 (11.1%)	15 (12.7%)	0.8	0.1-7.3
History of CAD	8 (7.3%)	2 (22.2%)	10 (8.5%)	3.6	0.6-20.3

*($p < 0.05$; CI 95%)

**(Odd Ratio for 95% CI)

Abbreviations: CAD, coronary artery disease; OR, odds ratio; CI, confidence interval.

Table 4 presents the ECG findings. Non-cardiac chest pain without ECG abnormalities was most common (n=102, 93.6%). Inverted T waves were the most frequent finding in cardiac chest pain (n=5, 55.6%). The Chi-square analysis showed a statistically significant relationship between chest pain and ECG findings.

Table 4 Chest pain regarding ECG findings.

	Group		
	Non-cardiac	Cardiac	Total
ECG Findings*	N (%)	N (%)	N (%)
Unremarkable	102 (93.6%)	2 (22.2%)	104 (88.1%)
Not Performed	4 (3.7%)	0	4 (3.4%)
ST elevated	3 (2.8%)	2 (22.2%)	5 (4.2%)
T Inverted	0	5 (55.6%)	5 (4.2%)
Total	109 (92%)	9 (8%)	118 (100%)

*($p < 0.05$; CI 95%)

Abbreviations: ECG, electrocardiogram.

Table 5 presents chest pain data regarding hs-cTn, NT-pro-BNP, HEART score, MACE score, and patient disposition. Hs-cTn was not performed in 66 (55.9%) non-cardiac pain cases. Cardiac chest pain had high hs-cTn levels in six patients (66.6%). NT-pro-BNP was not performed in 69 (63.3%) non-cardiac pain cases. NT-pro-BNP levels in the reference range was more common in cardiac patients with chest pain (n=6, 66.7%).

The HEART score was not applicable in most non-cardiac chest pain cases (n=66, 60.6%). A lower HEART score (0 to 3), indicating a lower risk of MACE, was more frequent in cardiac chest pain (n=5, 55.6%). High-risk HEART/MACE scores were more prevalent in cardiac chest pain (n=3, 33.3%). Most patients with chest pain were discharged from the ED (n=110, 93.2%), with non-

cardiac cases predominating (n=106, 97.2%). The admission rate was higher in cardiac chest pain cases (n=4, 44.4%). No patient with chest pain died in the ED during the study period.

Table 5 Chest pain regarding Troponin T, NT pro BNP, Heart/MACE score and disposition

Variables*		Group		Total
		Non-cardiac	Cardiac	
		N (%)	N (%)	N (%)
Hs-cTn	Not performed	66 (60.6%)	0	66 (55.9%)
	Unremarkable	41 (37.6%)	3 (33.3%)	44 (37.2%)
	High	2 (1.8%)	6 (66.6%)	8 (6.7%)
NT-pro-BNPb Levels	Not performed	69 (63.3%)	2 (22.2%)	71 (60.2%)
	Unremarkable	36 (33%)	6 (66.7%)	42 (35.6%)
	120 to <500	2 (1.8%)	0	2 (1.7%)
	500 to 1000	1 (0.9%)	1 (11.1%)	2 (1.7%)
	> 1000	1 (0.9%)	0	1 (0.8%)
Heart score (MACE)	NA	66 (60.6%)	0	66 (55.9%)
	0 to 3 (0.9-1.7)	41 (34.9%)	5 (55.6%)	43 (36.4%)
	4 to 6 (12-16.6)	2 (1.8%)	1 (11.1%)	3 (2.5%)
	7 or more (50-65)	0	3 (33.3%)	3 (2.5%)
Disposition	Discharged	106 (97.2%)	4 (44.4%)	110 (93.2%)
	Admitted	3 (2.8%)	4 (44.4%)	7 (5.69%)
	Transferred	0	1 (11.1%)	1 (0.8%)
Total		109 (92.4%)	9 (7.6%)	118 (100%)

*($p < 0.05$; CI 95%)

Abbreviations: hsCTn, high-sensitivity cardiac troponin; NT-pro-BNP, brain type natriuretic peptide; MACE, major adverse cardiovascular event.

Discussion

A study conducted in Australia [10] on patients with undifferentiated chest pain in the ED found that nearly half were women, with a mean age above 60 years. This contrasts with our investigation, where men and individuals under age 40 were predominant. Regarding cardiac chest pain, another study [11] on patients with obstructive coronary disease found a predominance of women with a mean age older than 60. In contrast, our study found that men aged between 40 to 60 years were more common. These differences reflect the characteristics of the Qatar hospital ED where our research was conducted, as the surrounding population mainly comprises male expatriate workers from companies, factories, and farms.

A higher incidence of cardiac chest pain has been reported [12] among Southeast Asian patients, particularly those of Indian origin, who are younger, have more ST-segment elevation myocardial infarction, and more frequent coronary plaque erosion. Other investigators [13] have noted that Southeast Asian natives living in other populations have a disproportionately greater burden of atherosclerotic cardiovascular disease, which often occurs before age 50 and is more aggressive compared to other ethnic subgroups. Our findings align with these reports, showing a predominance of Southeast Asian origin among patients with cardiac chest pain. These results can be attributed to the general composition of Qatar's population [14], which includes many Southeast Asians, such as Indians, Pakistanis, Nepalis, and Bangladeshis. Additionally, the geographic location of the hospital, approximately 80 km from Qatar's capital, Doha, which houses more than 90% of the population [14], may explain the lower incidence of Qatari patients in our study.

Atheroma plaque is recognized [15] as the main cause of coronary artery disease (CAD), causing artery lumen narrowing and reduced oxygen supply to the myocardium. Smoking, hypertension, hyperlipidemia, and diabetes are the most significant risk factors for CAD. A systematic review [16] found that obesity, uncontrolled diabetes, hypertension, positive family history of CAD, increased cholesterol, and smoking habits are closely related to ischemic heart disease. Our investigation frequently found these risk factors associated with cardiac chest pain.

Most patients with chest pain in the ED do not exhibit ECG findings, although more than half are admitted to the hospital due to acute coronary syndrome [17]. This result is similar to our study, except for T wave inversion, which was prevalent in patients with cardiac chest pain.

Troponin I is elevated in almost 20% of patients suspected of having acute coronary syndrome [18], a higher value than observed in our research, where high hs-cTn levels were seen in less than 10% of patients with non-cardiac and cardiac chest pain. One report [19] found that hs-cTn was not determined in approximately 10% of patients with chest pain in the ED, a lower value than in our study, where hs-cTn was performed in around 40% of cases. Those authors reported approximately 20% of study participants had elevated troponin levels, whereas we observed high hs-cTn levels in more than 60% of patients with cardiac chest pain.

The European Society of Cardiology [20] has set a threshold of NT-pro-BNP at 125 pg/mL to rule out heart failure in the non-acute setting. In our study, higher values had a very low incidence, and most patients did not undergo NT-pro-BNP testing.

HEART and Thrombolysis in Myocardial Infarction scores are accepted predictors of 30-day MACE [21]. Patients are eligible for accelerated discharge at low risk for 30-day MACE based on a non-ischemic ECG and negative serial hs-cTn results at presentation and two hours later. A systematic review [22] reported a predominance of HEART scores less than 3 for patients presenting with acute chest pain without acute myocardial infarction in the ED, consistent with our findings.

More than 50% of patients are discharged from the ED due to low-risk chest pain [23], a lower figure than in our investigation, where more than 90% of non-cardiac and cardiac chest pain patients were discharged. Our research found that the admission rate for cardiac chest pain was above 40%, higher than that of another study [24], which showed a 16.4% admission rate for cardiac chest pain after implementing a protocol based on the HEART score.

This study has several limitations. First, the retrospective design may introduce selection bias, as it relies on the accuracy and completeness of medical records. The study was conducted at a single hospital in Qatar, which may limit the generalizability of the findings to other regions or populations with different demographic and clinical characteristics. The sample size, particularly for patients with cardiac chest pain, was relatively small, which may affect the statistical power and the ability to detect significant associations. Finally, the study did not include follow-up data beyond the initial ED visit, preventing the evaluation of long-term outcomes and the effectiveness of interventions initiated in the ED. Future research should address these limitations by incorporating a multicenter approach, larger sample sizes, and prospective designs to validate and extend our findings.

In our research, patients with cardiac chest pain were more likely to be male, older, of Southeast Asian origin, and to have more risk factors, ischemic ECG changes, and elevated hs-cTn levels. Despite having low-risk HEART/MACE scores, cardiac pain patients were admitted at higher rates. These findings suggest that current risk assessment tools may need adjustment to better identify cardiac chest pain patients who require hospital admission despite low-risk scores.

Abbreviations

Abbreviation	Definition
CAD	Coronary Artery Disease
ECG	Electrocardiogram
ED	Emergency Department
HEART	History, ECG, Age, Risk factors, and Troponin
hs-cTn	High-sensitivity Cardiac Troponin
MACE	Major Adverse Cardiovascular Events
NT-pro-BNP	Brain Type Natriuretic Peptide

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