Advances
in
Bioresearch

ORIGINAL ARTICLE

Door-to-ECG Time and Associated Factors Among Patients with Chest Pain Attending Emergency Department of King Fahad Hospital in Al-Hofuf, Saudi Arabia

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ABSTRACT

The triage nurse decides how to prioritize several patients experiencing chest pain who are presenting at the same time. Regardless of the final diagnosis, early Electrocardiogram (ECG) performance is always essential in the initial assessment of all patients with chest pain. This study aims to assess the current performance of Door-to-ECG and to describe patients' comorbidities and other risk factors influencing the time of Door-to-ECG. A descriptive cross-sectional study was conducted targeting all patients who visited the emergency department and complained of chest pain at King Fahad Hospital in Al-Hofuf, Saudi Arabia. Data were collected using an electronic survey, which contains two parts. The first is biographical data and consists of 3 questions, and the second part consists of 14 questions about chest pain and related symptoms and assesses the time for door-to-ECG in these patients. 492 patients with chest pain as the main complaint attended ED were included. Patients ages ranged from 20 to more than 60 years, where 244 (49.6%) aged 40-60 years and 165 (33.5%) aged more than 60 years. Exact of 332 (67.5%) patients were males. A total of 109 (22.2%) patients undergone ECG within 10 minutes of ED arrival, 161 (32.7%) within 10-15 minutes, 115 (23.4%) within 16-30 minutes while 107 (21.7%) after 30 minutes of arrival. The most likely diagnosis among patients attended ED with chest pain, King Fahad Hospital, Al-Hofuf. A total of 144 (29.3%) cases showed non-cardiac causes, while 122 (24.8%) showed STEMI, 88 (17.9%) were diagnosed with unstable angina, and 80 (16.3%) had NSTEMI. The current study revealed that compliance with appropriate door-to-ECG time (within 10 minutes) was reported among nearly one out of five cases of chest pain attending the ED.
***Keywords:** Chest pain, door-to-ECG time, emergency, features, outcome, factors, Saudi Arabia.*

INTRODUCTION

A wide variety of illnesses affecting digestive, cardiac, and respiratory systems can all present with chest pain as the initial symptom. The decision of how to prioritize several patients experiencing chest pain who are presenting at the same time lies on the triage nurse. Regardless of the final diagnosis, early performance of an Electrocardiogram (ECG) is always essential in the initial assessment of all patients with chest pain. (1) The 12-lead ECG is the most common cardiovascular test, with roughly 200 million ECGs conducted globally each year. It is a critical tool for evidence-based care of patients with most cardiovascular disorders,

including acute myocardial infarction, suspected chronic cardiac ischemia, cardiac arrhythmias, heart failure, and implanted cardiac devices. (2) Care for these patients depends heavily on how long it takes from the emergency department arrival to ECG performance. (3) According to the American College of Cardiology (ACC) and American Heart Association (AHA) guidelines, patients with persistent chest pain, especially that is suggestive of acute coronary syndrome (ACS), should undergo an ECG within 10 minutes of their arrival. (4) The guidelines for door-to-ECG time are part of a larger effort to reduce door-to-therapy time in order to enhance outcomes in ST-elevation myocardial infarction (STEMI) patients. Rapid and potentially life-saving therapy with thrombolytics or coronary angioplasty is greatly aided by early ECG evaluation and detection of a myocardial infarction. (3) In order to reduce the Door-To-ECG time, several quality improvement strategies have been suggested. Among them, triage ECG is commonly used in the emergency department setting, which is the collection of an ECG during triage prior to history-taking by emergency physicians. (5) A study showed that the median Door-To-ECG time was 7 minutes with 37.9% of patients exceeding the recommended time of 10 minutes compared to a study done in Saudi Arabia which revealed that most patients did not receive an ECG within 10 minutes. (6)(7) No studies have been conducted to estimate the door-to-ECG time in Al-Ahsa region. The purpose of this study is to estimate the time taken to perform an ECG for patients arriving with chest pain to Emergency department of King Fahad Hospital in Al-Hofuf. This study aims to analyze the current performance of Door-to-ECG and to describe patients' comorbidities and other risk factors influencing time of Door-to-ECG. It also aims to identify adherence to the guidelines of achieving a door-to-ECG time of 10-minutes for patients with chest pain and to study the advantages of performing ECG within the first 10 minutes.

MATERIAL AND METHODS
Study design
This is a cross-sectional study (descriptive study) that was conducted by direct interview by using an electronic survey which contains two parts, the first as biographical data and consists of 3 open-ended questions, and the second part consists of 14 open/closed questions about the chest pain and related symptoms and assess the time for door-to-ECG in these patients, the survey had been distributed to all patients who visited emergency department and complaining of chest pain from 5 September 2022 to 12 July 2023 at King Fahad Hospital in Al-Hofuf Saudi Arabia. The questionnaire validity was obtained by a pilot study.

Study population
The targeted patients are all adults who visited the ED complaining of chest pain.

Sample
There is a sample size of 385 adult people living in Al-Ahasa in Saudi Arabia. A P-value of < 0.5 will be the cutoff point for assessing significant differences among different categorical data. 95% confidence interval will be applied where necessary. We calculated the power of study as 80%.

Selection criteria
Inclusion criteria: Adult (age ≥ 18) complaining of active or inactive chest pain, complaining of typical or atypical chest pain (male and female) who have visited ED King Fahad Hospital in Al-Hofuf (Saudi and non-Saudi).

Exclusion criteria: Exclusion criteria are patients with unwell mental abilities for any reason. Children (age <18), any patients not complaining of chest pain, any trauma history, and any incomplete survey responses.

Data analysis
After data were extracted, it was revised, coded, and fed to statistical software IBM SPSS version 22 (SPSS, Inc. Chicago, IL). All statistical analysis was done using two-tailed tests. P value less than 0.05 was statistically significant. Descriptive analysis based on frequency and percent distribution was done for all variables, including patient's personal data, co-morbidities, and chest pain data, while door-to-ECG time and clinical diagnosis were graphed. Also, the patient's clinical outcome was frequent. Crosstabulation was used to assess factors associated with Door-to-ECG among patients with chest pain who attended ED and also to investigate the distribution of study patients' outcomes by their door-to-ECG time. Relations were tested using Persons' chi-square and exact probability tests for small frequency distributions.

Data management
The data was stored in a computer database and other backup copies put in hard disk and cloud storage to prevent loss of data. The data kept private and only the investigators will be able to gain access.

Ethical considerations

Ethical approval was obtained from the institutional review board of King Faisal University (KFU-REC-2023- FEB-ETHICS629). An arabic informed consent by direct interview was obtained. Ethical consideration and confidentiality of all participants' information were maintained throughout the study. The data have been collected from a direct interviewer survey. The online questionnaire was created with Google Questionnaire.

RESULTS

A total of 492 patients with chest pain as the main complain attended to the ED were included. Patients ages ranged from 20 to more than 60 years, where 244 (49.6%) aged 40-60 years, and 165 (33.5%) aged more than 60 years. Exact of 332 (67.5%) patients were males. As for co-morbidities, 200 (40.7%) complained of hypertension, 126 (25.6%) were diabetic and 44 (8.9%) had IHD. Vital signs were abnormal among 284 (57.7%) patients as shown in Table 1.

Table 1. Bio-demographic data of study patients with chest pain attending ED, King Fahad Hospital, Al-Hofuf

Bio-demographic data	No	%
Age in years		
20-40	83	16.9%
41-60	244	49.6%
> 60	165	33.5%
Gender		
Male	332	67.5%
Female	160	32.5%
Chronic diseases		
DM	126	25.6%
HTN	200	40.7%
IHD	44	8.9%
CKD	18	3.7%
Other	104	21.1%
Vital signs		
Abnormal	284	57.7%
Normal	208	42.3%

The data in Table 2 indicate that the onset was less than 1 hour among 64 (13%) cases, 1-2 hours among 107 (21.7%) patients, 2-4 hours among 152 (30.9%) cases, and more than 12 hours among 110 (22.4%) cases. The chest pain was typical among 388 (78.9%) cases and active among 396 (80.5%). ECG showed ST changes among 186 (37.8%) cases.

Table 2. Clinical features of chest pain among patients attended ED, King Fahad Hospital, Al-Hofuf

Chest pain	No	%
Onset of the chest pain		
< 1 hour	64	13.0%
1-2 hours	107	21.7%
2-4 hours	152	30.9%
> 6 hours	59	12.0%
> 12 hours	110	22.4%
Is it typical chest pain or not?		
Yes	388	78.9%
No	104	21.1%
Is it active chest pain or not?		
Yes	396	80.5%
No	96	19.5%
ECG findings		
No specific changes	155	31.5%
Normal	151	30.7%
ST changes	186	37.8%

A total of 109 (22.2%) patients undergone ECG within 10 minutes of ED arrival, 161 (32.7%) within 10-15 minutes, 115 (23.4%) within 16-30 minutes while 107 (21.7%) after 30 minutes of arrival as shown in Figure 1.
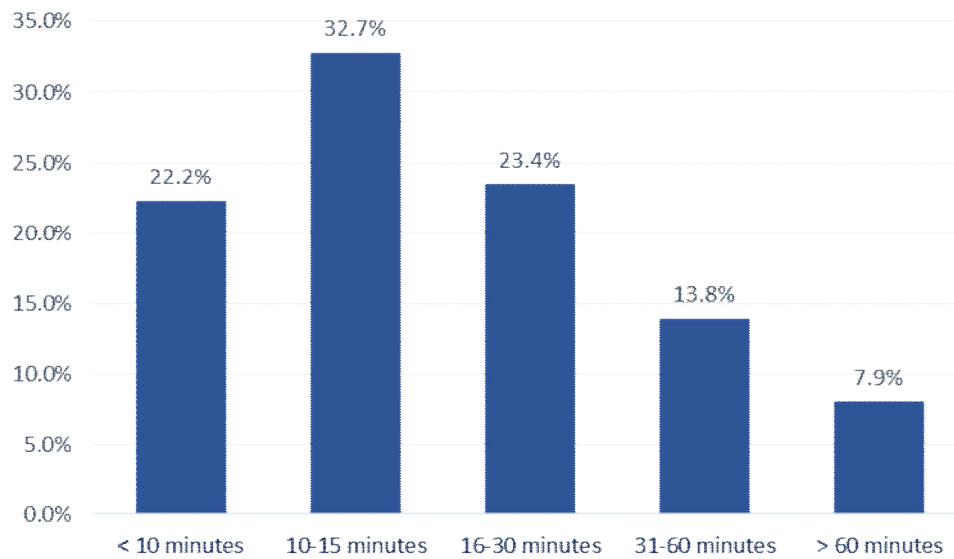

Figure 1. Door-to-ECG time among study patients with chest pain attended ED, King Fahad Hospital, Al-Hofuf

The data in Figure 2 indicate that 144 (29.3%) cases had non-cardiac causes, 122 (24.8%) showed STEMI, 88 (17.9%) were diagnosed with unstable angina, and 80 (16.3%) had NSTEMI.
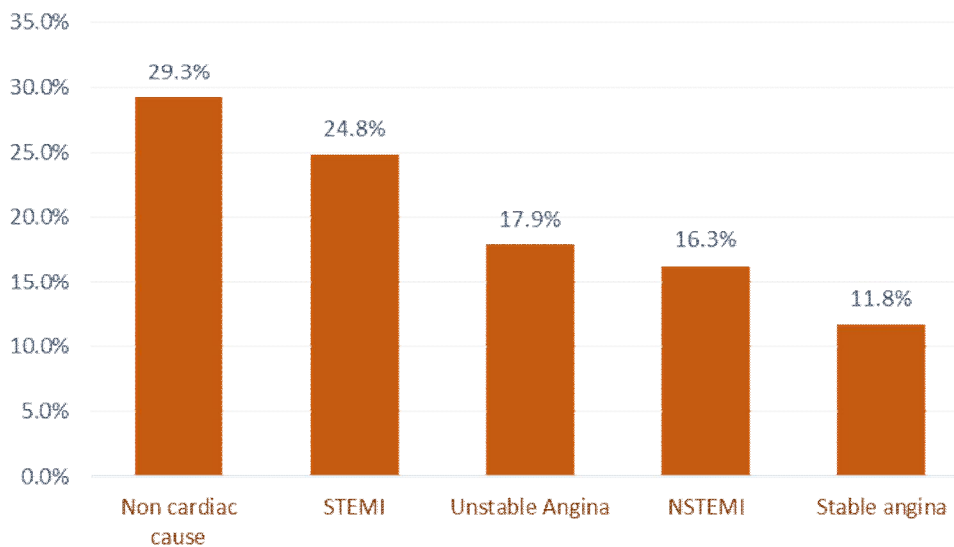

Figure 2. The most likely diagnosis among patients attended ED with chest pain, King Fahad Hospital, Al-Hofuf

Table 3 shows that an exact of 408 (82.9%) patients ordered troponin and 300 (61%) attached to a monitor.

Table 3. Clinical outcome among patients attended ED with chest pain, King Fahad Hospital, Al-Hofuf

Outcome	No	%
Were troponin ordered?		
Yes	408	82.9%
No	84	17.1%
Is the patient attached to a monitor?		
Yes	300	61.0%
No	192	39.0%

A total of 30.9% of patients aged more than 60 years undergone ECG within safe time (Door-to-ECG time was within 10 minutes) versus 20.5% of others aged less than 40 years with recorded statistical significance (P=.003). Also, Appropriate door-to-ECG time was reported among 29.9% of patients with abnormal vital signs versus 11.5% of others with normal signs (P=.001). Door-to-ECG time was within 10 minutes among 48.4% of patients with pain onset for less than 1 hour compared to 16.4% of others with pain for more than 12 hours (P=.001). Likewise, 38.2% of patient's abnormal ECG findings undergone ECG within 10 minutes in comparison to 11.6% of others with non-specific changes (P=.001). Additionally, Door-t-ECG time was appropriate among 45.1% of patients with STEMI, 27.5% of patients with NSTEMI, and only 9.1% of unstable angina (P=.001) as presented in Table 4.

Table 4. Factors associated with Door-to-ECG among patients with chest pain attended ED, King Fahad Hospital, Al-Hofuf

Factors	Door-to-ECG				p-value
	≤ 10 minutes		> 10 minutes		
	No	%	No	%	
Age in years					.003*
20-40	17	20.5%	66	79.5%	
41-60	41	16.8%	203	83.2%	
> 60	51	30.9%	114	69.1%	
Gender					.084
Male	81	24.4%	251	75.6%	
Female	28	17.5%	132	82.5%	
Chronic diseases					.174
DM	29	23.0%	97	77.0%	
HTN	53	26.5%	147	73.5%	
IHD	9	20.5%	35	79.5%	
CKD	2	11.1%	16	88.9%	
Other	16	15.4%	88	84.6%	
Vital signs					.001*
Abnormal	85	29.9%	199	70.1%	
Normal	24	11.5%	184	88.5%	
Onset of the chest pain					.001*
< 1 hour	31	48.4%	33	51.6%	
1-2 hours	32	29.9%	75	70.1%	
2-4 hours	19	12.5%	133	87.5%	
> 6 hours	9	15.3%	50	84.7%	
> 12 hours	18	16.4%	92	83.6%	
Is it typical chest pain or not?					.283
Yes	90	23.2%	298	76.8%	
No	19	18.3%	85	81.7%	
Is it active chest pain or not?					.371
Yes	91	23.0%	305	77.0%	
No	18	18.8%	78	81.3%	
ECG findings					.001*
No specific changes	18	11.6%	137	88.4%	
Normal	20	13.2%	131	86.8%	
ST changes	71	38.2%	115	61.8%	
Most likely diagnosis					.001*$
Non-cardiac cause	17	11.8%	127	88.2%	
NSTEMI	22	27.5%	58	72.5%	
Stable angina	7	12.1%	51	87.9%	
STEMI	55	45.1%	67	54.9%	
Unstable Angina	8	9.1%	80	90.9%	

P: Pearson X^2 test $: Exact probability test; * P < 0.05 (significant)

Table 5 shows the distribution of the study patients' outcomes by their door-to-ECG time. A total of 92.7% of patients who underwent ECG within 10 minutes had troponin versus 80.2% of those with delayed ECG

(P=.002). Also, 76.1% of patients who underwent ECG within 10 minutes were attached to a monitor compared to 56.7% of others with delayed ECG (P=.001).

Table 5. Distribution of study patient's outcome by their door-to-ECG time

Outcome	Time to ECG				p-value
	< 10 minutes		> 10 minutes		
	No	%	No	%	
Were troponin ordered?					.002*
Yes	101	92.7%	307	80.2%	
No	8	7.3%	76	19.8%	
Is the patient attached to a monitor?					.001*
Yes	83	76.1%	217	56.7%	
No	26	23.9%	166	43.3%	

*P: Pearson X² test   ; * P < 0.05 (significant)*

DISCUSSION

Reference to the American College of Cardiology and the American Heart Association (ACC/AHA), a 12-lead electrocardiogram (ECG) should be undergone and understood immediately after a patient reaches an emergency department (ED) complaining of chest distress or symptoms distrustful for the acute coronary syndrome (ACS). (8)(9) The recommended time is within 10 minutes of arrival, which may be an endorsed goal. On the other hand, the Veterans Health Administration measures the percentage of patients with cardiac symptoms who undergo an ECG within 10 minutes and do not measure the duration of the extra step of ECG interpretation (10). Additionally, the ACC/AHA advised that cases with ST-segment elevation myocardial infarction (STEMI) receive percutaneous coronary intervention (PCI) within 90 minutes. ([11]) The current study aims to assess the current performance of Door-to-ECG and to describe patients' comorbidities and other risk factors influencing the time of Door-to-ECG. It also aims to identify adherence to the guidelines of achieving a door-to-ECG time of 10 minutes for patients with chest pain and to study the advantages of performing ECG within the first 10 minutes. The study showed that about one-third of the patients aged more than 60 years, about two-thirds were males while vital signs were abnormal among more than half of the included patients. *Cunningham MA et al.* (12) found that the age-adjusted relative risk of myocardial infarction for males was 1.8 coinciding with the current study. Also, *Hess EP et al.* revealed that women had a lower prevalence of known coronary artery disease (21.0% v. 34.2%,) and a lower rate of typical pain (37.1% v. 45.7%). (13) For chest pain, one-third of the cases had chest pain for more than 6 hours and one-fifth had chest pain for more than 1 to 2 hours. The vast majority of the study cases had typical chest pain which was active among more than three-fourths of the patients. ECG showed ST changes among more than one-third of the study patients. *Martínez-Sellés M et al.* reported that Chest pain was nonischemic among 59.9% of the patients, undefined in 24.4%, and ischemic in 15.7%. (14) An ECG was performed for 88.4% of ED cases, and 6.5% had an acute myocardial infarction (AMI). As for door-to-ECG time, the current study showed that about one-fifth of the cases admitted to ED underwent ECG within 10 minutes, and one-fifth of them underwent ECG after 30 minutes. A higher rate of undergoing ECG within appropriate time (10 minutes) was reported by *Diercks DB et al.* as 34% and 40.9% of patients with non–ST-elevation ACS and ST-elevation myocardial infarction (STEMI), respectively, had an ECG performed within 10 minutes of arrival. (15) Also, similar results were reported by *Jackson et al.* who reported an average door-to-data time of 17 to 25 minutes in patients who received fibrinolytic therapy for STEMI at two institutions. (16) *Yiadom MY et al.* reported that the overall missed case rate (the percentage of primarily screened ED patients diagnosed with STEMI who did not receive an ECG within 15 minutes of ED arrival) for all EDs was 12.8%. (17) The mean difference in door-to-ECG times for captured and missed patients were 31 minutes, with a range of 14 to 80 minutes of additional myocardial ischemia time for missed cases. *Keats A et al.* applied an intervention to reduce door-to-ECG time. Before the intervention, compliance with a door-to-EKG time of 10 minutes or less was found to be 62.6%. (18) Post-intervention, compliance improved to 87.7%. Many studies revealed that faster DTE times lead to decreased time to aspirin, or reduced door-to-balloon (DTB) time, which are crucial steps in the management pathway of acute MI. (19-21) Regarding factors associated with door-to-ECG time, the current study revealed that old patient age, rapid onset of the pain, abnormal vital signs, ST changes, and suspicious of STEMI, NSTEMI, and unstable anginal were significantly associated with compliance to appropriate door-to-ECG time (within 10 minutes). *Lambrew et al.* found that sex and mode of transportation were factors affecting the time to ECG in patients with STEMI. (22) *Soumerai et al.* examined the care provided to the elderly between health maintenance organizations or fee-for-service insurance providers and found no difference in time to ECG acquisition. (23).

CONCLUSION AND RECOMMENDATIONS

In conclusion, the current study revealed that compliance to appropriate door-to-ECG time (within 10 minutes) was reported among nearly one out of each five cases with chest pain attending ED. The higher compliance was more among old-aged patients with acute onset pain, abnormal vital signs, and those with ischemic signs. Two-thirds of the cases were attached to a monitor mainly those who had undergone ECG within the recommended time. Supportive effort in the ED with a commitment to standard guidelines can result in significantly more adherence to the 10-minute-or-less door-to-ECG time average for chest pain patients in ED.

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