Research Article

Diagnostic Value of Clinical Suspicion of Residents and Emergency Physicians for Acute Myocardial Infarction

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Abstract:

Objective: To evaluate clinical suspicion in residents and emergency medicine specialists in Edalatian emergency department (ED) patients with suspected cardiac chest pain, in the diagnosis of acute myocardial infarction

Methods: This was a cross-sectional study on patients with suspected acute myocardial infarction (AMI) who were visited by emergency medicine specialists, first- and third-year residents. Each of the doctors completed a form of clinical suspicion of myocardial infarction after clinical suspicion, after electrocardiography (ECG), and the first troponin test. Golden diagnostic criteria were serial ECG and troponin levels till 6 hours, incorporated by a cardiologist.

Result: Total of 430 patients were studied, of which 68 patients (15.8%) were diagnosed with AMI. Diagnosis of the first-year resident, third-year resident, and emergency specialist based on clinical suspicion had a sensitivity of 72.06%(95%CI:59.9 to 82.3), 97.06%(95%CI:89.8 to 99.6), 94.12%(95%CI:85.6 to 98.4) and specificity of 32.60%(95%CI:27.8 to 37.7), 61.88%(95%CI:56.7 to 66.9), 55.80%(50.5 to 61.0), respectively. Adding the ECG findings, sensitivity increased or remained unchanged and specificity decreased in all three groups. After including troponin results for diagnosis, sensitivity increased in all groups but specificity decreased in first-year residents and increased in third-year residents, and emergency physicians.

Conclusion: The use of clinical suspicion for ruling out myocardial infarction is a tool with average power. The accuracy of diagnosis varied among different levels of experience of physicians, with third-year residents having the highest sensitivity and emergency physicians having the highest specificity. These findings highlight the importance of considering multiple factors in the diagnosis of myocardial infarction and the value of experience in medical decision-making.

Keywords: Clinical suspicion, Residents, Emergency physician, Acute myocardial infarction, Chest pain

Introduction

Today, cardiovascular diseases are the most common causes of emergency department visits so in some centers, about a quarter of patients referring to the emergency are cardiovascular patients whose primary complaint is chest pain [1, 2]. Chest pain is the most common manifestation of cardiac

emergencies [3-4], which can also be considered as the complaint of the disease in other various organs including lungs, stomach and intestines, muscles and bones, and mental illnesses, each requiring a therapeutic measure tailored to its diagnosis [3]. Despite extensive research and significant advances in recent years, the final rejection of myocardial infarction still lasts at least 6 hours on average [2, 3]. Notwithstanding research and development of diagnostic technologies, patients with symptoms probably caused by the acute coronary syndrome are usually put under examination for at least 6 hours [5-7]. Besides, only in about 25% of cases on admission, the diagnosis of acute coronary syndrome can be definitely rejected and in the remaining cases, rejection of acute coronary syndrome diagnosis and particularly myocardial infarction needs more time [1, 2]. Thus, many researchers have been long trying to develop a diagnostic strategy based on which they can rule out acute coronary syndrome in suspected patients admitted to the emergency in the shortest possible time so that unnecessary hospital admissions and other unnecessary diagnostic procedures are prevented [3,8]. Moreover, they are seeking a solution for the quick diagnosis of myocardial infarction in admitted patients with chest pain [8] so that significant results can be achieved in improving the patients by treating it as quickly as possible [9,10]. Recent studies are mostly based on new diagnostic biomarkers and attempt has been made that examination medical history to be applied as a powerful tool in ruling out myocardial infarction in the emergency by increasing clinical variables. Nevertheless, history and examination cannot be used as reliable tools for ruling out myocardial infarction in many centers since in many cases, uncommon complaints occur in patients with myocardial infarction so it has been stated in a study that there has been undiagnosed acute myocardial infarction by about 6% of the patients discharged from the emergency department complaining of chest pain [3,12]. Furthermore, recent studies have shown that general physicians have average accuracy in using history and physical examination [3,10]. The main goal of this study is to determine the diagnostic value of the clinical judgment of emergency physicians in myocardial infarction diagnosis in patients admitted to the emergency department with chest pain. This judgment is made based on the clinical symptoms at the time of admission to the emergency and also ECG findings and troponin level during the time of being under observation in the emergency. The secondary goals intended in this research comprise the separate study of sensitivity and diagnostic value of clinical judgment of first-year and third-year residents and emergency medicine specialists.

Methods

This study followed STAndards for the Reporting of Diagnostic accuracy studies (STARD) guidelines [11].

Participants

Participant recruitment:

This research is a cross-sectional design study. Inclusion criteria were Age of more than 18 years, having a manifestation of chest pain with suspected heart disease, and Starting patient complaints within 24 hours prior to admission. Exclusion criteria were existence of any other concurrent disease that leads to hospitalization, kidney failure requiring dialysis, chest trauma, patients with a suspected myocardial contusion, non-Persian speaking patients, prisoners (those who cannot be followed) and decease within less than 6 hours after hospitalization.

Participant sampling

Patients with chest pain suspected of myocardial infarction were examined by first-year and third-year residents and a faculty member physician. Sampling was performed in Mashhad Edalatiyan Emergency from October until the end of February 2016. Based on the Cochran formula and concerning the sensitivity of 95%, history of myocardial infarction diagnosis, and the prevalence of myocardial infarction by 17% in the study by Body et al. [2]. Conducted previously and by considering the confidence interval of 95% and accuracy of 0.05, the sample size is calculated as follows: n= (pqz2)/d2 n=430 patients.

Data collection

Each physician completed the clinical suspicion form, selecting one of the options associated with clinical suspicion of myocardial infarction. The form options include "definitely no", "probably no", "not sure", "probably yes" and "definitely yes". Besides, the demographic data of patients were recorded by the principal researcher of the project. None of the physicians was aware of the results related to the troponin level and ECG of patients. Then, the clinical suspicion form was again completed by the physicians after performing ECG and finally, after providing the result of the initial troponin level, all three groups of physicians again completed the clinical suspicion form for each patient. Each physician completed the clinical suspicion form and selected one of the options associated with the clinical suspicion of myocardial infarction.

Test methods

index tests were clinical suspicion, clinical suspicion and ECG, clinical suspicion and ECG, and troponin level. Standard test was the final diagnosis at 6 hours by cardiologist. Ultimately, the final diagnosis was made by a cardiologist faculty member based on the patient ECG and troponin level on two occasions (on admission and 6 hours later).

Table 1. Baseline characteristics of included patients

Variable	total N=430	AMI N=68	Had unstable angina n=96	others n=266
Age in years, mean (SD)	61.4	65.37	64.3	59.3
Men (%)	252(58.6%)	40 (58.8%)	57(59.3%)	147(55.2%)
Previous angina (%)	213(49.5%)	33 (48.5%)	48(48.9%)	132(49.6%)
Previous myocardial infarction	87(20.2%)	18 (26.4%)	24(25%)	45(16.9%)
Hypertension	211(49%)	40 (58.8%)	59(61%)	112(42%)
Hyperlipidemia	74(17.2%)	12 (17.6%)	19(19.7%)	43(16.1%)
Diabetes mellitus	139(32.3%)	23 (33.8%)	42(43%)	74(27%)
Smoking	123(28.6%)	21 (30.9%)	30(31.2%)	72(27%)
Addiction	76(17.7%)	13 (19.1%)	20(20.8%)	43(16.1%)
Previous coronary intervention	109(25.3%)	27 (39.7%)	34(35.4%)	48(18%)
Previous CABG	34(7.9%)	11 (16.2%)	14(14.5%)	9(3.4%)
Nausea	213(49.5%)	26 (38.2%)	35(36.4%)	152(57.1%)
Vomiting	134(31.1%)	25 (36.8%)	35(36.4%)	74(27.8%)
Dyspnea	217(50.4%)	38 (55.9%)	48(50%)	131(49.2%)
Sweating	97(22.5%)	20 (29.4%)	25(26%)	52(13.8%)

Table 2. diagnosis of residents and emergency medicine specialists based on clinical suspicion alone, with ECG and with ECG and troponin serum levels.

	Definitely / Probably not AMI	not sure	Probably AMI	Definitely AMI
Clinical suspicion of the first-year resident	0	19(27.9%)	49(72.1%)	0
Clinical suspicion of the third-year resident	0	0	51 (75.0%)	17 (25.0%)
Clinical suspicion of the emergency medicine specialist	0	4(5.9%)	50(73.5%)	14(20.6%)
First-year resident diagnosis with clinical suspicion and ECG	0	3 (4.4%)	49 (72.1%)	16 (23.5%)
Third-year resident diagnosis with clinical suspicion and ECG	0	0	26 (38.2%)	42 (61.8%)
Emergency medicine specialist diagnosis with clinical suspicion and ECG	0	2 (2.9%)	25 (36.8%)	41 (60.3%)
First-year resident diagnosis with clinical suspicion, ECG, and troponin level	0	4 (5.9%)	47(69.1%)	17 (25.0%)
Third-year resident diagnosis with clinical suspicion, ECG and troponin level	0	0	13(19.1%)	55(80.9%)
Emergency medicine specialist diagnosis with clinical suspicion, ECG and troponin level	0	1 (1.5%)	8 (11.8%)	59 (86.8%)

AMI, acute myocardial infarction

If patients underwent angiography or passed away, the results until hospitalization were recorded and in case of decease within less than 6 hours after hospitalization, they were excluded from the study. definitely yes option was considered as positive test results and all other categories as negative.

Statistical methods

The sensitivity and specificity of clinical suspicion in myocardial infarction diagnosis were evaluated using MedCalc V.12.4.0.0 online software.

Results

In this study, 430 patients with cardiac chest pain admitted to Edalatiyan Emergency from October until the end of February 2016 were analyzed. Of this number, 68 patients (15.8%) were diagnosed with myocardial infarction. Of these 68 patients, 24 subjects were put under angiography within 90 minutes after admission. Three people died. Of 68 patients, 41 underwent angiography in the first 30 days after myocardial infarction. The basic characteristics of patients have been shown in Table 1.

All the patients were visited by the first-year and third-year residents and the faculty member. Each of them initially completed the clinical suspicion form based on history without the knowledge of ECG and troponin level. In table 2 the mean rate of the diagnosis of residents and emergency medicine specialists has been displayed based on clinical suspicion alone, with ECG and with ECG and troponin serum level.

Diagnostic accuracy of clinical suspicion as a dual means of admitting or discharging the patients alone and along with ECG and troponin serum level has been provided in Table 3.

Discussion

In this study, the use of clinical suspicion to rule out myocardial infarction was evaluated as a medium-strength tool. Therefore, the diagnosis of myocardial infarction is not reliable only by considering clinical suspicion. After adding ECG and troponin to clinical suspicion, the accuracy of myocardial infarction diagnosis increased significantly; which indicates the high diagnostic value of ECG and troponin in the diagnosis of myocardial infarction.

Table 3. Diagnostic accuracy of strategies incorporating clinical suspicion

Strategy		Sensitivity	Specificity
Diagnosis with clinical suspicion	first-year resident	72.06 (59.9 - 82.3)	32.60 (27.8 - 37.7)
	third-year resident	97.06(89.8 - 99.6)	61.88(56.7 - 66.9)
	Emergency medicine specialist	94.12 (85.6 - 98.4)	55.80(50.5 - 61.0)
diagnosis with clinical suspicion and ECG	first-year resident	95.59 (87.6 - 99.1)	22.65 (18.4 - 27.3)
	third-year resident	97.06 (89.8 - 99.6)	47.51 (42.3 - 52.8)
	Emergency medicine specialist	98.53 (92.1 - 100.0)	47.51 (42.3 - 52.8)
diagnosis with clinical suspicion, ECG and troponin level	first-year resident	95.59 (87.6 - 99.1)	22.38 (18.2 - 27.0)
	third-year resident	100.00 (94.7 - 100.0)	52.49 (47.2 - 57.7)
	Emergency medicine specialist	100.00 (94.7 - 100.0)	52.49 (47.2 - 57.7)

The performance of the 3rd year assistants and emergency medicine specialists was also very good in this field and they had properly diagnosed myocardial infarction cases; However, differences in the diagnosis of myocardial infarction between the first-year assistant and the third-year and the faculty member in the diagnosis of myocardial infarction were obvious.

Only one study with a similar topic was found, which is also followed. However, two other studies that examined clinical evaluations in the diagnosis of acute myocardial infarction were also included. In a 2014 study by Body et al., the diagnostic power of emergency medicine doctors' clinical suspicion in diagnosing myocardial infarction alone and in combination with troponin and ECG was examined (2).

In this prospective study, patients with chest pain suspected of myocardial infarction were investigated. Physicians recorded their clinical suspicion ('gestalt') at the time of each patient's visit using a five-point Likert scale (definitely no, probably not, not sure, probably yes, definitely yes) without knowing the final diagnosis of the patients.

Then troponin T and baseline ECG were done for each patient. Also, the troponin T level was checked for each patient one more time (12 hours later). Finally, this group of researchers evaluated the use of clinical suspicion to rule out myocardial infarction as a tool with moderate power that requires more research. In another study conducted by Schillinger et al. in Austria in 2004, the diagnostic accuracy of complaints and symptoms of suspected myocardial infarction patients in the diagnosis of acute myocardial infarction was investigated (10). This study was conducted retrospectively on 1288 non-accident emergency patients presenting with acute chest pain. In this study, patient complaints (based on the typicality or non-typicalness of the complaint according to the location of the pain, the quality of the pain, the spread of the pain, how the symptoms started, accompanying symptoms, history of coronary artery disease and cardiovascular disease risk factors (two more cases) (including smoking, obesity, blood pressure, diabetes, dyslipidemia, family history) were recorded. Then the positive predictive value (PPV) and 95% confidence interval were calculated for predicting or rejecting acute myocardial infarction. Among suspected patients, 168 (13%) myocardial infarctions had occurred. The presence of 4 or more typical diagnostic criteria for myocardial infarction had a PPV of 0.21 (0.17-0.25) for the diagnosis of acute myocardial infarction. The presence of 4 or more atypical diagnostic criteria for myocardial infarction Myocardium had a PPV of 0.94 (0.96-0.91) for the diagnosis of acute myocardial infarction. In 165 of 476 patients younger than 40 years of age, the presence of 4 or more of the 4 atypical diagnostic criteria for myocardial infarction had a PPV of 0.98 (0.96-1.0) for Myocardial infarction was rejected (10).

In another study conducted in 2006 by Christenson et al., the diagnostic value of clinical evidence in the

diagnosis of acute myocardial infarction was investigated. This study was conducted on 769 patients over 25 years old. In this study, a model was developed for the diagnosis of myocardial infarction including cardiovascular risk factors, pain characteristics, clinical and electrocardiogram findings, and the results of cardiac markers. In this study, 77 (10%) patients were diagnosed with acute myocardial infarction and 11.4% (88 patients) were diagnosed with unstable angina. In this study, the diagnostic value of this model for diagnosing acute myocardial infarction had 98.8% sensitivity and 32.5% specificity (12). In this study, accompanying symptoms (nausea, vomiting, and shortness of breath), history of coronary artery disease (history of myocardial infarction, history of angiography and open heart surgery), and risk factors of cardiovascular diseases (including smoking, addiction, obesity, blood pressure, diabetes), hyperlipidemia) was recorded as a variable, but it was not calculated as a channel parameter in the statistical analysis. The findings of this study showed that among all patients referred to the Adalatian Emergency Department of Imam Rezai Hospital in Mashhad with suspected cardiac chest pain, 38.1% had acute coronary syndrome (15.8% myocardial infarction and 22.3% unstable angina). For the rest of the cases (61.9%), the diagnosis of persistent angina or other causes of chest pain was suggested. The average age of myocardial infarction patients was about 65 years, no cases of MI were observed under the age of 40 years, and the peak age was between 60 and 70 years. The incidence of both MI and unstable angina was higher in men than in women (about 59% vs. 41%).

According to the results of this research, the clinical suspicion of third-year assistants and emergency medicine specialists in ruling out myocardial infarction can be evaluated as moderate, and this diagnostic method can be used in emergency cases to rule out myocardial infarction in patients with a low-risk factor. To diagnose myocardial infarction, according to the results of this study, troponin serum level and ECG should be used along with clinical suspicion (100% sensitivity).

Limitations:

This study had some limitations. First, it was a single-center study, so we can't generalize findings to other settings with different patient populations and levels of experience among physicians. Second, the use of clinical suspicion as the initial diagnostic method may have a bias due to the subjective nature of symptoms and signs among different patients and physicians. Thirdly, the study did not consider other factors that may influence the accuracy of diagnosis, such as the timing of symptoms and the presence of comorbidities, which may affect the interpretation of ECG and troponin results. Finally, the study did not compare the accuracy of diagnosis based on the different diagnostic guidelines.

Conclusion

Clinical suspicion is a tool with moderate power to rule out myocardial infarction, but it is a valuable tool to raise the possibility of MI. The addition of diagnostic methods such as electrocardiogram and troponin to clinical suspicion, to prove the diagnosis of MI, is very helpful, but based on only one time of electrocardiogram and troponin, it is not possible to reject MI and discharge the patient. In addition to these, the level of basic knowledge and experience of the doctor is also very effective in this field.

Declarations:

Conflicts of interest:

None.

Authors' contributions:

AT؛ Conceptualization and methodology; Writing - original draft preparation; Writing - review and editing

ME: Conceptualization and methodology; Data curation and analysis; Conceptualization and methodology

EEM: Writing - original draft preparation; Conceptualization and methodology; Writing - review and editing

RF: Writing - original draft preparation; Conceptualization and methodology; Writing - review and editing

MJY: Writing - original draft preparation; Data curation and analysis; Conceptualization and methodology

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