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Emergency evaluation of acute chest pain

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ORIGINAL ARTICLE

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ABSTRACT

Objective: To determine the sensitivity and specificity of initial clinical assessment about the diagnosis of acute coronary syndrome (ACS) in patients presenting with acute chest pain by a cardiology resident in the emergency room and assess the 30-day outcome of patients with ACS and non ACS.

Study Design: Cohort study.

Place and Duration of Study: The study was conducted in the emergency department and cardiac care units of the Aga Khan University in 2006-07.

Methodology: A total of 202 patients, who presented to the emergency room with chest pain, were given an initial ECG and troponin check. Patients were assigned to initial ACS and non-ACS groups by the cardiology resident. After cardiac workup, patients were assigned to final ACS/final non ACS group. They were followed for outcome after 30 days of initial presentation. Sensitivity and specificity, if initial workup was determined, keeping final assessment after cardiac workup as the gold standard.

Results: Out of the 202 patients, 61.9% were males. Their mean age was 54.05±13 years. Sixty eight percent were placed in the initial ACS group and 30.7% were placed in the initial non ACS group. After workup, 36% were placed in the final ACS group and 28.7% in the final non-ACS group and 35% were undecided. The sensitivity of initial assessment of ACS by the cardiology resident was 100%. However, the specificity was 54.2%. In the 30-day outcome, one patient (1.3%) died in the ACS group due to myocardial ischemia while no patient died from the non ACS group.

Conclusion: Initial assessment about ACS by cardiology resident based on character of chest pain, ECG and troponin I is highly sensitive. However, the specificity is low.

Key words: *Chest pain. Acute coronary syndrome. Cardiology resident. Non acute coronary syndrome. Sensitivity. Specificity.*

INTRODUCTION

Chest pain accounts for about 506 million emergency department visits annually, second only to abdominal pain as the most common reason for an emergency department visit. Most of the patients presenting with chest pain present in an acute setting in the ER and warrant thorough evaluation.[1]

A lot of them are hence admitted with the label of chest pain of possible cardiac origin or more precisely with initial assessment of Acute Coronary Syndrome (ACS) based on clinical grounds and preliminary investigations like electrocardiogram and troponin I. ACS comprises a group of entities including acute ST-segment elevation myocardial infarction (STEMI), non ST-segment elevation myocardial infarction (NSTEMI), and unstable angina. STEMI deals with complete occlusion of the coronary artery whereas NSTEMI and unstable angina deal with incomplete occlusion of coronary artery.[2] However only a minority of such patients actually turn out to have a definite diagnosis of acute coronary syndrome after cardiac workup. So there is clearly a substantial burden of potentially avoidable admissions as all patients with acute chest pain do not warrant admission.[3] Atypical chest pain has been reported to account for 49-60% of all admissions with chest pain.[4-5] Such patients are often discharged without a definite diagnosis which can result in depression, anxiety and a decrease in daily activity.

Patients seen in the ER with chest pain are admitted with an initial diagnosis of ACS on clinical grounds made by a cardiology resident. Evaluation of acute chest pain remains challenging despite many insights and innovations. None of these have become standards which could be followed throughout the world.[6] Patients with acute myocardial infarction who are mistakenly discharged from the emergency department have short term mortality rates of about 25%. This is actually twice of what would be expected if they were admitted to the hospital. It is also safer to admit the patient than to discharge them in doubt.[7] Clinicians can use validated decision aids (algorithm designed to improve decision making by physicians) and newly identified markers of myocardial injury to improve the accuracy of diagnosis and determination of risk. Clinical decision making based on fixed algorithms along with cardiac markers improves the consistency of risk stratification by physicians.[8-9] The aim of this study was to determine the sensitivity and specificity of the initial clinical assessment by a cardiology resident in the emergency room of patients presenting with acute chest pain in the diagnosis of (ACS) and to determine their 30-day outcome.

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METHODOLOGY

It was a prospective cohort study conducted in 2006-07 at the Aga Khan University Hospital. Patients presenting to the emergency room of age more than 18 years and presenting with the chief complaint of chest pain (suspected to be cardiac by the triage nurse) who had electrocardiograph done and had an initial serum Troponin I measured were included. Those patients with chest pain who had other serious medical illnesses besides a suspected cardiac event and those with no chest pain, but who were positive for troponin or ischemic evidence of electrocardiogram (ECG) alone were excluded from the study. All patients were recruited keeping in view the Helsinki declaration for ethical principles.

Patients were initially designated to an initial ACS group and a non ACS group assigned by the cardiology resident in ER. If either with typical chest pain history alone or with ischemic ECG or troponin I positive patient was placed in initial ACS group and those who had atypical chest pain along with no Troponin I leak and normal or nondiagnostic ECG as assessed by the cardiology resident were assigned to the initial non ACS group.

After cardiac workup, (coronary angiography or myocardial perfusion scan or Dobutamine stress echocardiography or exercise tolerance test) they were finally placed into final ACS group and non-ACS group. Both final ACS and final non ACS groups were followed up for 30 days after discharge from hospital for outcome. Their outcome was assessed in terms of recurrent chest pain or no chest pain and death or survival.

The outcome at 30 days was seen as this is the critical period by which patients with ACS are at high risk for morbidity and mortality. Data collection tool was a self devised performa comprising of demographics and comorbids, initial assessment of the cardiology resident (based on character of chest pain, electrocardiograph, troponin I), cardiovascular clinical exam, final assessment of ACS and nonACS based on the cardiac workup and outcome of the patient during the inpatient stay and after 30 day of follow up.

Typical chest pain was defined as chest pain or discomfort (pressure, heaviness, tightness, squeezing sensation in center or left sided chest pain), neck/jaw pain, arm or shoulder pain + diaphoresis, + dyspnea. Atypical chest pain: discomfort (chest fullness, stabbing, right sided chest pain) indigestion, upper extremity numbness, tingling, pain with cough or deep breath, palpitation, mid back pain, dizziness/faint, fatigue.[1] ECG indicating ischemia was defined as having in atleast 2 leads; new Q waves > 1 mm in depth or more, ST segment elevation at the j point of 2 mm in leads V1, V2, V3 and > 1 mm in other leads or, ST depression of 1mm or more or inverted T wave (these changes will not be significant in presence of LVH, LBBB, early repolarization or pacer). Nondiagnostic or normal ECG is defined as < 1 mm ST elevation/depression, no T wave changes, and no Q wave changes. Troponin I of > 1 was taken as positive.

Data on comorbids and cardiovascular examination was also recorded. After this, patients from both initial ACS groups and initial non ACS group underwent cardiac workup either in the form of coronary angiography or myocardial perfusion scan or dobutamine stress echo or exercise tolerance test. Based on their results, they were then again redesignated into final ACS or final non ACS groups. Those patients who did not undergo any cardiac workup further on were excluded from the study. Each group was followed up during inpatient stay and at 30 days for recurrence of chest pain and survival by telephone.

Patients were sampled by non probability purposive method. A sample size of at least 57 patients in the initial ACS group and 57 patients in the initial non ACS group was taken to achieve the power of 80% with difference in mortality of 16% between both groups, using two-sided chi-square test with continuity correction and with a significance level of 5%.[6] However, it was expected that 30% of patients may not have workup so 35 extra patients were enrolled.

Data was analyzed on SPSS (Statistical package of social sciences version 14). ACS was taken as the dependent variable. Typical chest pain, atypical chest pain, demographics, comorbids, electrocardiogram, troponin I, cardiac workup, return to ER, recurrent myocardial infarction (MI)/angina were taken as the independent variables. Results are presented as mean and standard deviation for quantitative variables and percentages for qualitative variables. Sensitivity, specificity, positive predictive value and negative predictive value of initial clinical diagnosis of ACS group based on final clinical diagnosis of ACS as gold standard were calculated. In univariate analysis, the chi square test was used for qualitative variables and the Fischer exact test was used wherever applicable. Student t-test was used for quantitative variables. Significance was taken at $p < 0.05$.

RESULTS

A total of 202 patients were enrolled during the study period. Sixty one percent were males. Their mean age was 54.05 $\pm$ 13 years. Risk factors for CAD were present in 86.1% (174) patients; hypertension in 52% (n=105), diabetes in 35.6% (n=72), prior history of CAD in 22.3% (n=45), smoking in 22.3% (n=45) and positive family history for CAD in 13.4% (n=27). Sixty-eight percent were placed in the initial ACS group and 30.7% were placed in the initial non ACS group (Table I). Out of the 202 patients, 15.9% were excluded from further

Table I: Clinical criteria for initial acute coronary syndrome/non acute coronary syndrome groups.

	Initial ACS group (n=132) % (n)	Initial non-group (n=70) % (n)	ACS p-value
Character of chest pain	Typical 65%	Atypical 34.7%	
Electrocardiogram			
Ischemic	87.8% (65)	12.2% (9)	< .001
Normal/non-diagnostic	52.3 % (67)	47.6 % (61)	
Troponin I			
> 0.1 (+ve)	93.5% (43)	6.5% (3)	< 0.001
< 0.1 (-ve)	57.1% (89)	42.9% (67)	< 0.001

assessment as they did not get admission. Out of a total 202 patients, 50.5% (102) patients had cardiac workup done; 25.2% (51) had coronary angiography done, 18.3% (37) had myocardial perfusion scan (MPA) done, 5% (10) had exercise tolerance test (ETT) done and 2% (4) had Dobutamine stress echo cardiography (DSE) done as cardiac workup leading to the final assessment of ACS. Cardiac workup was done within 48 hours in all these patients during their admission. Those patients who had STEMI and NSTEMI had coronary angiography while the rest had noninvasive testing in the form of MPS, DSE or ETT. After workup, 45.94% were placed in the final ACS group, 34.5% in the final non-ACS group and 19.9% were undecided because of lack of workup (Figure I). NSTEMI was the most common diagnosis in the ACS group 33% (n=34), followed by unstable angina 32.8% (n=24) and ST elevation MI 21.91% (n=16). The sensitivity of initial assessment of ACS by cardiology resident was 100%. However, the specificity was 54.2% with positive predictive value of 55.30% and negative predictive value of 100% with positive predictive value of 55.30% and negative predictive value of 100%.

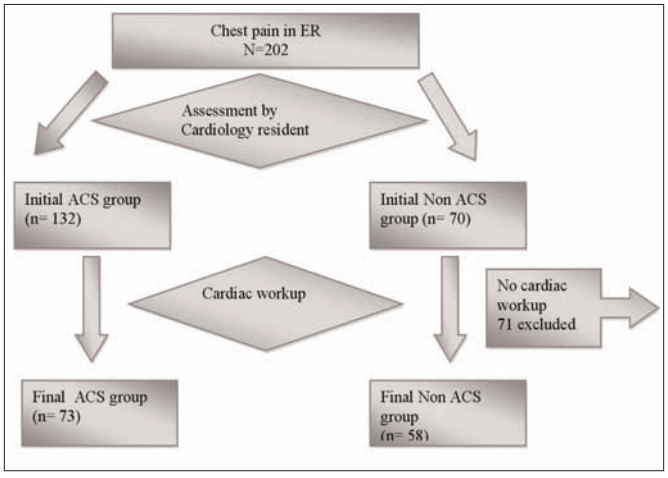

Figure 1: The in-hospital course of study patients.

During the in-patient stay, 7 patients had recurrent angina/MI and one died. Two patients returned to the ER with MI/Angina and 2 with atypical chest pain. In the 30-day outcome, one patient (1.3%) died in the final ACS group due to MI/angina and no patient died from the non ACS group. Those 71 patients who were not admitted or who were not worked up were also followed up. Their outcome was mainly uneventful. However, 8.45% of them had recurrent atypical chest pain and 16.9% could not be contacted. Those 71 patients who were not admitted or who were not worked up were also followed up. Their outcome was mainly uneventful. However 8.45% of them had recurrent atypical chest pain and 16.9% could not be contacted.

DISCUSSION

In this study, an algorithm with a clinical component (based on history and physical examination), electrocardiogram and enzyme marker troponin I was used. The reason such a criteria was used was because in using only a clinical component, the tendency is to over diagnose patients with ACS.[1] The sensitivity of initially diagnosing patients with ACS by the cardiology resident, keeping final diagnosis of ACS after cardiac workup as gold standard, is high. This suggests that the chance of missing a patient with chest pain is low based on the criterion that was followed in this study. This high sensitivity has mainly been possible due to the fact that every patient with typical chest pain was included in the initial ACS group. So correct assessment of chest pain into typical/atypical is of paramount importance. However, the specificity was low indicating that there were a substantial number of false positives. The low specificity of the initial assessment of ACS does result in the labeling of many patients without ACS as ACS in the ER. The high sensitivity and low specificity of the clinical diagnosis of chest pain has been reported in earlier studies as well. Although no patient with acute chest pain of cardiac origin was missed, some having non cardiac chest pain was diagnosed as cardiac. Physicians with higher levels of training had a higher sensitivity for detecting myocardial infarction, but at the expense of decreased specificity. So the correct identification of ischemic chest pain was not dependent on clinical experience alone.[12] The Goldman risk score had a sensitivity of 88% to 91% for predicting acute myocardial infarction, with a specificity of 78% to 92%.[8]

Although over the years, a number of different algorithms have been invented but implementing them has been difficult. The low specificity also highlights the point that the major proportion of these chest pains, which later prove to be atypical, should be investigated in the ER in the chest pain unit. This would both save cost and also help in allaying anxiety in such patients. Also, as ECG is an integral part of the initial clinical assessment, so improving the analysis and the interpretation of ECG could improve decision making. The correct interpretation of ECG is important as it gives a good idea about possible cardiac ischemia and is also a cost effective investigation.[13-14] Widely available

biomarkers (such as creatinine kinase, troponin I) have low sensitivities for the diagnosis of myocardial infarction measured at initial presentation to the emergency department, particularly within 6 hours of the onset of symptoms. Troponin checked within the initial 4-6 hours of presentation with acute chest pain into the ER does not have much clinical validity, as this is the minimum time the cardiac muscle takes to release enzymes into the circulation.[8,16] Even after a decade of research on cardiac ischemia, there is no perfect way to exclude cardiac ischemia in a cost effective and safe way in the ER without having some noninvasive or invasive imaging. A short period of observation along with essential cardiac workup is a better approach. There have been validated decision protocol in the form of a flow chart, ECG findings and other clinical data incorporated into the flow chart as proposed by Goldman.[8] These are used to predict the patients risk of acute MI and have a sensitivity of 88% and a specificity of 74%. Although what Goldman proposed has a substantially good sensitivity and specificity, it has not been found to be practical and could not be implemented as a standard tool.[17-18]

All patients presenting with acute chest pain in the study were followed for their outcome at 30 days. Death was seen in the final ACS group while there were no deaths in the final non ACS group or those who had no workup done. Mortality in the final ACS group was 1.3% which is low when compared to figures quoted in other studies. The reason for this could be the small sample size. Also, recurrent angina and MI was seen more in patients with final ACS. Santos *et al.* has also demonstrated a similar trend in this study in which no deaths were seen in the non ACS group.[19] A thirty day mortality for unstable angina is 5% and those who are not hospitalized are 2.1%. The mortality rate for myocardial infarction is 10.5%. In this study, there was no mortality in the non ACS group and also amongst those who were not worked up. Also, this group mainly had atypical symptoms at follow up. The reason for a considerably better outcome in this group was that a very stringent criteria was used in labeling patients with ACS/non-ACS chest pain. The sensitivity in this study of identifying patients with ACS chest pain was 100%, so no patient with typical symptoms was missed and the rest had a good outcome. One year mortality also follows a similar trend; for atypical chest pain 2.7% and for typical chest pain 18.3%.[6]

One of the major limitations of this study was that a good 19.9% of patients did not have any cardiac workup done. Either their symptoms proved to be atypical and they had a consistent diagnosis of their atypical symptoms or they were unwilling to have further investigations. The sample size in this study was small so conducting the study with a larger sample size would be required. It was a single centered study so the results cannot be generalized all over.

CONCLUSION

Following a stringent criteria for evaluation of acute chest pain, a high sensitivity for identification of patients with ACS can be achieved, although at the cost of low specificity. To improve the low specificity, noninvasive imaging should be available in an ER setting. Also, patients in the non ACS group need to have further workup to identify the cause of the atypical chest pain.

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