Misdiagnosed Acute Coronary Syndrome: Characteristics of Patients with Acute Coronary Syndrome Discharged Home from the Emergency Department

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Abstract

Objective: To investigate the characteristics of patients with a misdiagnosis of acute coronary syndrome (ACS) in the Emergency Department (ED) of a tertiary hospital.

Methods: The computerized file data of 89 selected patients hospitalized directly from the ED for ACS in 2002-2003 were compared with those of 26 consecutive patients hospitalized for ACS only on their second visit to the ED, within 48 hours of the first.

Results: Statistical analysis yielded several significant differences between the groups. The study group was characterized by a younger age (27% <52 years vs. 13% in the comparison group), higher proportion of Arab-Israelis (54% vs 33%), higher rate of hypertension (50% vs. 28%), and higher rates of cerebrovascular accident (4% vs 9%) and depression (7.7% vs 0); they had more symptoms of atypical chest pain and abdominal and epigastric pain; ECG findings were normal in 38.5% vs 0 in the comparison group, and the abnormalities noted in the remaining patients were not diagnostic; laboratory findings were normal in all cases. In addition, a much larger proportion of study patients presented at night. There were no between-group differences in mortality rate.

Conclusion: These findings support earlier studies of a high rate of misdiagnosis of ACS in the ED. Reasons include atypical clinical presentation, failure of interpretation of the history, failure to correctly interpret the electrocardiogram, failure to perform an electrocardiogram when necessary, and lack of proper use of cardiac enzyme test.

MeSH Words: Acute coronary syndrome, myocardial infarction, diagnosis, misdiagnosis, emergency department

Introduction

Acute coronary syndrome (ACS) is a group of disorders characterized by myocardial ischemia. The most common are unstable angina pectoris, non-ST elevation myocardial infarction (MI), and ST elevation MI [1]. Although unstable angina (new-onset, ascending, Prinzmetal, resting, and post-MI) has not yet been precisely defined, it is generally considered a "middle ground" between stable angina and MI. Its sole distinction from non-ST elevation MI, which is a consequence of complete obstruction of a blood vessel [2], is the duration of the ischemia.

Chest pain accounts for 5-20% of all visits to the Emergency Department (ED). However, only about half the affected patients have clinical evidence suggestive of ACS, based on the past medical history and physical examination, and only about half of these have definitive findings on the electrocardiogram (ECG). Indeed, ACS is

notoriously difficult to diagnose, and this uncertainty causes many physicians to err on the side of caution, placing a heavy economic burden on the health-care system [3]. At the same time, a misdiagnosis occurs in 2-10% of patients, who later acquire acute MI which doubles their risk of death compared to patients correctly diagnosed at the initial ED visit [3,4]. These errors account for 20-39% of all payouts in medical malpractice lawsuits [3,5-7].

For the proper diagnosis of ACS, the history should be thorough, and include the characteristics of the pain, its duration, and physical findings that reflect the cardiac status. It is crucial that the ECG be performed within 5 minutes of the patients' appearance at the ED. Lee and Goldman [8], in a study of 2000 patients with acute chest pain, found that 80% of those with an ST elevation of more than 1 mm, and 20% of those with ST depression or T-wave inversion, had acute MI. The prolonged ischemia in non-ST elevation MI causes irreversible myocardial necrosis with the release of cardiac enzymes. Thus, another diagnostic tool that aids the physician are laboratory tests of cardiac markers that indicate the destruction of myocytes. These include creatinine kinase-myocardial band (CK-MB) enzyme, which is known to increase 4 hours after onset of myocardial symptoms, in addition to troponin T and I, which are more specific and may stay elevated longer, sometimes up to 14 days [8-16]. Several authors have also suggested various supplemental computer protocols and predictive tools for use in the triage of patients with complaints of chest pain or other symptoms suggestive of ACS [17-22].

One of the main reasons for misdiagnoses of ACS is atypical pain, which occurs in a large proportion of patients, and a normal or noncontributory ECG (mostly no ST elevation). Interestingly, this patient group is about twice the size of the patient population with ST elevation MI, and their long-term prognosis is similar [23]. Other reasons include an inability to perform a timely ECG, misinterpretation of the ECG findings, and inaccurate timing of the enzyme tests.

In a large multicenter study of 10,685 patients with chest pain indicative of ischemia, Pope et al. [23] found that only 1861 (17%) fulfilled the criteria of ACS: 972 with unstable angina and 834 with MI. Misdiagnosis occurred in 2.3% and 2.1% of the patients, respectively. Characterization of the misdiagnosed group yielded a high proportion of women, non-whites, patients younger than 55 years, and patients with a normal or nondiagnostic ECG. Schor et al. [4], in a 30-day follow-up study, found that 8% of patients with a MI were discharged home on their first visit to the ED. In a larger, multicenter study of patient disposition in the ED, McCarthy et al. [24] reported a 1.9% rate of initially misdiagnoses of MI. The group in which misdiagnosis occurred had significantly higher rates of nondiagnostic ECGs and a negative history for ischemic heart disease or treatment with nitroglycerin compared to the discharged patients who did not have a MI. Twenty-five percent of the misdiagnosed patients died or had critical health complications as a result of the early discharge home. Lee et al. [25] noted a 4% rate of early incorrect discharge for similar reasons, with a higher mortality rate in the patients in whom the misdiagnosis occurred than in the hospitalized patients. According to their calculations, death would have been prevented in 49% of the patients with a misdiagnosis had more attention been addressed to interpretation of the ECG. Zarling et al. [26] added that failure to consider the possibility of ACS was another reason for misdiagnoses, especially when the attending physician was not a specialist in internal medicine or cardiology.

The present study was conducted as HaEmek Medical Center in northeast Israel, with serves a catchment area of 400,000 residents, about 55% Jewish and 45% Arabic. Its ED has an annual census of about 130,000. The day staff (8:00 am to 4:00 pm) of the Internal Medicine ED includes two specialist physicians in cardiology, in addition to specialists in internal and family medicine; the night/weekend/holiday staff includes physicians on call from the internal medicine wards. The aim of the present study was to investigate the rate of misdiagnoses of ACS at HaEmek Medical Center and to compare the characteristics of the correctly and incorrectly diagnosed patients. We also analyzed mortality in these two groups at one and 6 months.

Methods

The computerized database of HaEmek Medical Center in Israel was searched for all patients

admitted with ACS following an ED visit for chest pain between January 1, 2002 and December 31, 2003. Of the 1064 patients identified, 446 were diagnosed with ST elevation MI, 214 with non-ST elevation MI, and 407 with unstable angina. Twenty-six patients had initially presented to the ED within the previous 48 hours and been discharged home; these included 16 patients with unstable angina and 12 with MI. The remainder were diagnosed and hospitalized at their initial visit to the ED. For purposes of the study, 89 patients were randomly selected from the patients hospitalized at their first visit, of whom 59 had angina and 30, MI. This group was compared with the 26 patients hospitalized at the second visit, for the following parameters: age, sex, ethnic group, medical history risk factors, season during which the complaint occurred, hour of presentation to the ED, clinical picture, ECG findings, and laboratory findings. The data were collected from the files and recorded uniformly in an ad hoc questionnaire. Data for the 6-month mortality rate were derived from accessible medical records and by telephone interviews with staff in the patients' community clinics.

Statistical analysis

Data were analyzed with the SPSS program. Chi-square test was used to compare categorical variables (sex, ethnic origin, background disease) between the groups, and t-test or Mann-Whitney test was used to compare continuous variables (age, etc.), according to the distribution of the findings.

Results

The patients with a misdiagnosis accounted for 24% of all patients with ACS hospitalized at our center during the study period. The findings for the patients with a misdiagnosis or correct diagnosis at their first visit to the ED are shown in Table 1. There was no significant between-group difference in sex distribution. The patients with a misdiagnosis were younger than the patients with a correct diagnosis, with 27% under age 52 years compared to 13%. The ethnic distribution also differed, with Arabs accounting for 54% of the patients with a misdiagnosis and 33% of the patients with a correct diagnosis. No differences between the groups were found for risk factors of diabetes, hyperlipidemia, positive family history, smoking, or obesity. Half the

study group had hypertension compared to 28% of the comparison group analysis of the medical history yielded no differences in peripheral vascular disease, congestive heart failure, atrial fibrillation, renal failure, previous coronary angiography, chronic obstructive pulmonary disease, hematological disorders, peptic disease, or thyroid dysfunction. A history of cerebrovascular accident was noted in 4% of the study patients compared to 9% of the comparison group. Depression was documented in 2 patients, both in the study group (p=0.05).

Table 2 summarizes the clinical presentations and patient complaints. The patients hospitalized at the second visit had significantly higher rates of abdominal pain, atypical chest pain and epigastric pain, and significantly lower rates of typical chest pain, shortness of breath, and sweating,

The medications the patients were taking are shown in Table 3. No statistically significant differences between groups were found for medications taken.

The ECG findings were interpreted as normal in only 38.5% of the patients with a misdiagnois. The major findings in the remainder (Table 4) were old MI, ST-T segment and T-wave abnormality, arrhythmia, and conduction disturbances.

There were no significant differences between the groups in findings on laboratory tests except for creatinine phosphokinase (CPK) levels, which were within normal range in all patients in the study group and abnormal in 34% of the comparison group. A small, nonsignificant, proportion of patients in the study group had a minor degree of anemia (Table 5).

Analysis by time of admission revealed no significant seasonal or monthly difference in the distribution of patient visits. However, analysis of the time of day of presentation, yielded overall significantly fewer patients during the day and more patients presenting at night for those in the misdiagnosed group compared to the group hospitalized at their first visit (table 6).

There was no difference between the study and comparison group in mortality rate at one month (3.7% vs 5.6%, respectively) or 6 months (3.8% vs 3.4%).

Table 1. Demographic and clinical characteristics of patients in whom ACS was missed or correctly diagnosed at the initial ED visit

Characteristics	Missed diagnosis (n=26)	Correct diagnosis (n=89)	P value
Sex			
Male	76.9%	74.7%	NS
Female	23.1%	25.3%	NS
Age			
<50 yr	26.9%	12.6%	NS
≥50 yr	73.1%	86.4%	NS
Ethnicity			
Jewish	47.8%	66.7%	NS
Arabic	53.8%	33.3%	NS
Risk factors			
Smoking	42.3%	37.1%	NS
Obesity	34.6%	23/6%	NS
Diabetes mellitus	42.3%	37.1%	NS
Acute hypertension	50.0%	71.9%	0.037
Hyperlipidemia	73.1%	68.5%	NS
Family history of CAD	23.1%	18.0%	NS
Systemic disease			
IHD	42.3%	40.4%	NS
CHF	11.5%	11.2%	NS
CRF	15.4%	9.0%	NS
His cor. Angio.	34.6%	44.9%	NS
COPD	7.7%	7.9%	NS
CVA	3.8%	9.0%	NS
PVD	3.8%	3.4%	NS
Depression	7.7%	0	0.05

CAD-coronary artery disease, CRF-chronic respiratory failure**,** CHF-congestive heart failure, His. Cor. Angio. –history of coronary angiography, COPD-chronic obstructive pulmonary disease, CVA-cerebrovascular accident, PVD-peripheral vascular disease

Table 2. Symptoms and signs on presentation in patients in whom ACS was missed or correctly diagnosed on their initial ED visit

Symptoms/signs	Missed diagnosis (n=26)	Correct diagnosis (n=89)	P value
Typical chest pain	65.4%	95.5%	0.00
Atypical chest pain	26.9%	1.1%	0.00
Abdominal pain	46.2%	5.6%	0.00
Dyspnea	7.7%	44.9%	0.001
Sweating	11.5%	31.5%	0.044
Epigastric pain	11.5%	0	0.011
Response to nitroglycerin	0	19.1%	0.012

Table 3. Medications being taken by patients in whom ACS was missed or correctly diagnosed at the initial ED visit

Drug	Missed diagnosis (n=26)	Correct diagnosis (n=89)	P value
Aspirin	53.8	60.7%	NS
Beta blockers	34.6%	52.8%	0.103
Calcium channel antagonists	23.1%	22.5%	NS
ACE inhibitors	23.1%	40.4%	0.106
Antiarryhthmics	3.8%	2.2%	NS
Nitrates	23.1%	39.3%	0.128
Statins	42.3%	36.0%	NS
Insulin	7.7%	7.9%	NS
Oral antidiabetics	17.3%	13.4%	NS
None	26.9%	18.0%	NS

ACE-angiotensin converting enzyme.

Table 4. ECG findings in patients in whom ACS was missed or correctly diagnosed at the initial visit to the ED

Parameter	Missed diagnosis (n=26)	Correct diagnosis (n=89)	P value
ECG performed			
Once	57.7%	100.0%	0.000
Twice	38.4%	0	0.000
Old MI on ECG	19.2%	14.6%	NS
ST depression	3.8%	16.9%	0.115
T-wave inversion	7.7%	13.5%	NS
LVH-strain	15.4%	1.1%	0.000
LBBB	0	4.5%	NS
RBBB	3.85	3.4%	NS
Atrial fibrillation	3.8%	0	NS
ST elevation	0	20.0%	0.000
Normal	38.5%	27.0%	0.258
No ECG performed	3.8%	0	NS

ECG-electrocardiogram, MI-myocardial infarction, LVH- left ventribular hypertrophy, LBBBB-left bundle branch block, RBBB-right bundle branch block

Table 5. Laboratory findings in patients in whom ACS was missed or correctly diagnosed at the initial ED visit

Parameter	Missed diagnosis (n=26)	Correct diagnosis (n=89)	P value
Abnormal CPK	0.0%	33.7%	0.001
Hyperglycemia	38.5%	37.1%	NS
High BUN	15.4%	21.3%	NS
High creatinine	11.5%	10.1%	NS
Anemia	50.0%	31.5%	0.083
Normal	23.1%	19.1%	NS

CPK-creatinine phonsphokinase, BUM=blood urea nitrogen

Discussion

Our work was prompted by the many reports of the considerable proportion of patients with ACS who are discharged home from the ED because of a misdiagnosis of atypical chest pain. We sought to examine the dimensions of this problem at the Internal Medicine ED of HaEmek Medical Center in Israel by comparing the characteristics of patients hospitalized for ACS at their first presentation to the ED with patients initially discharged home who re-presented within 48 hours.

The 2.4% rate of initial misdiagnoses found here is in line with earlier studies (2-10%) [23].

Analysis of the demographic factors yielded two significant findings: a greater proportion of younger patients (less than 50 years) and a higher proportion of Arabic patients in the misdiagnosed group compared to the group hospitalized at the initial ED visit. The first difference may be attributable to the lower index of suspicion of ACS in younger patients. The second may be due to physician-patient language barriers leading to miscommunication during history taking or patient descriptions of their symptoms. When we analyzed the relatively large number of Arabs in the study group against the overall percentage of Arabs in the population that visits the Internal Medicine ED of our center, this finding became even more significant (p=0.038, chi-square test and goodness-of-fit test). Accordingly, Pope et al. [23] reported a relatively high prevalence of non-white patients older than 55 years in their misdiagnosed group.

The physical complaints of patients with undiagnosed ACS have been well discussed in the literature [8,18,23]. The most noteworthy between-group difference in the present study was the higher rate of atypical chest pain concomitant with a lower rate of typical chest pain in the study group. The study group also had more abdominal pain and pain related to eating, and less dyspnea and sweating and fewer responses to nitroglycerin.

Given the diagnostic value of the ECG in this setting [8], several findings of the present study should be emphasized.

In all the patients correctly hospitalized at their initial ED visit, the diagnosis was based on one ECG.

In the misdiagnosed group, one patient did not undergo ECG examination before discharge at all. .

Only 38.5% of the patients with a misdiagnosis underwent more than one ECG before the decision to discharge was made.

In 57.7% of the patients with a missed ACS there were one or more abnormalities on the ECG (Table 4). Indeed, the abnormalities were noted in the files by the attending physician, who nevertheless misdiagnosed.

These results are in line with the many previous studies that site lack of a follow-up ECG and misinterpretation of the ECG as two of the main reasons for misdiagnoses of ACS [4,8,18,23-25].

CPK levels were normal in the study group and abnormal in 34% of the comparison group, indicating MI. It should be noted that during the time frame of the study, troponin was not available at our center.

Although there was no difference in the seasonal/monthly distribution of cases, there was a conspicuous difference in the hourly distribution, with a clear prevalence of misdiagnoses of ACS in the night shift as compared to the relatively low rate of misdiagnosis in the morning group. This finding may be explained by physician exhaustion, the lack of specialist/senior physicians, particularly cardiologists, in the ED at night, and the particular set-up of the Internal Medicine ED at our center. The morning staff of the ED is dissociated from the internal medicine ward and can therefore make decisions regarding patient disposition unencumbered by considerations of cost and overcrowding. By contrast, at night, the ED is staffed by physicians from the ward itself.

In summary, our work for the most part supports the current literature. A significant number of patients with ACS are misdiagnosed in the ED, mainly because of an atypical clinical presentation, failure of interpretation of the history, failure to correctly interpret the ECG, failure to perform an ECG when necessary, and lack of proper use of cardiac enzyme test.

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