Acute Nontraumatic Chest Pain in Emergency Department and Cost-Effectiveness Evaluation

Acil Serviste Akut Nontravmatik Göğüs Ağrısı ve Maliyet Etkinliği Değerlendirmesi

Zeynep Cakir1, Ayhan Saritas1, Sahin Aslan1, Mucahit Emet1, Hayati Kandis1

1Atatürk University, Faculty of Medicine, Department of Emergency Medicine, Erzurum, Turkey

Correspondence to: Zeynep Cakir, Atatürk University, Faculty of Medicine, Department of Emergency Medicine, 25270, Erzurum, Turkey. Phone: +90.442.3166333/1463, Fax: +90.442.3166340, e-mail: zeynepgcakir@gmail.com

Abstract

Objective: Cost-effective use of cardiac markers for the evaluation of ischemic chest pain (CP) patients at the emergency department (ED) is attracting the attention of researchers. The aim of this study is to define how cost-effective an approach should be for evaluate CP patients and to evaluate whether testing for cardiac markers is done cost-effectively in CP patients.

Materials and Methods: In this retrospective study, 1028 ischemic CP patients (aged from 17-89 years, 389 female, 639 male) with non-diagnostic electrocardiography (ECG) who were admitted to the ED between September 2002 and September 2003 were enrolled into the study.

Results: The conditions of how diagnostic tests were actually or-dered for these patients and how they should have been ordered cost-effectively were assessed and both the cost and effectiveness were compared. The actual total cost of the diagnostic tests ordered to investigate ischemic CP was $42,476. The cost would have been $32,342 if they had been ordered in the most cost-effective manner, for a total savings of $10,134. The ED cost, the calculated cost-effective cost and the lost amount were compared with the Student’s t-test, and the differences between them was found to be statistically significant (p<0.001). The effectiveness was compared using the chi-square test and was found to be significant (χ2= 12.20, SD=1, p< 0.001).

Conclusion: In conclusion, fast and effective evaluation of ischemic CP in the ED and correct management of patients by correct determination of the risk factors provides a high level of cost-effectiveness. Every ED should determine an algorithm for patients admitted with CP and physicians should obey this algorithm.

Keywords: Cardiac markers, Chest pain, Cost-effectiveness, Emergency department

Özet

Amaç: Acil servislerde iskemik göğüs ağrısı (GA) hastaların değerlendirilmesinde kardiyak belirteçlerin bedel etkin kullanımı araştırıcıların dikkatini çekmektedir. Bu çalışmanın amacı, iskemik GA’lı hastalarda bedel etkin yakalamın nasıl olması gerektiğini belirlemek ve bu hastalarda kardiyak belirteçlerin bedel etkin olarak istenip istenmediğini değerlendirilmektedir.


Bulgular: Başvuran hastalara iskemik göğüs ağrısı yönünden istenen tettiklerin toplam bedelinin 42476$ olduğu görülmüştür. Bedel etkinlik kurallarına göre tettik istenmiş olsa da 32342$ olacaktır ve fark 10134$ bulunarak acil servis bedeli, bedel-etkin olduğu düşünülen bedeli ve bedel kaybi Student’ t testi ile kıyaslansınamamıştır (p< 0.001). Hastaların acil servis etkinliği, bedel-etkin olduğu düşünülen etkinlikle Chi-Square testi ile kıyaslansınamamıştır (p< 0.001).

Sonuç: Sonuç olarak, akut travmatik olmayan göğüs ağrısının acil servislerde değerlendirilmesinde hızlı ve etkin bir hasta triajıyla, doğru risk ayımı yapılarak hastaların doğru bir şekilde yönlendirilmesi, üst seviyede bedel-etkinlik sağlayabilir. Göğüs ağrısı hastaların acil serviste bedel-etkinlik değerlendirilmesi için, her acil servisin önceden belirlenmiş bir algoritma olması gerektiğiğini göstermiştir.
Introduction

Regulation of medical care according to cost-effectiveness measures is increasingly important and a large amount of research has been conducted to identify strategies for more effective allocation of resources. The fact that the available funding for health services is limited and becoming progressively restricted suggests that medical care should be provided in accordance with cost-effectiveness rules and that these rules should be immediately followed. When physicians order a diagnostic test for a patient, they make an important decision on not only the patient’s treatment, but also on the cost of the treatment. Hence, it can be observed that the decision made by the physician affects 80% of the patient’s bill [1]. The idea that it is much safer to use a larger number of diagnostic tests in order to prevent medical mistakes is not proven by any data. This incorrect opinion has led to an increase in the number of diagnostic tests and have brought forth 52-180 billion dollars of additional burden to medical spending in the U.S.A. [2]

Chest pain (CP) is one of the most frequent and complex causes for admission to the ED worldwide and in our country. In the U.S.A, patients with CP constitute 5% of all admissions to the ED with a total of approximately 5 million visits per year [3]. In addition to ECG, which can aid in the diagnosis, most non-invasive diagnostic tests do not lead to a definite diagnosis, but are generally used only as guiding tests [3, 4]. In recent years, measuring the serum levels of cardiac markers, which are enzymes released into the serum by damaged myocardium, has become an important tool for the clinical diagnosis of ischemic heart diseases [5]. However, when these biochemical parameters are not assessed properly, the value of the diagnosis decreases and the cost is increased [6].

While the cost-effective approach is considered increasingly important, the aim of this study is to retrospectively investigate whether or not cardiac marker tests that are widely ordered for patients admitted with CP are requested in a cost-effective manner.

Materials and Methods

For this retrospective study, the files of patients who were admitted to the Emergency Department of Atatürk University Medical School Research Hospital with acute non-traumatic CP complaints from September 2002 to September 2003 were scanned. Patients whose first ECG was diagnostic for acute myocardial infarct (AMI) were excluded from the study. From the files of the remaining 1028 patients, demographic information, a short history, a summary of examination findings, tests ordered for the patient and their results, and prognostic results of the patient were collected using a previously prepared study form. In addition, the study forms also documented whether the requested tests were cost-effective, the way of asking for a cost-effective test, the cost and the effectiveness had been stated. These data were analyzed using the SPSS statistical package. When determining cost-effectiveness, recommendation sentences and agreement reports which take part in the international literature are taken as a basis [7].

Statistical Evaluation:

Patients’ ED cost, the possible cost if the tests were ordered in a cost-effective manner and the differences between the two were compared using the Student’s t-test. This comparison is presented in Table 1.

The effectiveness of the ED, the possible effectiveness of ordering cost-effective tests and the loss of effectiveness were compared using the chi-square test.

Results

Our study included a total of 1028 patients, consisting of 389 females (38%) and 639 males (62%), with ages ranging between 17 and 89 (average age 52±15 years). Our study included patients who had ischemic CP without ST elevation, MI and angina pectoris (AP). Patients who had non-diagnostic findings on the initial ECG taken upon admission consisted of 38.2% (n=393) of the total. Of these patients, 65.9% (n=259) were considered high risk.

Of the patients, 36.7% were found to have typical AP symptoms, while 63.3% had atypical or partially atypical AP symptoms. Twenty-one percent (n=87) of the patients who were hospitalized in the cardiology intensive care unit (ICU) had atypical or partially atypical characteristics in terms of ischemic CP. Forty-two patients (42%) admitted to our ED with CP defined intramuscular injection, muscular-skeletal system diseases or muscular-skeletal region trauma in their history. These patients constituted 25% of the 168 patients whose CK values were high and 10% of the 127 patients with high CK-MB values.

Among the cardiology markers studied in this study, 5.8% (n=60) of the patients had Tn T values above 0.1 ng/ml, while 92.5% (n=951) had Tn T values below 0.1 ng/ml. Tn T tests were not ordered in 1.7% of the patients. Similarly, the patients whose initial CK-MB/CK rates above 5% were calculated to be 4.1% (n=42), while the patients whose initial CK-MB/CK rates below 5% were found to be 94.1% (n=967). CK and CK-MB tests were not ordered for 1.8% of the patients (n=19).

Cardiology consultation was requested for 56% of the patients (581/1028) included in our study. Of these patients, 69% (n=401) were accepted to the cardiology service. Forty-three percent (n=447) of patients were discharged from the ED after a cardiology consultation. Of these discharged patients, 54.3% (n=211) had very low risk factors, while 45.7% of them had low or moderately low risk factors. Among the patients who did not get a cardiology consultation, 40.4% of them (n=184) were directly discharged from the hospital, while 59.6% of them were directed to receive further advanced tests after being observed.

Considering all of the cases, we found that 414 patients...
Discussion

Patients who have acute non-traumatic CP are one of the most challenging groups of patients for emergency physicians (EPs) to handle. These patients may seem very sick or completely healthy. Regardless of their initial presentation, this group is at serious risk for sudden cardiac death or MI. In the United States, between 2–5% of AMIs are discharged from the ED and 20% of malpractice claims against emergency physicians relate to the management of acute coronary syndrome [8]. Because of the inadequacy of patient feedback, we do not know the frequency of possible cardiac complications among patients discharged from the ED. Among the patients who arrived with sudden cardiac death, none of them were found to have been admitted to the ED with CP complaints within the previous 48 hours. However, two of our patients were lost due to ventricular fibrillation while the examinations were underway in the ED.

Cavanagh et al. [9] conducted a study on a total of 502 patients arriving with CP complaints (321 (64%) male, 181 female (36%). They found that of the patients transferred to the cardiology service, 257/502 (51%) patients were sick and 245 (49%) were healthy. These results are very similar to the results of our study.

Two-thirds of all patients who are hospitalized due to CP are first evaluated in the ED. However, only 10-15% of them are found to have AMI [9, 10]. Unfortunately, among the patients who are discharged, 2-5% of them have had misdiagnosed AMIs, and they have four times the mortality rate of patients who were hospitalized [11]. As previously mentioned, the frequency of misdiagnosis in our hospital is not known due to the inadequacy of patient feedback. However, among those who were considered to be high risk and, therefore, admitted to the cardiology service, the frequency of coronary artery disease was found to be 58.2%, which is consistent with the results of other studies [9].

The best way to decrease mortality and morbidity is to minimize the duration between the onset of damage and the specific treatment [12-14]. Hence, providing fast diagnosis and preventing missed diagnosis in atypical cases is at least as important as diagnosing correctly [15]. Due to all of these reasons, CP feel it safer to order more tests for patients who arrive with CP. However, most of the time, ordering more tests increases both the complexity and the cost of the results. The correct approach is to order the right test at the right time [3]. In order to achieve this, researchers have conducted many studies to identify a diagnostic strategy with the most appropriate effect with the lowest cost [7, 15]. Different diagnosis and treatment schemes were developed both for avoiding the risk of missing an AMI diagnosis in the ED and for minimizing hospitalization.

None of the cardiac markers utilized today is adequate if used alone [6, 16]. Research studies and consensus reports recommend utilizing more than one marker [7, 15]. Tests could be ordered consecutively or simultaneously [16]. On the other hand, in another study [17] of patients who arrived with CP complaints, seven different methods were evaluated. When comparing all of these methods, requesting CK-MB and Tn I simultaneously was determined to be the most cost-effective. However, the most frequently suggested test variations in the literature are the utilization of myoglobin, CK/CK-MB or myoglobin, Tn I or T [18-20], because although myoglobin has fairly low specificity, it appears in the serum the earliest. On the other hand, subforms of CK/CK-MB appear in the serum in 3-4 hours, while their specificity (especially in serial measurements) is fairly good [3, 4, 10]. The most specific cardiac markers for ischemic heart disease are Tn I and T [17, 21, 22]. In our study, CK/CK-MB, Troponin T tests were available as cardiac biomarkers in our laboratory; CK/CK-MB and Troponin T tests were used together as cardiac markers. This choice of triple testing is advantageous due to its high specificity, although it is not very suitable in terms of disease diagnosis because each marker appears in the serum at approximately the same time. In particular, the markers requested in the 3rd, 6th and 9th hour increase the effectiveness significantly [23].

The literature points out that [24] in low-risk patients (those who are not clearly cardiac in origin), there is no need to order
enzyme work and ECGs could be taken if necessary. In our ED, the rate of ordering enzyme work for very low-risk patients is 92.2%. Due to this fact, a cost loss of $6,688 and an effectiveness loss of 11% have occurred. The reasons for requesting an excess of tests are likely due to concerns that a cause of ischemic CP may be missed or possibly to ensure patient satisfaction. The key point here is the personal experience of the doctor and coming to a certain or almost certain decision about the patient’s condition. Even a slight doubt indicates the need for more tests, which makes the increase in cost seem trivial.

For moderate or low-risk patients, the literature suggests that emergency service CP evaluation units should be constructed where patients are monitored with a series cardiac marker measurements and ECG [8, 14, 23, 24]. Experience in the US has demonstrated that such units manage patients at low risk for MI as effectively as inpatient admission and at a lower cost [8].

The patient would be accepted in the coronary ICU if a change in ECG or an increase in enzymes occurs during the monitoring period, or else is directed to pursue further non-invasive tests [7, 14]. Although it seems that this application increases the ED costs and increases length of stay in the ED by hours, it avoids months of stays in the ICU caused by possible complications and makes the loss of cost and effectiveness trivial since it also prevents sudden cardiac deaths. Our ED was found to be moderately effective regarding this application. It was observed that 47.6% of the patients within the moderate or low-risk groups are monitored in the ED, while 52.4% were discharged from the hospital based on a single ECG and enzyme result. During the observation period, enzyme analysis and ECG were requested for these patients a total of four times, resulting in an increased ED cost of $49.60 per patient and a total of $8,107.60. Despite the increased cost, we found that an additional gain of 17% in effectiveness occurred. On the other hand, we found that discharging the patients after a single enzyme and ECG result when they have to be monitored causes a 40.3% loss of effectiveness.

When the patients who were low risk based on medical history, physical examination and initial enzyme and ECG results were monitored, we found that 2.2% of them experienced enzyme and/or ECG changes and were hospitalized in the coronary ICU. When complications are taken into account, the rate of patients who are not skipped due to monitoring is significant. As mentioned before, because of the lack of patient feedback, we were unable to identify patients who developed complications or experienced sudden death due to being discharged while monitoring was required. This deficiency in patient care is not believed to originate from doctor malpractice, but from limited ED resources and the need to allocate monitoring beds to high-risk patients. This unfavorable condition can be eliminated by creating a Chest Pain Evaluation Unit within every ED and monitoring only the low-risk patients within this unit [7, 8, 23].

Another cost-effectiveness problem is the fact that the patients who need to be observed on monitor and even need to be treated in coronary ICU are sometimes monitored in the ED [14, 23]. Among the high-risk patients, the percentage of those who are monitored in the ED is 64%. Of these patients, 5.5 had enzyme and ECG changes and were transferred to the cardiology service at some point during their monitoring. This application has led to a cost loss of $13,118 in addition to an effectiveness loss of 10.8%. The cause of this wrong application is believed to be the inadequacy of allocation sources in the ICU rather than physician’s malpractice.

In conclusion, fast and effective evaluation of acute non-traumatic CP in the ED and correct management of patients by correct determination of risk factors is highly cost-effective. Ordering the correct test at the correct time for correct group of patients can only be possible if the biochemical properties of the tests are known well. Every ED should determine an algorithm for patients admitted with CP and physicians should obey this algorithm.

For very low-risk patients there is usually no need to request any testing except an ECG, but the doctor’s experience and success in risk detection is of great importance. In addition, Chest Pain Evaluation Units should be built within the ED, and low-risk patients should be monitored there and directed to pursue other non-invasive tests at the end of their monitoring period. Our study has shown that in the ED, the fact that there are not enough monitoring beds allocated for patients with CP complaints and the necessity of monitoring high-risk patients instead of low-risk patients results in the lack of management of low-risk patients. This problem is important in terms of cost-effectiveness.

Conflict interest statement The authors declare that they have no conflict of interest to the publication of this article.

References

7. Braunwald E, Antman E, Beasley JW et al. ACC/AHA: a guideline update for the management of patients with unstable angina and non-ST-elevation myocardial infarction: a report of the American College of Cardiology/America Heart Association task force on practice guidelines (committee on


