Appropriateness of the current guidelines on reperfusion treatment for patients applying to our hospital with ST-segment elevation acute myocardial infarction

Hastanemize ST-segment yükselmeli miyokart infarktüsü ile başvuran hastaların reperfüzyon tedavilerinin güncel kılavuzlara uygunluğu

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ABSTRACT

Objectives: This study investigated the appropriateness of treatment for patients admitted with ST-segment elevation myocardial infarction (STEMI) according to the current guidelines. We also aimed to determine in-patient and out-patient factors affecting optimal reperfusion therapy.

Study design: The reperfusion therapy of 176 patients with STEMI was determined. The time period from first contact with a healthcare provider to the time of balloon inflation (door to balloon time), and from the time period of first contact with a healthcare provider to the time of initiation of a thrombolytic (door to needle time) were calculated. Similarly, the time from admission at the emergency service (ES) of our hospital after referral to the moment of balloon inflation (ES to balloon time) and the period from admission to ES at our hospital to the moment of initiation of a thrombolytic (ES to needle time) were calculated. In order to determine the amount of in-hospital delay, the time from ES admission to the call to the cardiology department and the time for the cardiologist to evaluate the patient and transfer time were recorded. Whether the referring physician was a cardiologist and the effect of work hours on the reperfusion period was also recorded.

Results: The door to balloon time in the referred patient group was calculated as an average of 228 minutes, while the time for patients directly admitted to ES was calculated as an average of 98 minutes. Patients referred for the mechanical reperfusion period compared to American Heart Association (AHA) guidelines consisted of only 6% of the eligible patients, while according to the European Society of Cardiology (ESC) guidelines 13% of patients were appropriate. Patients who were directly admitted to ES, experienced rates according to AHA guidelines and 73% experienced these rates according to ESC guidelines. We also found no significant effect of working hours or referring physician's specialty (cardiologist or other) on reperfusion time.

Conclusion: Compliance rates of reperfusion therapy for patients presenting with STEMI was very low. We realized, when taking into consideration the reasons for delay in terms of both health community and the policy of the country, it is obvious that we have to take strict measures.

ÖZET

Amaç: Bu çalışmada, hastanemize ST-segment yükselmeli miyokart infarktüsü (STEMI) ile başvuran hastaların reperfüzyon tedavilerinin güncel kılavuzlara uygunluğu araştırıldı. Ayrıca optimal reperfüzyon tedavisini etkileyebilecek hastane içi ve dışı faktörlerin belirlenmesi hedeflendi.

Çalışma planı: STEMI ile başvuran 176 hastanın reperfüzyon stratejisi belirlendi. Bir sağlık kuruluşuna ilk başvurudan balon anjiyoplasti veya trombolitik tedavi başlama anına kadar geçen geçen süreler (kapı-balon ve kapı-iğne süreleri), başvurulan ilk sağlık kuruluşundan sevk edildikten sonra hastanemiz acil servisinde balon anjiyoplasti veya trombolitik başlama anına kadar geçen süreler (acil servis-balon ve acil servis-iğne süreleri) hesaplandı. Hastane içi gecikme sebeplerini belirlemek amacıyla hastanın acil servise kabulünden sonra kardiyoloğun aranma zamanı, kardiyoloğun hastayı görme zamanı ve transfer süreleri kaydedildi. Hastayı sevk eden hekimin kardiyolog olup olmaması ve başvurunun çalışma saatlerinde olup olmamasının reperfüzyon sürelerine etkisi incelendi.

Bulgular: Kapı-balon süresi başka merkezden sevk edilen hastalarda ortalama 228 dakika, doğrudan acil servisimize başvuran hastalarda ise ortalama 98 dakika olarak hesaplandı. Sevk edilen hastaların mekanik reperfüzyon süreleri, Amerikan Kalp Derneği (AHA) kılavuzuna göre sadece hastaların %6'sında uygunken, Avrupa Kardiyoloji Derneği (ESC) kılavuzuna göre hastaların %13'ünde uygun bulundu. Doğrudan hastane acil servisine başvuran hastalarda ise bu oranlar AHA kılavuzuna göre %58 iken ESC kılavuzuna göre %73 idi. Bununla birlikte başvurunun çalışma saatleri içinde olması ve sevk eden hekimin kardiyolog olup olmamasının reperfüzyon süresine anlamlı derecede etki etmediği görüldü.

Sonuç: STEMI ile hastanemize gelen hastaların reperfüzyon tedavilerinin tavsiye edilen hedef sürede gerçekleştirilmesinde günümüz kılavuzlarına çok düşük oranda uyulduğu ortaya çıkmıştır. Çalışmamız sırasında tespit ettiğimiz gecikme sebeplerine bakacak olursak gerek sağlık camiası, gerekse ülke politikası bakımından ciddi derecede önlemler almamız gerektiği ortadadır.

Presented at the 26th National Cardiology Congress (October 21-24, 2010, Istanbul, Turkey).

Received: March 17, 2012 *Accepted:* June 14, 2012

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The cornerstone of acute myocardial infarction treatment is timely acute reperfusion. Guidelines exist, such as those from the European Society of Cardiology (ESC) and the American Heart Association (AHA), which are prepared and updated for specific time intervals in ST-segment elevation myocardial infarction (STEMI) therapy. Two separate guidelines propose that door-to-needle time should be lower than thirty minutes and door-to-balloon time should be lower than ninety minutes. However in some cases the ESC recommends that the delay should not exceed 120 minutes.

This study aimed to determine to what extent reperfusion therapy provided to patients admitted with STEMI was appropriate according to the criteria recommended in the guidelines. At the same time, we wanted to investigate the effect of working hours on reperfusion time and the effect of whether the physician who was referred to the patient was a cardiologist or another specialist.

PATIENTS AND METHODS

Patients who were admitted to our faculty between December 17, 2008 and August 31, 2009 with ischemic symptoms, ECG findings of STEMI, or newly formed left bundle branch block were considered for inclusion in this study. The patients who could provide sufficient history and whose time of first medical contact (FMC) could be determined were included in this study.

The patients were divided into two groups: those who were referred to the center from outside, and those who were directly admitted to emergency service. Patients who were referred to emergency service were referred from the districts of Konya or close to the provincial (i.e., Karaman and Aksaray). Door-to-balloon time, door-to-needle time, emergency service-to-balloon time and emergency service-to-needle time were separately evaluated. In order to determine factors the could lead to a delay in the hospital, the time of emergency service admission, the call time for cardiology, the time for the cardiologist to evaluate the patient, and the transfer time for the patient to arrive at the angiography laboratory were recorded. Working hours were evaluated in three groups: 08:00-17:00, 17:00-24:00, and 24:00-08:00. Door-to-balloon time intervals were classified as ninety minutes, under 120 minutes, and above 120 minutes. The drugs applied during transfer were recorded from referral papers. The duration of hospitalization, in hospital mortality rate and complications were recorded from the epicrisis of our clinic.

Abbreviations:

AHA	*American Heart Association*
AMI	*Acute myocardial infarction*
ESC	*European Society of Cardiology*
FMC	*First medical contact*
PCI	*Percutaneous coronary intervention*
STEMI	*ST-segment elevation myocardial infarction*

Statistical analysis

In all statistical analyses, the software SPSS version 15.0 (SPSS, Chicago, IL, USA) was used. Data was expressed as median (twenty-fifth, seventy-fifth percentages), mean, number, and percentage. Nonparametric groups were compared with the Mann-Whitney U-test. The relationship between the groups in the absence of statistical significance with the Kruskal-Wallis test for post-hoc analysis of data, and the Bonferroni/Dunn test were compared. A value of $p<0.05$ was considered statistically significant.

RESULTS

This study enrolled 189 patients with STEMI (Table 1). Four patients did not accept the treatment. Also, TIMI 3 flow was not achieved in four patients. The coronary angiography device was broken down during the procedure for one patient. Four patients were

Table 1. Demographic characteristics of ST-segment elevation myocardial infarction patients

Characteristics	Number	Median - %
Age	176	59 (50-69)
Female	40	21.1%
Diabetes mellitus	47	24.8%
Hypertension	80	42.3%
Cigarette	130	68.7%
Hyperlipidemia	76	40.2%
Family history	50	26.4%
Coronary artery disease	22	11.6%
Systolic blood pressure	189	120 (100-140)
Diastolic blood pressure	189	80 (60-90)
Low-density lipoprotein	180	110.3 (84.3-132.8)
Trygliceride	180	96.5 (66.75-139.25)
High-density lipoprotein	180	33.6 (27.9-40.725)
Total cholesterol	180	168 (141.0-193.25)
Blood sugar	182	143 (116.0-197.25)
Serum creatinine	182	1.0 (0.8-1.1)

Table 2. Periods of first medical contact up to the reperfusion

	Referred patients		Directly admitted to the hospital		*p*
	Patients (n)	Mean minute (min and max values)	Patients (n)	Mean minute (min and max values)	
Door-balloon	127	228 (45-617)	22	98 (34-240)	**<0.0001**
Door-needle	24	150.8 (53-945)	3	146.6 (25-330)	NS
Emergency-balloon	127	72 (22-400)	22	98 (34-240)	**<0.05**
Emergency-needle	24	45.38 (15-120)	3	146.6 (25-330)	**<0.005**
Time to call for cardiology		8.45 (1-270)		28.96 (1-230)	**<0.005**
The cardiologist's time to examination		5.30 (1-31)		5.79 (1-15)	NS
In-hospital transfer time		19.85 (1-88)		34.54 (8-165)	**<0.0001**
Time to TIMI 3 flow after transfer (for PCI)		40 (53-945)		40 (53-945)	NS

Min: Minimum; Max: Maximum; NS: Not significant.

taken to rescue percutaneous coronary intervention (PCI). For these reasons, thirteen patients were excluded from the study. Other centers referred 151 patients of the remaining 176, and the other twenty-five were admitted to our emergency department directly. The mean duration of time from the onset of chest pain to application to health institutions was 122.7 minutes. PCI was applied as a reperfusion strategy in 127 referred patients, while the remaining twenty-four patients were given thrombolytic therapy. Door-to-balloon, door-to-needle, emergency-department-to-balloon, emergency-department-to-needle, cardiologist notification, cardiologist examination and transfer times for all patients are given in Table 2.

Door-to-balloon time was longer in referred patients. However, door-to-needle times were similar in both groups. Patients directly admitted to our hospital had longer cardiologist notification times than referred patients. In addition, emergency-department-to-balloon, emergency-department-to-needle and transfer times were shorter in referred patients. However, time for the cardiologist to examine the patients was similar in both groups.

Fifty-six percent of the patients referred (85 patients) had been transferred from the other center having no cardiologist. Times over sixty minutes were recorded for 84% of patients referred (127 patients), 6% of referred patients (5 patients) from the center having no cardiologist had times of sixty minutes and shorter, and as a result, 14% of referred patients (12 patients) had ninety minutes and shorter times to reach the hospital. On the other hand, 18% of referred patients (12 patients) from the center having a cardiologist had times that were sixty minutes and shorter, and as a result 32% of these patients (21 patients) had times of ninety minutes and shorter to reach our hospital.

Table 3. Appropriateness in time PCI according to the recent guidelines recommendation

	ESC guide		ACC/AHA guide	
A	127 patients underwent PCI	16 patients appropriate (13%)	127 patients underwent PCI	8 patients appropriate (6%)
		111 patients not appropriate (87%)		126 patients not appropriate (94%)
B	22 patients underwent PCI	16 patients appropriate (73%)	22 patients underwent PCI	13 patients appropriate (58%)
		6 patients not appropriate (17%)		9 patients not appropriate (42%)

ESC: European Society of Cardiology; ACC: American College of Cardiology; AHA: American Heart Association; A: Referred patients; B: Patients directly admitted to the hospital; PCI: Percutaneous coronary intervention.

Table 4. The medications used during delivery chain

Drugs	Aspirin	Heparin	Morphine	Nitrate	B. Blocker	Clopidogrel
Patients n (%)	184 (97.3%)	180 (95.2%)	54 (28.5%)	95 (50.2%)	28 (14.8%)	28 (14.8%)

Heparin: Unfractionated heparin and low molecular weight heparin.

Table 5. Complication rate of the patients, the median length of stay, in-hospital mortality rates

	Number of patients	Median-%
Complication	22	11.6%
Length of stay (day)	189	4 (3, 5)
In hospital mortality	13	6.8%

Appropriateness rates regarding time for PCI according to the current ESC and AHA guidelines for PCI treatment of all patients are shown in Table 3. The number of patients who underwent PCI in the appropriate periods according to ESC guidelines was found to be higher than those that were appropriate according to AHA guidelines. However, the number of patients admitted to directly to the hospital was found to be higher than referrals according to both guidelines when considering PCI application in appropriate periods (Table 3).

The specialty of the referring physician did not have any effect on door-to-balloon, emergency-service-to balloon, door-to-needle, and emergency-service-to-needle times. In addition, the application time of the patient during the day and whether the application day occurred on a weekend did not have any significant effect on door-to-balloon and door-to-needle times.

The medications used during the delivery chain that began with FMC, the number of the patients and their rates are shown in Table 4.

The complication rate of the patients in our clinic during the period of hospitalization was 11.6% and the median length of stay was four days. The in-hospital mortality rate was determined as 6.8% (Table 5).

Several patients experienced complications during the study. Two patients experienced pseudoaneurysm in the puncture region. One patient experienced a coronary dissection during the procedure, while one patient had an acute cerebrovascular event. Three patients bled from the puncture region, four patients experienced acute renal failure, five patients had serious arrhythmias, and six patients experienced cardiogenic shock.

DISCUSSION

Despite advances in diagnosis and treatment in the last four decades, acute myocardial infarction (AMI) is the most serious health problem in developed countries and has an increasing importance in developing countries. Over one million patients with AMI per year are hospitalized to coronary intensive care units in the USA.[1] According to the results of the TEKHARF screening (Türk Erişkinlerde Kalp HAstalıkları ve Risk Faktörleri-Heart Disease and Risk Factors in Turkish Adults), there are 310,000 coronary events per year in Turkey.[2]

The relationship between treatment delay in primary PCI and adverse clinical outcomes is a well known association.[3,4] Delay of primary PCI is a theoretical value which is calculated through the duration between FMC and PCI time by subtracting the duration between FMC and time to start fibrinolytic therapy (door-to-balloon time - door-to-needle time). The extent to which the PCI-related time delay diminishes the advantages of PCI over fibrinolysis has been the subject of many analyses and debates. No specifically-designed study has addressed this issue.

It was calculated that the PCI-related time delay that may mitigate the benefit of the mechanical intervention varies between 60 and 110 minutes, depending on the fibrinolytic used.[5-7] In another analysis of these trials, the benefit of primary PCI over fibrinolytic therapy up to a PCI-related delay of 120 min was calculated.[8] Another study indicated that this time delay varied considerably according to age, symptom duration, and infarct location.[9]

Taking into account the studies mentioned above, primary PCI should be performed within two hours after FMC in all cases. In patients presenting early with a large amount of myocardium at risk, the delay

should be shorter. Although no specific studies have been performed, a maximum delay of only ninety minutes after FMC seems to be a reasonable recommendation in these patients.[10]

In accordance with a large number of studies comparing fibrinolytic therapy and PCI, PCI was found to be superior over fibrinolytic therapy for mortality rates in both the long and short terms. However, the benefits observed in the short term have not yet been viewed in the long , according to a current meta-analysis.[11] Although PCI is the preferred method of treatment in STEMI, reperfusion may be delayed for reasons such as transportation, waiting in the emergency department, and the preparation of the catheterization laboratory. Therefore, current guidelines resulting from the interpretation of these studies proposed the treatment method which can be applied earliest rather than the type of treatment in choosing reperfusion therapy.

Even in developed countries, this period of time recommended by the guidelines can be applied to less than 5% of transferred patients.[12] In the US, according to the data obtained from more than four thousand hospitals, the rate of patients with door-to-needle times under thirty minutes is 27% and the patients with door-to-balloon time under ninety minutes is 32%.[13]

When data from all patients enrolled in the study was analyzed, it was shown that 13.8% of the patients undergoing primary PCI had door-to-balloon times of ninety minutes and under, 22.6% had times of 120 minutes and under, and 77.4% had times over 120 minutes. Only one of twenty-seven patients given thrombolytic therapy reached the target door-to-needle times. Because our cardiology department is mainly a PCI-applied clinic, the number of patients receiving thrombolytic treatment was supposed to be low. Therefore, the reliability of the door-to-needle value will be low.

The mean value of door-to-ballon time was calculated as 228 minutes in referred patients and ninety-eight minutes in patients directly admitted to the hospital. While mechanical reperfusion time was appropriate in only 6% of the referred patients according to the AHA guidelines, 13% of patients were eligible according to the ESC guidelines. As for the patients admitted directly to the emergency department, the appropriateness rates were 58% percent for AHA guidelines and 73% for the ESC manual. As expected, low rate values for the referred patients were mainly due to the prolonged period of time depending on the patient's dispatch and transportation.

While considering the procedures after arrival to our emergency department, emergency-to-balloon times were shorter in the referred patients than the patients directly admitted due to the wait times for the cardiology consultation and hospital transfer durations. As a result, we can say that the period of diagnosis for STEMI was longer in patients directly admitted to the hospital compared to referred patients who had been previously diagnosed.

A striking finding from our study was that approximately half of the patients were referred from areas which had cardiologists. Whether the physician referring the patient was a cardiologist or not did not have any effect on door-to-balloon and door-to-needle times. This finding shows that a large number of the patients appropriate for thrombolysis were incorrectly referred. This may be due to physician's avoidance of responsibility, not following guidelines, or patients' persistent requests for referral to our hospital. Although the patients who underwent procedures during office hours (08:00-16:00) had shorter door-to-balloon times in a US study, FMC times in relation to the working hours were not statistically significant in our study.[14]

In addition, we detected that aspirin and heparin (unfractioned and low molecular weight heparin) therapies were administered in high rates but oral beta blocker and clopidogrel therapies were not given in adequate rates during patient transfers.

It was indicated in this study that the majority of the patients with STEMI could not receive appropriate reperfusion therapy. The reasons for this situation were the following: those areas that had a cardiologist available did not take sufficient responsibility for the importance of fibrinolytic therapy; the areas without cardiologists avoided the application of fibrinolytic therapy and prolonged patient transports due to patient referrals; the intensity of the CAG laboratory; allied health personnel were inexperienced because of frequent staff changes; or the quality of materials used in PCI were not adequate.

The greatest deficiency of our study was the small number of patients. Although our hospital is the refer-

ence hospital in its area, the other centers where PCI was performed are located in the same region. Therefore, the patient population may disperse to these centers as well. This may be the main reason for the small number of patients enrolled in our study.

For reperfusion therapy to be implemented properly and to reduce mortality rates, the following are required: 1) Coordination must be established between health institutions; 2) A good communication system must exist between health centers and ambulances; 3) Provision must be made to train health personnel; 4) The current guidelines' recommendations must be emphasized. 5) The significance of fibrinolytic therapy must be made clear, especially in instances where transportation periods take a long time; 6) Specially-trained medical teams who can interpret an ECG and transfer them to the center when necessary must be created; 7) Necessary facilities to ensure rapid diagnosis and rapid transfer in emergency departments must be developed; 8) Experienced personnel should be not be rotated out.

Each healthcare provider must determine its own reperfusion strategy immediately by taking into account its location, the patient's clinical condition, and the time at the onset of the patient's chest pain.

Conflict-of-interest issues regarding the authorship or article: None declared

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Key words: Angioplasty, balloon, coronary; myocardial infarction; myocardial reperfusion; practice guidelines as topic; thrombolytic therapy; time factors.

Anahtar sözcükler: Anjiyoplasti, balon, koroner; miyokart enfarktüsü; miyokard reperfüzyonu; uygulama kılavuzu; trombolitik tedavi; zaman faktörü.