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Original article

The survival rate of patients with ST-Segment elevation myocardial infarction treated with primary percutaneous coronary intervention and thrombolysis

Peyman Izadpanah[a], Farshad Falahati[b,c,*], Ali Mohammad Mokhtari[d], Fariba Hosseinpour[b], Behnaz Faham[b], Reihaneh Sheidaee[b], Shahla Jalali[b], Hamid Zare[b], Soheil Hassanipour[e,f]

[a] School of Medicine, Shiraz University of Medical Sciences, Shiraz, Iran
[b] Shiraz University of Medical Sciences, Shiraz, Iran
[c] Department of Health Services Management, North Tehran Branch, Islamic Azad University, Tehran, Iran
[d] Student Research Committee, Shiraz University of Medical Sciences, Shiraz, Iran
[e] Gastrointestinal and Liver Diseases Research Center, Guilan University of Medical Sciences, Rasht, Iran
[f] GI Cancer Screening and Prevention Research Center, Guilan University of Medical Sciences, Rasht, Iran

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ABSTRACT

Background: Cardiovascular diseases are the leading cause of death worldwide, and myocardial infarction is one of the common manifestations of these diseases. The goal of this study was to compare the survival rate of patients treated with thrombolysis and PPCI in patients with STEMI.

Method: This was a survival analysis study performed on 354 patients in Shiraz, Iran. Admission time was considered as the starting point and the time of death or the last follow-up time as the endpoint. All cases of STEMI patients were reviewed from the beginning to the end of 2018. Data were collected using a checklist and telephone call and they were analyzed using the Log Rank test, Kaplan-Meier and Cox regression models.

Results: The overall survival rate of patients in the PPCI group (92.4%) was significantly higher than that of the thrombolysis group (83.9%). The variables such as age, gender, diabetes history and type of treatment had an impact on the risk of death. After controlling the confounding factors, only the patients' age had a significant effect on death (HR: 1.05, P = 0.001, 95% CI: 1.02–1.09).

Conclusions: The survival rate of the PPCI group was higher than thrombolysis group. However, the difference in the criteria used to select the type of treatment may have a distorting effect on the subject. Therefore, it seems necessary to carry out studies with a more appropriate design.

1. Introduction

Cardiovascular diseases are the leading cause of death worldwide[1–3] and ST-Segment Elevation Myocardial Infraction (STEMI) is one of the common manifestations of these diseases.[1] Among patients with acute coronary syndromes, 25–40% are exposed to STEMI. Despite the advances made in recent decades in treating STEMI patients, the prevalence of STEMI in many parts of the world continues to rise.[4] STEMI is known as an emergency cardiovascular disease, which should be quickly identified and treated to ensure optimal results.[5,6]

The standard treatment for patients with myocardial infarction is re-establishment of blood flow in the closed vessels or reperfusion therapy.[7,8] Primary Percutaneous Coronary Intervention (PPCI) and Thrombolysis (TL) are two methods used for STEMI.[9] Reperfusion reduces mortality in myocardial infarction by recapitalizing epicardial blood flow (either with thrombolysis or PPCI).[10]

Thrombolysis is a pharmacological treatment that results in destruction of blood clots.[11] The benefits of primary thrombolysis in acute myocardial infarction have been proven in various studies. The efficacy of the thrombolytic drugs has the highest utility when it occurs at an early stage of acute myocardial infarction (call-to-needle time of less than 60 min).[12] In many randomized clinical trials, PPCI has been shown to be better than TL treatment in reducing mortality, recurrent infarction and stroke.[9]

The most recent guidelines of European Heart Association recommend PPCI as the preferred treatment whenever it is available within the first 90–120 min of the first contact.[1,9,13] However, the initial costs of PPCI in comparison with thrombolysis are of concern.[10]

* Corresponding author. Shiraz University of Medical Sciences, Shiraz, Iran.
E-mail address: dr.farshadfalahati@gmail.com (F. Falahati).

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Since many hospitals do not have the resources to provide PPCI, a large proportion of STEMI patients go to larger hospitals for PPCI. Transmission for PPCI involves a longer delay in treatment, resulting in a loss of potential gain compared to receiving drugs in local hospitals.[1]

A study in China compared the survival of patients with STEMI and the results showed that in general, PPCI-treated patients were more likely to survive in comparison to patients treated with thrombolysis over a one-year period.[1] Based on the results of a study that examined the status of European countries in terms of reperfusion therapy, North, West, and Central Europe provided well PPCI services, and for the 60–90% of all STEMI patients, this service was provided. But southern Europe and the Balkan countries used mainly TL treatment.[14]

Despite the benefits of PPCI, this intervention has not been implemented globally, and thrombolysis is still used for many patients.[15] Although the safety and efficacy of the PPCI have been more proven,[16] but this method is costly and requires special facilities, and the number of centers providing this technique are limited, therefore patients' transmission to the relevant centers may be delayed more in comparison to thrombolysis.[17] Many people feel that treatment using venous thrombolysis is more accessible and less dependent on the geographical situation and available facilities.[16] Regarding the above, the choice of treatment for patients with STEMI is always challenging. Therefore, considering the importance of the subject, this study aimed to compare the survival rate of both thrombolytic and PPCI treatments in patients with STEMI.

2. Methods

2.1. Study design and study population

This was a survival analysis study conducted in hospitals of Shiraz, Iran. Shiraz is the capital of Fars province, located in Southern Iran. Fars province is the fourth largest province in Iran.[18] In the present study, collected data was related to patients who had been treated from 2016 to 2017.

2.2. Inclusion and exclusion criteria

Inclusion criteria was ST-segment elevation in electrocardiogram in patients who had acute myocardial infarction. Patients who came late and did not receive PPCI or thrombolytic drug, patients who did not succeed in revascularization, and patients who were candidates for emergency Coronary Artery Bypass Grafting (CABG) were excluded.

2.3. Treatment process

The mechanism of choosing treatment for patients was the use of thrombolytic treatment if the use of mechanical therapy (PPCI) was not possible. The treatment process was to complete the initial form for all patients with symptoms of acute myocardial infarction (sudden and severe chest pain, cold sweat on forehead, nausea and vomiting which was less than 2 h since the onset of these symptoms). Then the code 247 (Emergency mode means 24 h a day and 7 days a week) was activated, and after verifying the STEMI (evaluating ECG by the physician), the form was approved and the patient was included in the follow-up samples.

2.4. Data collection

All medical records of patients with STEMI from the beginning to the end of 2018 were studied. After applying the inclusion and exclusion criteria, 354 patients were enrolled in the study. After coordinating with the hospitals, all patients' information was collected from their medical records and even their telephone contacts were used for follow up their survival. In cases that the patient or his family was not accessible for two times, the patient was excluded from the study.

Data was gathered using a checklist including demographic variables (age, sex, systolic blood pressure, diastolic blood pressure, heart rate, etc.), variables associated to the disease (time interval between the onset of the attack and arrival to the hospital, the interval between arriving and the start of the treatment, the history of previous disease, etc.) and the variables associated to the used treatment (the type of treatment, the outcome of treatment, etc.). All patients were followed up in 2018 and their outcome (death or surviving) was recorded. In the survival analysis of these patients, hospital admission was considered as the starting point for the study, and the endpoint for the dead patients was death time due to STEMI and the endpoint for survivors was the current tracking time.

2.5. Statistical analysis

The collected data entered in SPSS software version 20 and they were analyzed using the log rank test, Kaplan-Meier method and the univariate and multivariate Cox regression model. The variables that are significant at the level of 0.2, were entered into the multivariate Cox regression. The basic characteristics and demographic information compared between two groups based on the independent *t*-test, Mann–Whitney *U* test and chi-square test. The significance level of the tests was below 0.05.

3. Results

Information of 354 patients treated with reperfusion therapy were studied. The basic characteristics and demographic information of these

Table 1
The basic characteristics and demographic information of PPCI and TL treatment groups.

Variable			TL groups	PPCI group	P-value
Age (year)		Mean ± SD	59.79 ± 12.42	58.01 ± 12.65	0.185
Heart Rate (in a minute)		Mean ± SD	76.63 ± 13.92	76.91 ± 15.58	0.870
Systolic Blood Pressure		Mean ± SD	133.08 ± 25.71	128.28 ± 22.24	0.071
Diastolic Blood Pressure		Mean ± SD	80.09 ± 14.89	80.05 ± 12.88	0.976
Interval between attack and hospital arrival (minute)		Median (IQR)	120 (263)	240 (365)	0.078
Interval between hospital arrival and beginning of intervention (minute)		Median (IQR)	65 (81)	60 (65)	0.494
Gender	Female	Number (%)	36 (23.1)	44 (23.3)	0.921
	Male	Number (%)	120 (76.9)	143 (76.7)	
Marital Status	Single	Number (%)	1 (0.7)	7 (3.8)	0.076
	Married	Number (%)	151 (99.3)	176 (96.2)	
Smoking	Yes	Number (%)	70 (51.5)	84 (46.2)	0.348
	No	Number (%)	66 (48.5)	98 (53.8)	
Hypertension	Yes	Number (%)	68 (47.2)	67 (35.8)	0.037
	No	Number (%)	76 (52.8)	120 (64.2)	
Diabetes	Yes	Number (%)	44 (31.4)	41 (22.2)	0.060
	No	Number (%)	96 (68.6)	144 (77.8)	

Table 2
Survival rates after STEMI in the Primary Percutaneous Coronary Intervention (PPCI) and Thrombolysis (TL) treatment groups.

Time	TL group		PPCI group		P value
	Survival rate	Standard Error	Survival rate	Standard Error	
Thirty-day	93.2	0.021	96.0	0.015	0.246
Ninety-day	91.8	0.023	94.9	0.017	0.231
1 year	87.0	0.029	93.7	0.018	0.034
2 year	83.9	0.35	92.4	0.022	0.013

patients are presented in Table 1. As seen, in both groups, similar patterns were observed regarding the demographic variables and underlying factors of cardiovascular disease. However, there was a significant difference in hypertension variable between the two groups.

Among the 354 patients, treatment was used for 157 patients with TL and for 197 patients with PPCI. The number of deaths in the two groups was 20 and 12, respectively. The mean survival time for the TL treatment group was 632.66 days and for the PPCI group was 676.08 days.

In this study, overall survival rates for TL and PPCI groups were 83.9% and 92.4% respectively. The survival rate of one month, three months, and one year was also higher in the PPCI group, which is presented in Table 2. Comparison of survival curves between TL and PPCI groups is shown in Fig. 1. Although one-year survival period was not significantly different in the two groups, regarding two-year survival period, patients treated with PPCI had a significant higher survival rate (P = 0.034).

Analyzing the factors related to the risk of death in acute myocardial infarction showed that age, gender, history of diabetes and type of treatment had a significant effect on the risk of death (Table 3). The hazard of death in patients treated with TL treatment was more than in comparison to the patients treated with PPCI (Hazard ratio or HR: 2.12, P = 0.039, 95% CI: 1.03–4.34).

There was no significant association between Mortality and variables such as marital status, previous history of myocardial infarction, smoking, hypertension, and the time interval between the onset of pain and arrival to the hospital.

Based on the results of multivariate analysis of the factors associated with death, after controlling the effects of variables on each other, only patients' age remained a strong predictor of mortality in patients with acute myocardial infarction (HR: 1.05, P = 0.001, 95% CI: 1.02–1.09). Accordingly, an increase in the patients' age had significantly increased mortality rate in patients with STEMI.

4. Discussion

The survival rates of one month, three months, one year and two years were better in PPCI group than the TL treatment group. Age, sex, history of diabetes and the type of treatment were among the factors influencing the risk of death. Based on the results, the patient's age was a strong predictor of mortality in patients with acute myocardial infarction.

In this study, the rate of death resulted from acute myocardial infarction was significantly lower in patients treated with PPCI than patients treated with TL treatment. However, after controlling the effect of other variables, despite the lower rate of death in the PPCI group, this decrease was not significant. Another study in Iran compared the survival of STEMI patients over 60 years of age treated with thrombolysis and PPCI. Results showed that there was no significant difference between the two group's mortality and reinfarction at 6-month, but heart failure was higher in the thrombolysis group.[19] A study conducted in China compared the methods of thrombolytic therapy and PPCI and the results showed that there was no significant difference between the two methods in the first month, but this difference was significant in the first year and the patients treated with the PPCI method had a higher survival rate in the first year.[1] The findings of a study conducted on STEMI patient showed that after removing the effects of confounding variables, thrombolysis as well as PPCI reduced hospital mortalities, although the PPCI was superior and individuals receiving this treatment had lower mortality.[20] The results of another study which compared the therapeutic methods used in patients with myocardial infarction showed that treatment of patients with PPCI method had better clinical outcomes and shorter hospital stay in comparison with thrombolytic therapy.[21] In another study that used the results of randomized clinical trials, irrespective of the delay in treatment, PPCI significantly reduced 30-day mortality rate compared with the thrombolysis method in patients with acute myocardial infarction.[22] In the present study, the survival rate of patients treated with PPCI for the period of one month

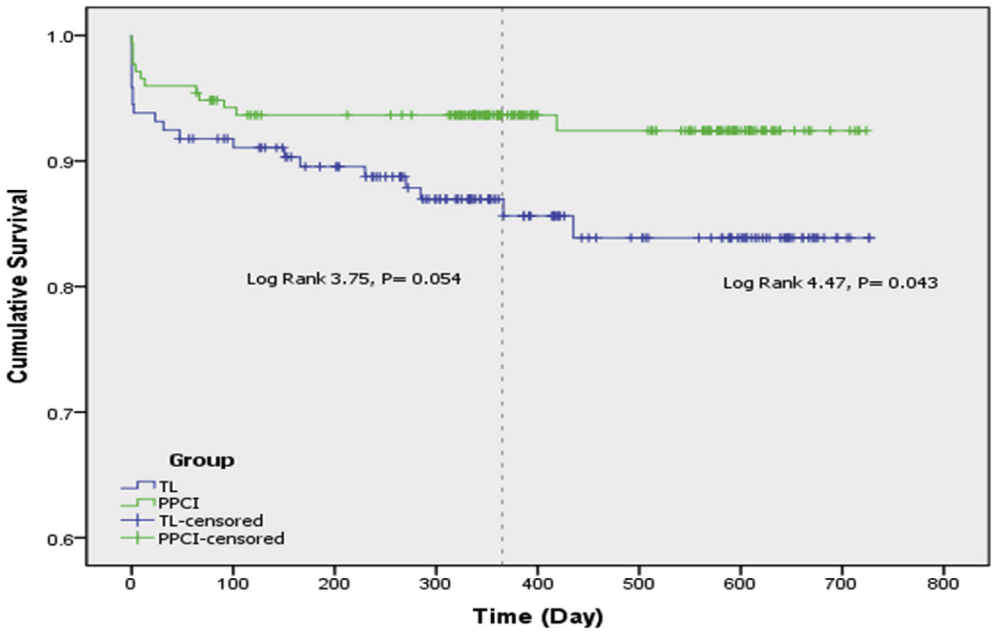

Fig. 1. Survival curves of patients with STEMI treated with PPCI and TL treatment.

Table 3
Predictors for mortality after ST-segment elevation MI.

Variables		Crude			Adjusted		
		HR[a] (95% CI)		*P* value	HR (95% CI)		*P* value
Age (per year)		1.06	1.03–1.10	< 0.001	1.05	1.02–1.09	0.001
Sex	Male	Ref	–	–	Ref	–	–
	Female	2.21	1.08–4.53	0.029	1.67	0.73–3.78	0.217
Marital status	Married	Ref	–	–			
	Single	1.15	0.15–8.47	0.890			
History of myocardial infarction	No	Ref	–	–	Ref	–	–
	Yes	1.97	0.88–4.44	.099	1.17	0.47–2.93	0.730
Smoking	No	Ref	–	–			
	Yes	1.36	0.64–2.88	0.416			
Hypertension	No	Ref	–	–			
	Yes	1.35	0.65–2.81	0.409			
Diabetes mellitus	No	Ref	–	–	Ref	–	–
	Yes	2.18	1.03–4.62	0.040	1.97	0.90–4.31	0.087
Time interval between attack and admission	Less than 3 Hours	Ref	–	–			
	More than 3 Hours	1.77	0.79–3.94	0.260			
Type of intervention	PPCI	Ref	–	–	Ref	–	–
	Medical treatment	2.12	1.03–4.34	0.039	1.81	0.83–3.97	0.134

[a] HR: Hazard Ratio.

and three months was higher than the patients in the TL treatment group.

Based on the findings of this study, factors such as age, sex, history of diabetes and type of treatment were the variables affecting death due to acute myocardial infarction, but after adjusting the effect of other variables, only age was significantly predictive for death in patients. Factors affecting PPCI failure in STEMI patients were investigated in a study and one of these factors was age greater than 65 years.[23] A study conducted in China found that a previous history of myocardial infarction was one of the predictive variables for death due to acute myocardial infarction in the first 30 days, although it had no significant predictive value for the first year.[1] In this study, patients who had a previous history of myocardial infarction, had a higher rate of death but this association was not significant.

In another study carried out in Isfahan, Iran, the 28-day survival rate for patients with acute myocardial infarction was 90.9%, and men had significantly higher survival rates than women.[24] In this study, women were at higher risk of death due to acute myocardial infarction. However, after eliminating the effect of confounding variables, the effect of gender was not significant. One of the possible reasons for the difference in the results of this study with other studies can be due to the sample size and study design. Considering that after controlling the effect of confounders, significant association have not been observed, it is needed to carry out studies with higher sample sizes or studies with cohort designs.

The findings of this study showed that there was no significant association between the time interval between onset of pain and arrival in the hospital with the patients' death. One of the reasons is that in a large number of cases, this time interval was not recorded. Therefore, failure to record the time interval between pain start and arrival in the hospital may be related to the patient's survival status (this variable may be not recorded for patients who have a worse condition). Based on the results of the study, transmission of patients with acute myocardial infarction from local hospitals to PCI centers was safe. This strategy significantly reduced mortality rate in patients who had been referred more than 3 h after the onset of symptoms. For patients who referred less than 3 h after the onset of symptoms, the TL therapy results were similar to those of PPCI.[17] The results of the one study showed that the time interval from the onset of symptoms to admission more than 12 h was the most important factor associated with the lack of reperfusion therapy. As a result, proceedings are needed to minimize the time interval between the onset of symptoms and hospital admissions in patients with STEMI.[25]

According to a study conducted in Denmark, health care system delay is a valuable performance for patients with STEMI treated with PPCI method, because the delay in the health care system was associated with death in these patients. Therefore, it was noted that a greater focus on the overall delay of the health care system may be the key for improving the survival of patients with STEMI.[26]

Considering the fact that in the present study, the type of treatment (PPCI versus TL treatment) in univariable analysis had a significant effect on the mortality rate due to acute myocardial infarction, but after adjusting the effect of other variables, this was not significant, Therefore, it seems that some of the effects of PPCI on reducing mortality rate is due to the different criteria used to select the type of treatment. Therefore, it is recommended to conduct studies with more appropriate design (such as prospective studies and clinical trials) to reduce the impact of confounding variables in order to evaluate the real effect of treatment type on the mortality rates in these patients.

Since the present study was not a randomized clinical trial and it was performed as a historical cohort, it was not possible to conduct a random allocation for type of treatments in patients, therefore, in allocating patient to the treatment methods there might be selection bias, which is one of the limitations of this study. Accordingly, it is recommended that if this is possible, prospective studies and randomized clinical trials conducted in order to achieve more reliable results. Another limitation of this study was the high number of censored patients in the survival analysis. It should be noted that due to different follow up times of patients in this study, most of these cases were executive censors (patients who include in study close to the end of study and had a limited time in the study). Therefore, increasing time of study or conducting study in prospective design might somewhat reduce this problem.

5. Conclusion

In the present study, the survival rate of patients in the PPCI group was higher than the TL treatment group. Variables such as age, sex, diabetes history and type of treatment were among the factors affecting the risk of death. However, after controlling the effects of confounders only the age was found as a predictor of mortality in patients with STEMI. According to the results of univariable and multivariable analysis, it is likely that the different criteria used to select the treatment type have a distortive effect on the association between treatment type and mortality in patients with STEMI. Therefore, in order to measure the real effect of treatment type on the survival rate of these patients, it

is necessary to carry out appropriate study design to reduce the effect of confounding variables.

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Declaration of competing interest

The authors declare that they have no conflict of interest.

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