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Evaluation of the influential factors on the mortality of patients with acute myocardial infarction

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Abstract

Introduction: Death caused by myocardial infarction (MI) usually occurs during the first hours after the onset of symptoms. Therefore, to manage, treat and decrease the mortality rate of these patients, early hospital admission is important.
Objectives: We aimed to investigate the impact of the influential factors on mortality of patients with MI.
Patients and Methods: In this case-control study, MI patients who were referred to the Ardabil Alavi Hospital, Ardabil university of medical sciences, Ardabil, Iran between April 2017 and April 2018 were included. The patients that had died due to MI were considered as the case group (n=27) and 27 matched patients that had died due to other causes were selected as the control group. Linear logistic regression was employed to analyze the data.
Results: The mean age of the patients in the case group was significantly higher than in the control group (75.1±11.7 versus 63.;1±11.6, $P=0.001$). The history of non-cardiac diseases in the case group (44.4%) was significantly higher than in the control group (7.4%; $P=0.002$). The number of PCIs (percutaneous coronary interventions) that were conducted in the case group (40.7%) was significantly lower than in the control group (74.1%; p=0.013). The time distance between hospital admission and PCI performance in the case group (110.9 minutes) was significantly higher than in the control group (56 minutes; $P=0.001$). However, the mean of delay time from the onset of symptoms to hospital admission (the patient delay) and from hospital admission to receiving treatment (the health system delay) was similar between the two groups.
Conclusion: This study showed that the number of performed PCIs, history of non-cardiac disorders and the interval between the onset of symptoms and PCI performance are significantly associated with the morality of MI patients.

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Introduction

Despite the improvements and advances in cardiopulmonary resuscitation, the prevalence of death due to sudden death is still high and is a major challenge in industrialized regions. In a study in Isfahan, Iran, the most common cause of sudden death was stroke (57%) (1).

Currently, vascular diseases, such as coronary artery diseases (CADs), are the leading cause of death in many countries. For example, according to the data by the health ministry of Iran, vascular disease is the first cause of death in Iran (2,3). Vascular diseases lead to the death of 16 million individuals per year worldwide with 82% of them occurring in developed countries (4).

Key point

The deaths caused by acute myocardial infarction (AMI) usually occur during the first hours after the onset of symptoms. Therefore, these patients should visit the hospital as soon as possible following the appearance of symptoms to receive the necessary medical care. The mortality of patients with AMI can be decreased by increasing the knowledge of the population about the symptoms, rapid referral of the patients with symptoms and early diagnosis and treatment of patients with AMI.

Acute myocardial infarction (AMI) is an acute medical condition caused by the absence of blood flow to some areas of the myocardium due to a sudden blockage of a coronary artery (5). The deaths caused by MI usually occur during the first hours after the

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onset of symptoms. Therefore, these patients should visit the hospital as soon as possible following the appearance of symptoms to receive the necessary medical care (6).

Most of the delays in visiting the hospital by patients are due to the time interval between the onset of the symptoms and the patient's decision to seek medical care, the time to reach the hospital, and the time spent on diagnosis and treatment. In addition, older age, female gender and the facilities of transferring the patients to the hospital are among the other influential factors (2,7). About half of the deaths due to MI occur before the arrival of the patient to the hospital (8). In a study, the death rate due to MI in the age groups of 35-45, 46-55 and 56-65 years were 6.2%, 29.6% and 64.2% respectively. This indicates a significant association between the age of the patients and death caused by MI. In addition, 59.3% had a positive history of ischemic diseases (9). On the other hand, the relative risk of hyperlipidemia and blood pressure (BP) in developing MI were higher in females of all age groups compared to males (10). Another study reported that about 36.6% of the patients with AMI died during a 5-year follow-up. Moreover, these patients had the following medical histories; 54.4%, 32.8% and 29.9% had hypertension (HTN), diabetes mellitus (DM) and hyperlipidemia, respectively (3). The mortality rate of myocardial infarction (MI) patients that had only received heparin has been reported to be 3% compared to 2% in those that had received streptokinase in addition to heparin (11).

Objectives

Due to the high prevalence of cardiovascular diseases, especially CAD and delay in receiving treatment, there is a high risk for mortality in patients with AMI. In this study, we aimed to investigate the patient and health system delays as well as the influential factors in the mortality of patients with AMI.

Patients and Methods

In this case-control study, the patients with AMI that were referred to the Ardabil Alavi hospital, Ardabil university of medical sciences, Ardabil, Iran between April 2017 and April 2018 were included. All of the patients that died due to MI were considered as the case group (n=27) and 27 matched patients that had died due to causes other disorders were selected as the control group. All of the patients in the two groups were evaluated in terms of age, gender, history of DM, history of HTN, history of MI, the mean of delay time from the onset of symptoms to hospital admission (the patient delay), the mean of delay time from hospital admissions to receiving treatment (the health system delay), number of PCIs (percutaneous coronary interventions) procedures, type of MI [ST elevated-MI (STEMI) or non-STEMI (NSTEMI)], the patient's location of residence, history of non-cardiac diseases and history of drug use.

Data analysis

The data for the patients of both groups were collected by the same checklist and then statistically analyzed with the SPSS software version 24. We employed the linear logistic regression model to determine the inflectional factors on the mortality of MI patients. The $P<0.05$ was considered as significant.

Results

The mean age of included patients in this study was 75.1 ± 11.7 years in the case group compared to 63.1 ± 11.6 years in the control group. Statistical analysis of the data showed that the mean age of patients in the case group was significantly higher than in the control group with a p-value of 0.001. Additionally, 33.3% and 25.9% of the patients in the case and control groups had DM, respectively. However, the difference was not significant. In addition, 44.4% of the patients in the case group and 63% of the patients in the control group had a history of HTN, however the difference was not significant. A history of non-cardiac diseases in the case group (44.4%) was significantly higher than the control group (7.4%; P =0.002). Additionally, a history of AMI in the case group (14.8%) was lower than the control group (22.2%); nonetheless, the difference was not statistically significant. Around 5.6% of the patients in the case group and 48.1% of the patients in the control group had a history of using cardiac medications. This difference between the two groups was also not statistically significant.

Furthermore, the number of performed PCIs in the case group (40.7%) was significantly lower than in the control group (74.1%; $P=0.013$). The time interval between hospital admission and PCI performance in the case group (110.9 minutes) was significantly higher than in the control group (56 minutes; $P=0.001$). The mean of delayed time from the onset of symptoms to hospital admission (the patient delay) and the mean of delayed time from hospital admission to receiving treatment (the system delay) were similar between the two groups (Table 1).

Analysis with logistic regression revealed that a history

Table 1. The time intervals that are involved in the treatment and follow-up process of the patients in both groups

Time-interval	Case group	Control group	*P* value
The onset of symptoms to hospital admission (h)	24.46 ± 44.5	20.6 ± 45.4	0.8
Hospital admission to receiving primary treatment (min)	9.1 ± 3.11	9.1 ± 2	0.9
Hospital admission to the initiation of PCI (min)	110.9 ± 128.8	56 ± 40.8	0.001

PCI, percutaneous coronary intervention.

of non-cardiac diseases (OR = 28.3) and the number of performed PCIs (OR = 24.5) had significant impacts on the mortality of patients with MI compared to other factors. Most of the patients in the two groups were from the city of Ardabil itself. Furthermore, 85.2% and 88.9% of the patients in the case and control groups had STEMI, respectively. However, the difference between the two groups was not statistically significant. In terms of the type of MI, most of the cases in both groups had anterior MI (70.5% in the case group versus 77.8% in the control group).

Discussion

The mortality of patients with AMI can be decreased by following some principles such as increasing the knowledge of the population about the symptoms (especially the high-risk individuals), rapid referral of the patients with symptoms and early diagnosis and treatment of patients with AMI. Therefore, we aimed to investigate some of the influential factors, such as the patient and health system delays, on the mortality of patients with AMI. These delays could be due to the lack of facilities, lack of access to relevant centers, lack of patient awareness and negligence of patient treatment.

Previously, Farkhani et al reported that, in patients with AMI, the risk of death within five years was lower in men than women (3). Moreover, Ghaffarian Shirazi et al had also reported that the risk of death in men was lower than in women. However, we could not evaluate the survival difference between the two genders in this study due to the inadequate sample size (12).

In our study, the mean ages of the total patients, the case group and the control group were 69.1, 75 and 63 years, respectively. The difference between the mean ages was not significant. However, in the study conducted by Hoseini et al the age of the patients had a significant association with death. The increase in age, increased the rate of death in patients with AMI (9).

We found no significant association between the history of DM and the mortality rate in patients with AMI. Johansson et al have also reported no significant difference between the survival rates of patients with DM and healthy individuals (10). However, Mosa Farkhani et al have reported that the risk of death in patients with DM was higher than in healthy individuals (3).

Furthermore, we did not find any significant relationship between the history of HTN and the mortality of patients with AMI. Similar to our study results, Johansson et al (10) have also reported that the survival probability of patients with AMI was the same in patients with and without a history of HTN.

According to our results, the history of non-cardiac diseases in the case group was significantly higher than in the control group. This indicates the negative impact of these diseases on the prognosis of patients with AMI and their mortality rate. Similar to our study, Sarfaraz et al have shown that histories of diseases and surgical treatment are influential in increasing the mortality of patients with AMI (11).

On the other hand, a history of AMI was not influential in the mortality of patients with AMI in our study. Hoseini et al have also shown that a history of AMI was not significantly correlated with death occurring in the first 28 days following AMI (9).

The history of drug use for cardiac diseases showed no effect on the mortality of patients with AMI in our study. This is contrary to the results of a study conducted by Sarfaraz et al (11). They reported that drug use for cardiac diseases in patients with a history of heart disease, significantly reduced the risk of mortality in these patients by about 11 %.

In addition, our results showed that the mean time between the onset of symptoms and hospital admission in the case group was 24 hours and 30 minutes compared to 20 hours and 35 minutes in the control group. The difference between the two groups was not statistically significant. Ghaffarian Shirazi et al (12) reported that death due to stroke increases with an increase in the time interval between the onset of symptoms and hospital admission. Nevertheless, they did not find any association between mortality and the time of hospital admission to treatment initiation.

Furthermore, Hasanzadeh Daloee et al showed that the mortality rate in patients with AMI who were early treated with statins was more than the control group (13). However, we could not evaluate the influence of this factor on the mortality of patients with AMI since treatment was initiated in both of the groups at the same time.

Our results show a significant association between the time of admission to the initiation of the PCI procedure. Therefore, this time interval could be a major cause for the increased mortality rate in patients with AMI. In addition, patient mismanagement was probably the cause of the delay in initiating PCI. Contrary to the results of our study, Dadgar et al reported no significant association between the mean interval of the onset of symptoms and the initiation of streptokinase therapy. They also found no association between the meantime of onset of symptoms to angiography with mortality rates during the hospital stay and at one month (14).

In our study, the number of PCIs was significantly lower in the patients that had expired due to AMI compared to those that survived. It could be hypothesized that CAD was more widespread and severe in those deceased patients. These patients may have required coronary artery bypass graft (CABG) surgery. However, due to their premature death, CABG was not performed. In addition, CABG has been associated with a higher risk in patients that other comorbidities, such as kidney failure. Jalalian et al also reported that PCI could be effective in the improvement and performance of patients with AMI and their prognosis (15).

The patient location of residence did not have any significant relation with the mortality of patients in our study. The time between the onset of pain to hospital admission by location of residence showed that the patients in the case group that came from the city of Ardabil itself or the urban areas arrived at the hospital earlier than in the control group. However, this could be due to the severity of symptoms and health issues in the patients of the case group. On the other hand, unlike the individuals from the urban areas, those from the rural areas reached the medical center with a significant delay. This delay was significant in this population compared to the control group as well. The lack of facilities for rapid referral, the long distance between the medical centers to the hospital, or the local culture may be the cause of this delay in the rural population. Nonetheless, overall, there was no significant relationship between the length of time to reach the hospital from the patient's location of residence and the number of deaths. Similar to our study, Masoumi et al have shown, no significant association between the delay length and the distance between the locations of the onset of symptoms and the center of receiving primary treatment (16).

Based on the results of the chi-square test, we found no association between the type of MI (STEMI or NSTEMI) and the mortality of patients. This is in line with the results of Sarafraz et al who also reported no significant association between the types of MI (STEMI or NSTEMI) and mortality (11). Besides, Adel et al showed that the mortality rate in acute anterior stroke was higher than lower acute stroke (17). Furthermore, Abdolazimi et al reported that among the types of MI, anterior MI had the lowest survival rate in both genders (18).

Conclusion

This study showed that the number of performed PCIs, history of non-cardiac disorders and the time interval between the onset of symptoms and PCI performance significantly affected the morality of patients with AMI. Further investigations with larger sample sizes and inclusion of other possible influential factors such as smoking, air pollution, or the weather are recommended.

Limitations of the study

There are some limitations like lack of access to information about patients who died in the emergency room and lack of accurate statistics on the number and cause of death of patients in the emergency room. Also there is a limitation about inability to reach patients who die of a heart attack before entering the hospital.

Authors' contribution

AH, MB, FA, SH, SAM and RJ were the principal investigators of the study. Ah, FA, SH and SAM were included in preparing the concept and design. FA, MB and SAM revisited the manuscript and critically evaluated the intellectual contents. All authors participated in preparing the final draft of the manuscript, revised the manuscript and critically evaluated the intellectual contents. All authors have read and approved the content of the manuscript and confirmed the accuracy or integrity of any part of the work.

Conflicts of interest

The authors declare that they have no competing interests.

Ethical issues

The research adhered to the principles of the Declaration of Helsinki. It was approved by the ethics committee of Ardabil University of Medical Sciences (IR.ARUMS.REC.1395.68). Accordingly, written informed consent was obtained from all participants prior to any intervention. This study was extracted from M.D., thesis of Sajjad Hakimian at this university (Thesis #616). In addition, ethical issues (including plagiarism, data fabrication and double publication) have been completely observed by the authors.

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