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Evaluation of urgent Coronary artery bypass grafting (CABG) survival in patients with acute myocardial infarction

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Background: Cardiovascular diseases are the leading cause of death in Iran and other countries. Due to the fact that in many centers, it is not possible to perform Urgent Coronary artery bypass grafting (UCABG) and the number of samples performed in other centers is low, so a similar study was not found in Iran. Therefore, the present study was performed to evaluate UCABG survival in patients with acute myocardial infarction.

Materials and Methods: In this historical cohort study, all patients with acute myocardial infarction who referred to Ayatollah Rouhani Hospital during 2011-2018 and underwent UCABG were included in the study. This plan was presented in the Ethics Committee of Babol University of Medical Sciences. All patients to be fully followed-up include: 1. Major cardiovascular complications (including cardiac death, major bleeding, and re-MI), 2. Major adverse cardiovascular events, 3. Re-admission rate, and 4. Requirement for angiography and re-angioplasty that the consequences were also evaluable and their history and paraclinical information were included in the file.

Results: The mean survival in non-diabetic patients was 55.81 (53.60-58.01) months and in diabetic patients was 56 (53.58-53.46) months which were not statistically significant (p= 0.48). The mean was 56.33 (54.27-39.39) months survival in patients without hypertension and was 55.32 (52.59-55.05) months in patients with hypertension, which was not statistically significant (p=0.40). The mean survival was 55.95 (54.24 - 57.66) months in patients without a history of MI during the first 3 years after surgery and was 54.14 (61.95-46.32) months in patients with a history of MI during the first 3 years after surgery which there did not have a statistically significant difference (p = 0.09). The mean survival was 55.99 (54.09-57.89) months in patients without a history of readmission and was 55.50 (52.01-58.98) months in patients with a history of readmission which were not statistically significant (p=0.33). The mean survival was 55.28 (53.13-57.42) months in men and was 56.95 (54.33-59.56) months in women which was not statistically significant (p = 0.19). According to Cox regression analysis, none of the variables was related to 5-year survival of patients.

***Conclusion*:** Based on the results of the present study, the mortality rate in patients undergoing UCABG was 18% over 5 years, which with a median survival of 56 months, had a good feedback in patients with acute myocardial infarction.

Keywords: Survival rate, Coronary artery bypass, Myocardial infarction, Complicity

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Introduction

Coronary artery disease is the most common cardiovascular disease, manifested by ischemia and acute myocardial infarction (1). Myocardial infarction (MI) is one of the life-threatening coronary events and the most severe clinical manifestation of coronary artery disease (CAD). More than 3 million people suffer from STE-MI annually. MI is the leading cause of death worldwide. Although the global mortality rate associated with MI has decreased, the incidence of heart failure (HF) remains high, and the mortality and morbidity rates in HF associated with MI remain high(2).

It has also been shown that the early (30-day) mortality rate due to AMI is approximately 30%, and more than half of these cases occur before the individual reaches the hospital. On the other hand, studies show that one in every 25 people with infarction who are discharged from the hospital dies within the first year after the infarction (3).

Several mechanisms have been defined for the development of AMI, the most important of which include: rupture and fissure of atherosclerotic plaques, an imbalance between the supply and demand of blood flow and oxygenation in the myocardial tissue, and an increase in the blood coagulation state (Hyper-coagulable State) (4).

Treatment of coronary artery disease with various methods including drug therapy, angioplasty, and finally coronary artery bypass grafting (CABG) surgery It is performed. Sometimes, in cases of complex coronary artery disease and in certain patients, angioplasty may not be possible and heart transplantation surgery may be required (5). In CABG, severe coronary artery stenosis of acceptable size is bypassed (6). If the necessary prevention tips are not followed (such as healthy diet, exercise, smoking cessation, control of high blood pressure and blood lipids) and the risk factors for atherosclerosis continue to exist, there is a possibility of occlusion of the grafted vessels or the development of new stenosis in other parts of the coronary arteries and the possibility of repeated heart attacks (7). In case of angina symptoms and chest pain, it may be necessary to re-examine the coronary arteries and grafted vessels (8). These patients may need revascularization by angioplasty or CABG.

The indication for CABG depends on factors such as the severity of the disease and coronary anatomy, left ventricular function, and the presence of diabetes. In patients with myocardial infarction, although primary angioplasty is the preferred method, sometimes it is not possible due to the anatomical conditions of the coronary arteries, and the patient is necessarily referred for emergency CABG (9). The aim of this study was to investigate the outcomes of emergency CABG in patients with AMI, including cardiac death, major bleeding, recurrent MI, readmission rate, and the need for angiography and repeat angioplasty.

Materials and methods

The present study is a historical cohort study conducted at Ayatollah Rouhani Hospital in Babol. In this study, the results of emergency CABG in patients who were hospitalized for MI from 2012 to 2018 and who were not able to perform PPCI due to coronary artery anatomy and underwent urgent CABG surgery (surgery within the first 24 hours after MI) were examined. On the other hand, patients who were not eligible for coronary surgery due to comorbidity were excluded from the study. In this study, the sample size was estimated to be 150 people based on type I error of 0.05 and a type II error of 0.20. Also, convenient sampling method was used for sampling. This plan was proposed to the Ethics Committee of Babol University of Medical Sciences and was approved with the ethical code (IR.MUBABOL.REC.1399.030).

A checklist was used to review the data. Information related to the independent variables included: age, sex, time from referral to CABG until it was performed and time from hospital visit to CABG, and dependent variables included: history of diabetes, hypertension, length of hospitalization, number of grafts, type of operation, time of death, ejection fraction, patient CPR, number of failed PCI cases and number of cases of not performing PCI and performing CABG were collected using a checklist. Data collection was through a study of the patients' hospitalization records and subsequent follow-up of the patients. EF results were examined in all patients before and after surgery and in patients who were alive, and echocardiography results of the follow-up phase were recorded. Other information such as cases of readmission, repeat CABG, repeat MI, and repeat PCI were reviewed by telephone call and, if performed, its documents were requested and reviewed from the patient.

Statistical Analysis

Statistical analysis was performed using SPSS version 25 software. For the statistical analysis of this study, in the descriptive statistics section, central indices (mean, median, and mode) were used, and for quantitative variables, dispersion indices (variance, standard deviation, range of variation, coefficient of variation), as well as frequency and prevalence for qualitative data were used. In the inferential statistics section, the chi-square test, Cox regression, and

survival analysis were used to examine the study hypotheses after examining the normality of the data. A P-value of less than 0.05 was considered a significant level.

Results

According to the information presented in **Table1**, 172 patients were studied in this study, including 110(63.9%) males and 62 (36.1%) females with a mean age of 61.98 years. Also, the mean EF of the patients before surgery was 42.70% and after surgery was 40.80%, which shows a statistically significant difference (p-value=0.012). Of the 161 patients discharged from the hospital, 31 (18%) died within 5 years, with the mortality rate in the first year being 5 (16.0%), the second year being 1 (3.0%), the third year being 11 (36.0%), the fourth year being 3 (9.0%), and the fifth year being 11 (36.0%).

Table 1. Demographic information of patients

Variable	Status	Frequency (%)
Gender	Male	110 (64.0)
	Female	62 (36.0)
Diabetes	Yes	67 (39.0)
	No	105 (61.0)
Hypertension	Yes	77 (44.8)
	No	95 (55.2)
History of CVA	Yes	6 (3.5)
	No	166 (96.5)

Table 2 shows information about inpatient mortality, and based on it, 7 men and 6 women died during surgery, which statistically did not show a significant difference in intraoperative mortality between the two sexes (p-value=0.54).

Table2. comparison of in-hospital deaths by gender

Death during hospitalization	Women Frequency (Percentage)	Men Frequency (Percentage)	P-value
No	56 (90.3)	103 (93.6)	0.54
Yes	6 (9.7)	7 (6.4)	

Table 3 shows the distribution of frequency and percentage of complications. According to it, the most frequent complication was pleural effusion (10.5%) and the least frequent was CVA (0.6%). Other complications included decreased hemoglobin (9.3%), wound infection (5.2%), MI during hospitalization (4.7%), and renal dysfunction (4.7%). Also, 7.6% of patients died during hospitalization. Of the 161 patients who were discharged from the hospital, 31 (18.0%) died within 5 years, of which 5 (2.9%) died in the first year, 1 (0.6%) in the second year, 11 (6.4%) in the third. year, 3 (1.7%) in the fourth year, and 11 (6.4%) in the fifth year. It should be noted that 5 patients died in less than 1 year and one-third of the deaths in the following

Table 3. Frequency distribution and percentage of complications and patient mortality over a five-year period.

Mortality	Frequency	Percent	Complications	Frequency	Percent
Under 1 year	167	97.1	Renal dysfunction	164	95.3
No	5	2.9	No	8	4.7
Yes			Yes		
1 to 2 years	171	99.4	Wound site infection	163	94.8
No	1	0.5	No	9	5.2
Yes			Yes		
2 to 3 years	161	93.6	Decrease in hemoglobin	156	90.7
No	11	6.4	No	16	9.3
Yes			Yes		
3 to 4 years	169	98.3	MI Relapse during	164	95.3
No	3	1.7	hospitalization	8	4.7
Yes			No		
			Yes		
4 to 5 years	161	93.6	CVA During hospitalization	171	99.4
No	11	6.4	No	1	0.6
Yes			Yes		
5-year-old	141	82.0	Pleural effusion	154	89.5
No	31	18.0	No	18	10.5
Yes			Yes		
			Death during hospitalization	159	92.4
			No	13	7.6
			Yes		

3 years were due to non-cardiac causes. The average survival in patients who died in the first year after discharge was 8.60 months with a median of 9 months, with a minimum of 5 months and a maximum of 11 months

The relationship between five-year survival rates and risk factors and gender is presented in **Table 4**. In examining the 5-year mortality rate based on the presence and absence of diabetes, hypertension, CVA, recurrent MI, and readmission, no significant difference was observed between mortality in patients with and without the above factors, nor by gender.

Multivariate analysis of factors affecting 5-year survival using Cox regression is presented in **Table 5.** Cox regression was used to examine the multivariate effect of various factors on patient mortality during the 5-year follow-up, and history of diabetes had the highest (HR = 2.04) and number of strokes the lowest (HR = 0.67) effect on predicting patient mortality, although these were not statistically significant.

Table 4. Association of five-year survival rates with risk factors and gender.

Variables		Frequency	Percent	Five years Mortality		
				Frequency	Percent	P-value
Diabetes	Yes	105	61	17	16.2	0.48
	No	67	39	14	20.9	
Hypertension	Yes	95	55.2	15	15.7	0.4
	No	77	44.7	16	20.7	
CVA	Yes	166	93.5	29	17.4	0.26
	No	6	3.5	2	33.4	
MIAgain	Yes	165	96	28	17	0.09
	No	7	4	3	42.9	
Readmission	Yes	134	77.9	22	16.4	0.33
	No	38	22.1	9	23.7	
Gender	Male	110	63.9	23	20.9	0.19
	Female	62	36.1	8	12.9	

Table 5. Multivariate analysis of factors affecting 5-year survival rate using Cox regression.

Variables	Hazard Ratio	95% confidence interval	P-value
Age	0.98	0.95-1.01	0.32
Gender, Woman	1.08	0.30-3.88	0.90
History of diabetes	2.04	0.85-4.90	0.11
History of hypertension	1.27	0.51-3.12	0.60
Length of hospitalization (Day)	1.01	0.96-1.06	0.62
Length of operation (hour)	0.69	0.37-1.29	0.25
Graft count	0.67	0.32-1.37	0.27
EF Before the operation	0.96	0.93-1.00	0.07

Discussion

This is the first cohort study to investigate the survival rate and factors affecting survival of patients undergoing emergency CABG from a single center and to evaluate the 5-year survival rate of these patients.

The 1-year mortality rate was 2.9% and 18.0%, respectively. Axelsson et al. reported a 5-year mortality rate of 13% in patients undergoing UCABG (10), which was lower than the mortality rate obtained in the present study. Also, in a study conducted by Mejía et al., the 3-year mortality rate of patients undergoing CABG was reported to be 19% (11). In the study by Merdler et al., the 30-day to 2-year mortality rate in the CABG group was 22% (12). Qanitha et al. reported a 32.3% mortality rate in patients with coronary artery disease during an 18-month follow-up (13). Pi et al. reported in their study that the mortality rate in STEMI patients who underwent timely CABG is low (14).

The 1-year survival rate in the present study was 97.1% and the 5-year survival rate was 82.0%. In the study of Axelsson et al., the 5-year survival rate in UCABG was 79%, which was lower than the 5-year survival rate in the present study (10). Also, the 5-year survival rate in the study of Rai et al. was 90.8% (15), which was higher than the 82% survival rate in the

present study. Although the present study examined patients undergoing UCABG and the study of Rai et al., patients undergoing conventional CABG, the difference in survival rates between the two studies is a strength of the present study. Mosorin et al. also found that the 5-year overall survival rate in patients with out-of-hospital cardiac arrest was 80.7% and in patients with acute myocardial infarction was 84.5% (16).

In the study of mid-term complications after UCABG, pleural effusion and bleeding were the most common, respectively. In a study by Hung et al., pneumonia was the most common complication after CABG with a rate of 23.9%. The need for dialysis due to acute renal failure with a rate of 12.6% and ventricular fibrillation with a rate of 11.3% were the three most common complications after CABG, respectively (17). Axelsson et al. reported in their study that early complications included recurrent bleeding (15%), postoperative stroke (6%), and dialysis for severe kidney damage (6%) (10).

This study also examined factors affecting the survival rate of patients undergoing UCABG. The results showed that age, female gender, history of diabetes, hypertension, length of hospitalization, duration of surgery, number of grafts, and preoperative EF did not affect the 5-year survival rate of patients. The reason for the lack of significant difference in the average survival in female gender, patients with diabetes and hypertension, CVA, recurrent MI after surgery, and history of rehospitalization could be due to the small sample size. It should be noted that various studies such as D'Agostino et al. and Ranucci et al. have been conducted so far regarding the risk factors for mortality after CABG such as female gender, obesity, hypertension, high blood lipids, diabetes, smoking, emergency surgery, prolonged cardiopulmonary pump and clamp duration, and low preoperative hematocrit, and there is no consensus on the effect of each risk factor in predicting mortality after CABG surgery (18, 19). In addition, according to the results of the study by Mejía et al., preoperative variables such as age over 65 years, creatinine above 2 mg/dL, and pulmonary systolic pressure above 60 mm Hg were identified as predictors of in-hospital mortality in patients with coronary artery bypass grafting and acute myocardial infarction (11). In the present study, the only similar criterion measured was age, which was not statistically significant in predicting mortality.

Among the factors examined in the study by Ladeira et al., preoperative cardiogenic shock and history of angioplasty were identified as worse prognostic factors in this group of patients (20). Ribeiro et al. reported in their study that in some studies, advanced age, high serum creatinine, and low ejection fraction were the main factors for mortality after CABG surgery, and in other studies, female gender, type of procedure, and number of procedures performed at a center were identified as factors affecting outcomes after CABG (21). The reason for the difference in the predictors of mortality could be the characteristics of the study population, severity of symptoms, comorbidity, and the number of vessels involved, which requires extensive and further studies in this field to realize the hypotheses and reach a consensus on these factors.

The present study has several weaknesses and strengths. Among the weaknesses of this study are the low sample size and the retrospective nature of the study, which did not allow the examination of some of the effective variables. In addition, conducting the study using information from patients in one hospital is another weakness of the present study. Among the strengths of the present study, it can be noted that it is the first study conducted in this field.

Conclusion

According to the results of the present study, the mortality rate in patients undergoing UCABG was 18% within 5 years, and given the low incidence of postoperative complications and relatively good 5-year survival, UCABG could be a good choice in patients with acute myocardial infarction in whom primary angioplasty cannot be performed for some reason.

Declaration

Conflict of interest

The authors reported no conflicts of interest.

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