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Coronary Artery Bypass Grafting in advance aged patients

Roxana Sadeghi[1,2]

Original Article

Abstract

INTRODUCTION: This study aimed to assess the impact of coronary artery bypass grafting (CABG) on outcomes in elderly patients compared to younger patients.

METHOD: An observational case-control study was conducted involving 535 patients, divided into two groups: older adults (≥75 years) and younger adults (<75 years). All patients underwent CABG following a similar protocol. The primary endpoints focused on early post-procedure outcomes, including in-hospital mortality and the duration of ICU or hospital stay. Patients were followed up for six months, and secondary study endpoints included long-term mortality, left ventricular ejection fraction, re-hospitalization rates, and repeated revascularization.

RESULTS: 535 patients who underwent CABG were enrolled in this study. The smoking habit was significantly higher among younger adults (38.2% vs. 12.5%, P=0.001). Hypertension was more prevalent among older adults than younger adults (75% vs. 60%, P=0.044). LDL cholesterol serum levels were higher among younger adult patients (94.9±32.5 vs. 80.9±32.9, P=0.028). In-hospital death was not significantly different between younger and older adults (2.8% vs. 5.0%, P=0.34). Mortality in the six-month follow-up was non-significantly higher in the elderly (2.1% vs. 8.1%, P=0.06).

A significant proportion of patients in both groups (46.9% in younger patients vs. 40% in older ones, P=0.40) received dual antiplatelet therapy (DAPT) prior to CABG due to a recent myocardial infarction and receipt of a new stent, but without increased major bleeding in both groups.

CONCLUSION: CABG should be considered a viable treatment option for elderly patients with acceptable operative risk in current clinical practice.

Keywords: Elderly, Coronary Artery Bypass Grafting, Mortality, Gastrointestinal Bleeding, Cerebrovascular Events, Ejection Fraction

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Introduction

The significant increase in the aging population is evident in most communities [1]. While the future growth rate of the elderly population is uncertain, the world, including Iran, is aging [2-4]. With the extension of life expectancy, the incidence of age-related diseases is inevitable. Therefore, a comprehensive understanding of these illnesses is crucial for enhancing disease management and improving life expectancy among the elderly [5, 6]. For instance, cardiovascular disease (CVD), a leading cause of morbidity and mortality, exhibits a steep rise between 40 and 80 years [7]. CABG has improved long-term survival compared to angioplasty in patients with reduced ejection fraction and multi-vessel disease [8, 9]. However, the outcomes of CABG in the elderly population are subject to conflicting evidence. Advanced age is often

1- Prevention of Cardiovascular Disease Research Center, Shahid Beheshti University of Medical Sciences, Tehran, Iran.
2- School of Medicine, Shahid Beheshti University of Medical Sciences, Tehran, Iran

Address for correspondence: Roxana Sadeghi, Prevention of Cardiovascular Disease Research Center, Shahid Beheshti University of Medical Sciences, Tehran, Iran. Email: roxan.sadeghi@sbmu.ac.ir

accompanied by comorbidities and medical frailty, which increase the potential operative risk for elderly patients. Numerous studies have reported mixed early results among elderly patients who underwent CABG [10, 11], with some authors reporting unfavorable early outcomes [12, 13]. Long-term outcomes have also generated controversy, with specific studies reporting satisfactory and comparable results or acceptable long-term outcomes in elderly CABG patients [14, 15]. Conversely, other studies have presented inconsistent findings, indicating better long-term survival in younger patients [16, 17]. Notably, no local study has specifically investigated the impact of concurrent CABG in elderly patients compared to younger patients. Consequently, this study aims to assess the influence of CABG on early-term and long-term outcomes in elderly patients versus their younger counterparts.

Materials and Methods

Study Design and Data Collection

This observational study included 535 patients from February 2018 to February 2021 at an academic hospital of Shahid Beheshti University of Medicine in Tehran, Iran. The study received ethical approval from the university's ethical committee, with the ethical code IR.SBMU.RETECH.REC.1401.539. Before participation, the study details were explained to the patients, and written informed consent was obtained. Adult patients undergoing cardiac surgical procedures were enrolled in the study and categorized based on their age.

Inclusion and Exclusion Criteria

The study included consecutive patients who were candidates for CABG. Patients who required valve replacement in addition to CABG were excluded. The selection of patients for the study was not based on the surgical method, on-pump or off-pump.

Data Collection: Upon admission, data were collected in four main categories:

1. Demographic, clinical, and paraclinical characteristics of the patients before CABG.
2. CABG-related parameters.
3. Clinical and paraclinical characteristics of the patients after CABG.
4. Clinical and paraclinical characteristics of the patients after six months.

Surgery Process

Before CABG, the severity of coronary involvement was assessed through coronary angiography. Echocardiography was also performed to evaluate the functional state of the left ventricle. All patients underwent CABG using a standardized protocol. The revascularization of the left anterior descending coronary artery (LAD) was carried out using the left internal mammary artery (LIMA), along with 1 to 3 venous grafts. The usage of the right internal mammary artery (RIMA) was limited. Preoperative data were collected and analyzed, including demographic information, clinical parameters, number of vessel involvement, left ventricular ejection fraction (LVEF), and intraoperative details such as blood transfusion, cross-clamp time, and cardio-pulmonary bypass time. Post-CABG data included hemoglobin and creatinine levels 48 hours after the operation, LVEF, and any major bleeding (fatal bleeding, intracranial bleeding, reoperation due to bleeding, transfusion of at least five units of packed red blood cells during 48 hours, chest tube drainage more than 2000 cc over 24 hours) or cerebrovascular events [18]. The study's primary endpoint was to evaluate early post-procedure outcomes, including in-hospital mortality and the total length of stay in the intensive care unit (ICU) or hospital. Secondary endpoints included long-term death, major bleeding or cerebrovascular events, LV ejection fraction, the need for re-hospitalization, and repeated revascularization procedures like percutaneous coronary intervention (PCI) or CABG.

Statistical Analysis

Quantitative variables were reported as mean ± standard deviation (SD), while categorical variables were presented as percentages. The comparison between groups was performed using the Student's t-test or Mann-Whitney

U test for continuous variables and the chi-square test (or Fisher's exact test if necessary) for categorical variables. A p-value of 0.05 or less was considered statistically significant. All statistical analyses were conducted using SPSS version 16.0 (SPSS Inc., Chicago, IL, USA).

Results

In this study, 535 patients who underwent CABG were included. Based on age, the study population was divided into two groups: younger adults under 75 years old (N=495) and older adults aged 75 or more (N=40). Table 1 presents the baseline characteristics of the patients who enrolled in the study. There is no significant difference in sex, educational level, and income between the two study groups. Strenuous physical activity (more than five times per week) is more prevalent among younger adults, but this statistic is insignificant.

Table 1. Baseline characteristics of the patients according to age

Variable	Younger adults (<75y) N=495	Older adults (≥75) N=40	Total N=535	P value
Mean age (mean ± SD)	59.1±8.4	78.4±3.20	60.5±9.5	<0.001
Gender (Female) %	151(30.5)	12(30)	163(30.5)	0.95
Marital status (Married)%	479(96.8)	34(85)	513(95.9)	<0.001
Education				
Less than diploma	179(36.2)	14(35)	193(36.1)	
Diploma	276(55.8)	23(57.5)	299(55.9)	
Graduate	40(8.1)	3(7.5)	43(8)	0.98
Income (Tomans/month)				
< 3 million	15(6.5)	1(5.6)	16(6.4)	0.44
3-10 million	198(85.3)	17(94.4)	215(86)	
> 10 million	19(8.2)	0(0)	19(7.6)	
BMI	26.6±4.2	26.1±3.1	26.6±4.1	0.47
Physical activity (Times/week)				
0–1 time	246(52.1)	23(65.7)	269(53.1)	
2-4 times	163(34.5)	11(31.4)	174(34.3)	
≥ 5 times	63(13.3)	1(2.9)	64(12.6)	0.13
Substance abuse				
Current smoker	189(38.2)	5(12.5)	194(36.3)	0.001
Current or past smoker	234(47.3)	9(22.5)	243(45.4)	0.002
Alcohol drinking	18(3.6)	0(0)	18(3.4)	0.39
Opium consumption	92(18.6)	1(2.5)	93(17.4)	0.08
Risk factors				
Family history of CAD	95(19.2)	5(12.5)	100(18.7)	0.39
Diabetes mellitus	249(50.3)	16(40)	265(49.5)	0.21
Hypertension	291(58.8)	30(75)	321(60)	0.044
Dyslipidemia	89(18)	9(22.5)	98(18.3)	0.47
Renal failure	35(7.1)	3(7.5)	38(7.1)	0.75
Dialysis	8(1.6)	1(2.5)	9(1.7)	0.50
Previous CAD	215(43.4)	15(37.5)	230(43)	0.46
Previous heart failure	16(3.2)	1(2.5)	17(3.2)	>0.99
Previous PCI	80(16.2)	3(7.5)	83(15.5)	0.17
Previous CABG	3(0.6)	1(2.5)	4(0.7)	0.26
CVA	33(6.7)	2(5)	35(6.5)	>0.99
COPD	30(6.1)	3(7.5)	33(6.2)	0.71
PAD	7(1.4)	3(7.5)	10(1.9)	0.032

Variable	Younger adults (<75y) N=495	Older adults (≥75) N=40	Total N=535	P value
Pharmacological treatment				
Aspirin	292(59)	22(55)	314(58.7)	0.62
Statin	258(52.1)	24(60)	282(52.7)	0.33
Insulin	48(9.7)	4(10)	52(9.7)	0.95
Beta / Calcium blockers	205(41.4)	20(50)	225(42.1)	0.29
ACEi/ ARBs	233(47.1)	22(55)	255(47.7)	0.33

CABG: Coronary artery bypass grafting; CAD: Coronary artery disease; COPD: Chronic obstructive pulmonary disease; CVA: Cerebrovascular accident; PAD: Peripheral arterial disease; PCI: Percutaneous coronary intervention.

Table 2. Clinical and para-clinical characteristics of the patients, before CABG

Variable	Younger adults (<75y) N=495	Older adults (≥75) N=40	Total N=535	P value
Serum hemoglobin (g/dl)	13.1±1.8	12.6±2.2	13±1.8	0.11
Serum creatinine (mg/dl)	1.2±0.8	1.4±1.3	1.2±0.8	0.14
Glomerular filtration rate	76.8±49.9	50.4±16.6	74.8±48.7	0.001
Platelet count (/mm^3.10^3)	226.5±71.8	238.2±103.6	227.4±74.6	0.34
Serum cholesterol (mg/dl)	151.9±41.4	133.7±38.3	150.8±41.4	0.26
Serum LDL (mg/dl)	94.9±32.5	80.9±32.9	94±32.7	0.028
Serum HDL (mg/dl)	35±8.1	34.5±7.9	35±8.1	0.75
Serum triglyceride (mg/dl)	149.1±97.6	107±39.1	146.3±95.4	0.024
Fasting blood sugar (mg/dl)	154.1±159.2	133±51.5	152.6±153.9	0.41
Hba1c	8.1±2.3	7.2±1.6	8.0±2.30	0.06
Clinical findings in admission				
Systolic blood pressure	127.6±21.7	132±20.7	128±21.6	0.22
Diastolic blood pressure	77.6±12.7	79.3±13.7	77.7±12.7	0.42
Heart rate	79.6±12.9	78.5±12.3	79.5±12.9	0.61
Complete heart block	3(0.6)	0(0)	3(0.6)	>0.99
Pulmonary edema	3(0.6)	0(0)	3(0.6)	>0.99
Cardiogenic shock	1(0.2)	0(0)	1(0.2)	>0.99
Heart failure	21(4.2)	1(2.5)	22(4.1)	>0.99
Syncope	2(0.4)	1(2.5)	3(0.6)	0.20
Number of diseased vessels				
1vessel Disease	20(4.1)	2(5)	22(4.2)	0.80
2 Vessel Disease	75(15.5)	4(10)	79(15.1)	
3 Vessel Disease	387(80.1)	34(85)	421(80.5)	
Left Main Disease	76(15.8)	8(20)	84(16.1)	0.48
DAPT before CABG	232(46.9)	16(40)	248(46.4)	0.40
Primary PCI before CABG	57(11.5)	4(10)	61(11.4)	0.77
Contrast induced nephropathy	9(1.8)	2(5.0)	11(2.1)	0.19
LVEF before CABG	43.9±10.1	43.9±9.8	43.9±10.1	0.99

CABG: Coronary artery bypass grafting; DAPT: Dual antiplatelet therapy; HDL: High density lipoprotein; LDL: Low density lipoprotein; LVEF: Left ventricular ejection fraction; PCI: Percutaneous coronary intervention.

The smoking habit is significantly higher among younger adults (38.2% vs. 12.5%, P=0.001). Similarly, opium consumption is significantly more prevalent in younger adults (18.6% vs. 2.5%, P=0.008). Alcohol drinking is more popular among younger adults than older adults (3.6% vs. 0.0%, P=0.39), but this difference is not significant. There are no significant differences in the coronary artery disease (CAD) risk factors, such as family history of CAD, diabetes, dyslipidemia, and kidney disease in both groups. In contrast, hypertension is more prevalent among older adults than younger adults (75% vs. 60%, P=0.044). The prevalence of peripheral arterial disease (PAD) is higher among older adults (7.5% vs. 1.4%, P=0.032).

Table 2 presents the clinical and para-clinical characteristics of the patients before CABG. There are no significant differences between serum hemoglobin, creatinine, glomerular filtration rate (GFR), platelet count, and fasting blood sugar (FBS) before administration. LDL cholesterol serum levels were higher among younger adult patients (94.9±32.5 vs. 80.9±32.9, P=0.028), and serum triglyceride levels were also higher among younger patients than older adults (149.1±97.6 vs. 107±39.1, P=0.024).

A significant proportion of patients in both groups were treated with dual antiplatelet therapy (DAPT) before CABG due to a recent myocardial infarction and receiving a new stent, but there was no significant difference between the two groups according to DAPT usage (46.9% in younger patients vs. 40% in older ones, P=0.40).

Table 3 presents the CABG-related parameters according to age. The rate of emergent CABG and the off-pump method was not significantly different among younger vs. oldert adults (P>0.05). There were no significant differences in the usage of LIMA, RIMA, and IABP between the two groups (P>0.05). There was no significant difference in the duration of IABP, cardio bypass time, cross-clamp time, and the number of grafts between the two groups of patients (P>0.05).

Table 3. CABG related parameters according to age

Variable	Younger adults (<75y) N=495	Older adults (≥75) N=40	Total N=535	P value
Emergent CABG	11 (2.2)	1(2.6)	12(2.3)	0.87
Off pump CABG	51(10.3)	3(7.5)	54(10.1)	0.56
LIMA usage	469(94.9)	37(92.5)	506(94.8)	0.50
RIMA usage	3(0.6)	0(0)	3(0.6)	>0.99
IABP use	10(2)	1(2.5)	11(2.1)	0.57
Mitral valve repair	19(3.8)	1(2.5)	20(3.7)	>0.99
Duration of IABP (hours)	0.1±0.5	0±0.2	0.1±0.4	0.65
Cardio bypass time (min)	121.5±41.7	129.8±57	122.2±43.1	0.26
Cross clamp time (min)	77.6±44.4	77.9±32.4	77.6±43.6	0.96
Number of grafts	3.2±1	3.2±1	3.2±1	0.76
Blood transfusion	428(86.5)	34(85)	462(86.4)	0.79
Blood transfusion in operation	0.87±0.79	1.40±1.15	0.91±0.83	<0.001
Number of received pack cell	2.6±2	3.5±2.4	2.7±2	0.005
Serum hemoglobin (g/dl)	8.9±1.5	9.2±1.9	9±1.5	0.30
Hemoglobin change (mg/dl)	4.1±2	3.4±2	4.1±2	0.025
Serum creatinine (mg/dl)	1.5±1.1	1.9±2.2	1.5±1.3	0.057

CABG: Coronary artery bypass grafting; Hemoglobin change: Hemoglobin before surgery- Hemoglobin after surgery; IABP: Intra-aortic balloon pump; LIMA: Left internal mammary artery; RIMA: Right internal mammary artery.

The emergency need to receive blood pack cells was higher among older adults than younger adults (3.5±2.4 vs. 2.6±2, P=0.005). The serum creatinine level after surgery was lower among younger adults (1.5±1.1 vs. 1.9±2.2, P=0.057).
Table 4 demonstrates that the rate of in-hospital death is not significantly different between the two groups of younger and older adults (2.8% vs. 5%, P=0.34); however, differences were seen in the length of ICU stay (6.8±3.4 vs. 8.4±3 respectively, P=0.006).

Table 5 presents the clinical and para-clinical characteristics of the patients six months after CABG. Re-admission was higher among older adults (14.8% vs. 27%, P=0.05). However, the pattern of pharmacological treatment was approximately similar among both groups, except for aspirin, which was used more frequently among younger adults (P=0.047). The rate of death in the first six months after discharge is non-significantly different between younger and older adults (2.1% vs. 8.1% respectively, P=0.06).

Table 4. Clinical and para-clinical characteristics of the patients, after CABG and before discharge

Variable	Younger adults (<75y) N=495	Older adults (≥75) N=40	Total N=535	P value
Serum hemoglobin (g/dl)	10.4±1.3	10.5±1.2	10.4±1.3	0.56
Serum creatinine (mg/dl)	1.2±0.8	1.3±0.8	1.2±0.8	0.57
LVEF before discharge	43.4±9.7	42.8±10.2	42.8±10.4	0.71
Minor bleeding	0	0	0	-
Major bleeding	0	0	0	-
Gastrointestinal bleeding	1(0.2)	0(0)	1(0.2)	>0.99
Cerebrovascular accident	33(6.7)	2(5)	35(6.5)	>0.99
Repeat sternotomy	10(2)	1(2.5)	11(2.1)	0.94
Death in hospital	14(2.8)	2 (5)	16(3)	0.34
Length of ICU stay	6.8±3.4	8.4±3.8	6.9±3.5	0.006
Length of hospital stay	14.5±8	15.7±6.1	14.6±7.8	0.35

LVEF: Left ventricular ejection fraction; ICU: Intensive care unit.

Table 5. Clinical and para-clinical characteristics of the patients, 6 months after CABG

Variable	Younger adults (<75y) N=495	Older adults (≥75) N=40	Total N=535	P value
Symptomized within 6 months				
Re-admission	70(14.8)	10(27)	80(15.7)	0.05
Re-angiography	12(2.5)	0(0)	12(2.4)	>0.99
Re-angioplasty	4(0.8)	0(0)	4(0.8)	>0.99
Re-CABG	0	0	0	-
Pharmacological treatment				
Aspirin	415(95)	25(86.2)	440(94.4)	0.047
Clopidogrel	358(82.5)	23(79.3)	381(82.3)	0.66
Statin	405(93.1)	25(86.2)	430(92.7)	0.16
Beta blockers	320(73.6)	19(65.5)	339(73.1)	0.34
ACEi/ ARBs	232(53.5)	14(48.3)	246(53.1)	0.58
LVEF after discharge	44.6±10.8	43.8±11.4	44.5±10.8	0.81
Gastrointestinal bleeding	4(0.8)	1(2.7)	5(1)	0.31
CVA	6(1.3)	2(5.4)	8(1.6)	0.10
Death	10(2.1)	3(8.1)	13(2.6)	0.06

CABG: Coronary artery bypass grafting; CVA: Cerebrovascular accident; LVEF: Left ventricular ejection fraction.

Discussion

CAD is the most common cause of mortality and morbidity in older adults [19-21], and most of these patients have functional impairment from the onset of symptoms [22]. This is a significant health problem for elderly patients. PCI is an invasive but non-surgical procedure to relieve the stenosis of the coronary arteries and improve blood flow to the ischemic myocardial tissue [23]. Several comparisons between PCI and CABG have demonstrated that PCI is associated with higher rates of repeat revascularization [24]. CABG is associated with lower cardiovascular death, myocardial infarction, and repeat revascularization, especially in patients with multi-vessel disease [25, 26]. Whether the survival benefit from CABG versus PCI extends to the elderly population needs to be determined [27, 28].

PCI is often the method of choice in elderly patients due to associated comorbidities, patient preference, and increased early risk with bypass surgery [29, 30].

The results of this study demonstrated that elderly patients are at similar risk of in-hospital mortality rates but have a more extended ICU stay. Therefore, in an urgent condition when needed, CABG could be performed in elderly patients. Furthermore, six months of follow-up in our study population revealed that re-admission of older adults was higher than younger adults ($P < 0.05$); and also, the mortality rate was non-significantly higher ($p=0.06$) with no significant differences in re-angiography, re-angioplasty, re-CABG, and left ventricular ejection fraction ($P>0.05$).

An important point in this study was the continuation of dual antiplatelet therapy (DAPT) before CABG in a significant part of patients regardless of age group according to recent guidelines and studies, without a significant increase in major bleeding in both groups. This finding is very valuable because it may lead to better preservation of vein grafts [31, 32].

CABG appears to be superior to PCI in patients with severe multi-vessel diseases or left main involvement, and the survival benefit from CABG extends to older patients [33]. Age per se cannot represent a contraindication for surgical revascularization when it is needed.

In a meta-analysis, Shan et al. showed that CABG can increase health-related quality of life in the elderly population by increasing life expectancy from 17.1 years at 65 years old to 8.2 years at 80 years old [15].

The life expectancy of the elderly continues to increase in recent decades, leading to a change in how the "elderly" population is defined. Initially, it was categorized as individuals over 70 years old, then it evolved to include those over 75 and now over 80 years of age. Developed countries are experiencing an aging population. There is an increasing number of elderly or very elderly patients with complex coronary artery diseases who need CABG [34].

A recent analysis on the SYNTAX Extended Survival study demonstrates that in patients more than 70 years old who underwent PCI or CABG due to complex coronary artery disease, the risk of death at 10 years did not differ significantly between the two revascularization strategies [35].

The latest guideline mentioned that in older patients, as in younger ones, the revascularization strategy must be based on coronary details, cognitive function, life expectancy, and the patient's desire [36].

Therefore, a heart team approach and individual decision-making is the best strategy.

Limitation

Indeed, the results of this observational study are limited to the findings of surgery on elderly patients in one center with a limited number of cases in the elderly group. Therefore, more cases from multiple centers are needed for a more comprehensive decision-making process.

Conclusion

CABG should be considered as a feasible method of revascularization for elderly patients with reasonable operative risk according to heart team consultation.

Conflict of interest

None

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