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Original Article

Age Factor Influencing on Patients Subjected to Coronary Artery Bypass Grafting

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Abstract

Objective: To study age-dependent trends in long-term survival with its predictors in patients who underwent isolated CABG.

Methods: 177 consecutive patients, operated on within 2014 were included in our study. The patients were divided into two age groups for the purposes of the statistical analysis: <60 year's (*n*=96), and ≥60 years (*n*=81). The mean age was 54.5±2.9 year's in the group of <60 years, whereas 63.6±2.5 in the ≥60 years. In both groups, the impact of the prevalence of comorbidities, severity of coronary lesion, revascularization degree (complete/incomplete) on postoperative outcome was assessed. Furthermore, the whole predictors of mortality were identified according to both age groups by means of multivariate analysis. End point of this study was overall survival. All data were obtained from patients' medical, out-patient follow-up records, operative reports.

Results: The mean follow-up of the overall cohort was 5.1±1.7 years. Chronic pulmonary disease, extracardiac arteriopathy, and neurologic dysfunction disease were significantly less frequent in the group of <60 years, whereas the prevalence of BMI ≥30, unstable angina, previous myocardial infarction, and preoperative severe depressed left ventricular ejection fraction were significantly higher in this population. At 5 years follow-up, survival rate was 94.8% in patients under 60 years (5 patients), 90.1% (8 patients) in those aged 60 and more year's (p<0.001). By multivariate analysis, previous myocardial infarction, chronic renal failure, diabetes, chronic pulmonary disease, extracardiac arteriopathy and left main coronary artery disease were considered as independent predictors of mortality. The area under the receiver operating characteristic curve was 0.834 (p<0.001, 95% CI: 0.724-0.902).

Conclusion: Despite the coronary artery bypass grafting are more secure for both groups, a strict attention should be focused in order to design and improve preventive strategies aiming to reduce the impact of specific cardiovascular risk factors on younger patients, such as diet, lifestyle, weight control and more aggressive medical therapy. The reasonable revascularization strategy with its underscored threshold for elderly patients with multivessel and left main coronary artery diseases, potential risk factors for death as concomitant pathologies should be elaborated.

Keywords: Coronary artery bypass grafting; Coronary artery disease; Multivessel disease

Introduction

Considering the increase in life expectancy of the world population in general in recent decades and the prevalence of cardiovascular diseases among the elderly, the percentage of this population who needs cardiovascular surgery is increasing, including those who have reached or exceeded the average life expectancy for Uzbekistanians (72 years of age) [1]. Meanwhile, major surgeries in elderly populations, such as cardiac surgeries (especially those 65 years of age or older), are associated with high morbidity and mortality, while aging simultaneously results in the reduction of functional reserves of various organs and systems [2]. The prevalence of other comorbidities among the elderly is high [3].

With regard to young patients, premature Coronary Artery Disease (CAD) is a rapidly progressive form of the disease [4]. Numerous studies reported that young patients with CAD have a significant prevalence of classic cardiovascular risk factors [5,6], and that the premature clinical onset of their symptoms can be more aggressive than in elderly patients [7]. In fact, young adults who undergo coronary artery revascularization are a specific subpopulation of patients, and there have been few studies on survival data, cardiovascular events [8]. Young patients undergoing Coronary Artery Bypass Grafting (CABG) demonstrate survival rates similar to those of Percutaneous Coronary Intervention (PCI), but lower rates of repeated revascularization [9]. There are few long-term reports of the impact of age stratification on CABG outcomes both for young and elderly patients.

The aim of our study was to investigate age-dependent trends in long-term survival with its predictors in patients who underwent isolated CABG.

Methods

Within 2014, data of all patients undergoing coronary CABG in Republican Specialized Center of Surgery (Tashkent, Uzbekistan) were gathered. All data were obtained from patients medical, out-patient follow-up records, operative reports. The requirement for

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individual patient consent was waived because of the retrospective design of the study and because data were collected from routine care procedures. All data were anonymized and deidentified prior to statistical analysis.

Exclusion study criteria were emergency, cardiogenic shock, associated valve surgery procedures, major aortic surgery, and supra-aortic vessels disease requiring surgery. After these exclusions, we filtered 177 patients subjected to isolated CABG. The patients were divided into two age bands for the purposes of the statistical analysis: <60 years (*n*=96), and ≥60 years (*n*=81).

Decisions about the type of treatment were taken according to local practices and there were no standard regional protocols. The choice of CABG technique, performed either with the use of extracorporeal circulation or off-pump, was left to the surgeon's discretion. Whenever possible, the left internal thoracic artery was used preferentially for revascularization of the Left Anterior Descending artery (LAD). Complete revascularization was performed with other arterial conduits, namely, radial artery or and saphenous vein grafts. Follow-up angiography was not performed routinely in either group of patients. All-cause death included overall mortality occurring during the index hospital admission or thereafter. Cardiac death was defined as any death due to a cardiac cause (e.g., Myocardial Infarction (MI), low output failure, and fatal arrhythmia), and other types were procedure-related death and death of unknown cause.

Statistical Analysis

Demographic and clinical features of the patients were presented as counts, percentages, and were compared between the two age classes, using the Chi-square test. Independent predictors of 5 years mortality risk were estimated using a stepwise multivariable Cox proportional hazards model. All the analyses were performed with SPSS version 22.0.

Results

The entire study cohort showed that patient risk profiles differed significantly between the groups (Table 1). The prevalence of patients under 60 is 54.2% (96 of 177 patients). Patients over 60 show a significantly higher prevalence of baseline comorbidities. In particular, serum creatinine, diabetes, chronic pulmonary disease, systemic arterial hypertension, extracardiac arteriopathy, and neurologic dysfunction disease were significantly less frequent in this younger population (Table 1).

On the other hand, the prevalence of Body Mass Index (BMI) ≥30 Kg/m2, unstable angina, Previous Myocardial Infarction (PMI) was higher in the group of <60 year's than in patients aged 60 and more year's. Moreover, patients <60 reported more frequently a preoperative severe depressed Left Ventricular Ejection Fraction (LVEF), although this was not statistically significant (p=0.147). We found that coronary revascularization was performed off-pump more frequently in patients over 60, whereas patients under 60 received more frequently on pump total arterial revascularization (p<0.001) (Table 1).

Analysis of the coronaroangiography results showed that the most pronounced changes in the coronary bed were detected in patients over 60 years. Multivessel disease in patients of the latter group significantly prevailed over that of <60 years group. (96.3%, 89.6% respectively). Moreover, left main coronary artery disease was observed significantly 3,7 times more in patients over 60 (Figure 1).

Patients characteristics		<60 yrs (n=96)%	≥60 yrs (n=81)%	p
Age		54.5±2.9	63.6±2.5	<0.001
Male, n (%)		82 (85.4)	71 (90.1)	<0.0001
BMI ≥ 30 kg/m2, n (%)		24 (25)	17 (20.9)	<0.0001
Urgency, n (%)		1(1)	-	=0.038
Unstableangina, n (%)		15 (15.6)	12 (14.8)	<0.0002
III/IV CCS class, n (%)		74 (77)	67 (82.7)	<0.0001
LVEF (%)		51.3±6.5	51.1±6.5	=0.147
LV Dysfunction, n (%)	Severe (EF 30-44%)	19 (19.8)	14 (17.3)	=0.45
	Moderate (EF 45-54%)	41 (42.7)	35 (45.6)	
	Mild (EF≥55%)	36 (37.5)	28 (37.0)	
III/IV NYHA class, n (%)		10 (10.4)	9 (11.1)	<0.001
Previousmyocardialinfarction, n (%)		44 (45.8)	35 (43.2)	<0.0001
Serum creatinine ≥177 mmol/l, n (%)		3 (3.1)	5 (6.1)	=0.037
Diabetes, n (%)		18 (18.7)	16 (21)	<0.0001
SAH, n (%)		64 (66.7)	66 (81.5)	=0.824
Chronicpulmonarydisease, n (%)		1 (1)	2 (2.5)	<0.0001
Extracardiacarteriopathy, n (%)		3 (3.1)	5 (6.2)	<0.0001
Neurologicaldysfunctiondisease, n (%)		-	2 (2,5)	=0,048
Off-pump		4 (4.2%)	10 (12.3%)	<0.001
Previous PCI		1 (1)	-	<0.001
CPB time (min)		93.98±23.72	88.81±16.67	=0.035

Table 1: Baseline characteristics and preoperative clinical data of patients according to different age classes.

BMI: Body Mass Index; CCS: Canadian Cardiovascular Society grading of angina pectoris; LVEF: Left Ventricular Ejection Fraction; NYHA: New York Heath Association; SAH: Systemic Arterial Hypertension; PCI: Percutaneous Coronary Intervention; LMCA: Left Main Coronary Artery; CPB: Cardiopulmonary Bypass

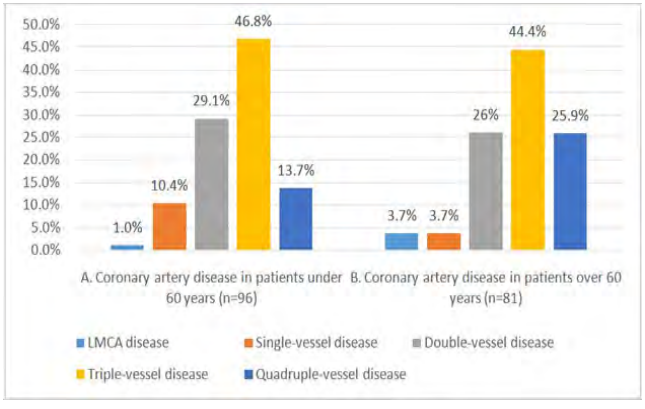

Figure 1: Coronaroangiography data (n=177).

According to the study data, patients of the both groups mostly experienced a triple-vessel disease. The latter disease was identified more often in both groups with concomitant diabetes (43.7% and 44.4% respectively). On top of that, a quadruple-vessel disease occurred in 25% patients of ≥60 years who had diabetes.

As shown in table 2, LAD was mostly exposed to atherosclerotic stenosis in both groups. Circumflex artery lesions were more often found in patients ≥60 years old in comparison to ≥60 years old, 17% and 12%, respectively, while right coronary artery lesions were more common in patients <60 years old compared to ≥60 years old, 11% and 8 %, respectively.

Coronary artery disease	<60 yrs	≥60 yrs	p
	Total lesions (n=250)	Total lesions (n=232)	
LAD, n (%)	95 (31%)	80 (34.5%)	<0.001
DA, n (%)	14 (4%)	18 (7.7%)	<0.001
Cx, n (%)	29 (11.6%)	40 (17.2%)	<0.001
OM-1, n (%)	36 (14.4%)	28 (12%)	<0.001
OM-2, n (%)	2 (1%)	4 (1.7%)	<0.001
AI, n (%)	11 (4.4%)	8 (3.4%)	<0.001
RCA, n (%)	27 (10.8%)	19 (8.1%)	<0.001
PDA, n (%)	36 (14.4%)	35 (15%)	<0.001
Complete arterial grafts revascularization, n (%)	87 (90.6)	68 (83.4)	<0.0001

Table 2: Types and quantity of coronary artery disease.

LAD: Left Anterior Descending Artery; DA: Diagonal Artery; Cx: Circumflex artery; OM-1: Obtuse Marginal-1 artery; OM-2: Obtuse Marginal-2 artery; AI: Intermedia Artery; RCA: Right Coronary Artery; PDA: Posterior Descending Artery

Table 3 reports multivariate analysis with significant independent predictors of mortality at 5 years. The area under the receiver operating characteristic curve was 0,834 (P<0.001, 95% CI: 0.715-0.914).

Parameter		HR	95% CI of HR	*P*
<60 years old	Previousmyocardialinfarction	1.7	1.1-1.6	=0.0048
≥60 years old	Serum creatinine ≥ 177 mmol/l	2.5	1.5-3.2	<0.0002
	Diabetes	1.8	1.3-1.8	<0.0002
	Chronic pulmonary disease	2.1	1.3-2.5	<0.0005
	Extracardiac arteriopathy	1.9	1.4-2.1	<0.0001
	LMCA disease	2.7	1.2-4.4	=0.023

Table 3: Predictors for 5-year's mortality risk (Cox proportional hazards model).

CI: Confidence Interval; HR: Hazard Ration; LMCA: Left Main Coronary Artery

As given in figure 2, despite the indication to operation, few patients of <60 (6.3%) and ≥60 (16%) did not undergo CABG due to multiple risk factors and severity of atherosclerotic disease, consequently ≥60 aged patients 9.7% less operated in comparison to the patients group of <60 (p<0.05). Besides complete revascularization was carried out in the group of ≥60 aged on 7.2 % less than in that of <60 (p<0.05).

The mean follow-up of the overall cohort was 5.1±1.7 years. At follow-up, survival rate was 94.8 % in patients under 60 years (5 patients), 90.1% (8 patients) in those aged 60 and more years.

Discussion

Recent studies conducted in Western Countries have found that the incidence of CAD has declined in the general population over the last few decades [10,11], probably due to better prevention of cardiovascular risk. On the other hand, the incidence of CAD, including acute coronary artery syndromes, among young to middle-aged adults has been shown to have increased [12]. Previous studies of CAD in young adults have mostly been single-center analyses [7,8], and few have been designed with the aim of studying young patients undergoing coronary revascularization [6,8,9,13-15].

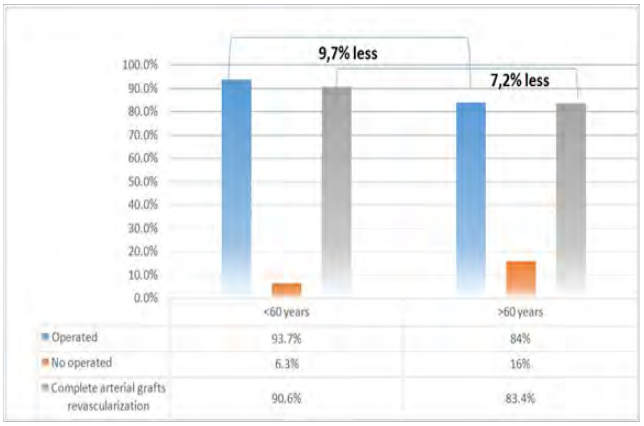

Figure 2: Percentage of operated/no operated patients, complete revascularization of both groups (n=177).

The aim of our retrospective study was to investigate age-dependent trends in mortality in a population of patients undergoing isolated CABG. The main findings of this study are as follows. Of particular interest is that at 5 years the <60 group who underwent CABG reported unadjusted significantly lower long-term mortality than older patients (5.2% versus 9.9%).

It is well known that cardiovascular risk factors vary with regard to their impact on age of presentation with CAD. Our study confirms that patients younger than 60 have a different clinical pattern of presentation of CAD in comparison with elderly patients. Particularly, obesity, the history of previous myocardial infarction, the presence of depressed LVEF, and a history of previous PCI have been found to be highly prevalent among patients <60, confirming the results of a recent study by Moussa et al., [16]. Obesity has already been recognized as an independent risk factor for CAD [17] and recently a close association between severity of obesity, measured by BMI >30 kg/m2, and a progressive reduction in the mean age of patients with symptomatic CAD has been demonstrated [18]. In particular, abdominal obesity has been found to be closely associated with the risk of myocardial infarction [19] and this is observed more often in men [20,21]. On the basis of these observations and our results, it is reasonable to postulate that the risk of CAD due to obesity may be higher in men than women. On the other hand, systemic comorbidities usually associated with severe CAD, such as chronic pulmonary disease, diabetes, stroke, and extracardiac arteriopathy in our study, proved to be less frequent in patients aged <60. This is consistent with the previous international literature [22,23] and may be explained by the fact that the onset of diabetes mellitus and systemic hypertension usually occurs later in life, and their effect on the pathogenesis of CAD may require several years or decades to become clinically evident. Obviously, in terms of our data, the accumulation of these concomitant pathologies explains the higher rate of off-pump bypass grafting in elderly group. The purpose of this study was not to

primarily investigate the risk factors determining premature CAD, but our findings clearly confirm that the pathogenesis of coronary artery disease remains complex and that both genetic and environmental factors contribute to the early onset of coronary artery disease.

Long-term mortality was considerably lower in patients <60 years than in patients ≥60, and this result is consistent with mortality rates reported in previous studies of young patients undergoing CABG [9,12,16,24]. In fact, in our study multivariate analysis confirmed that all classic clinical cardiac conditions and systemic comorbidities (history of previous myocardial infarction in the younger group, whereas, chronic renal failure, diabetes, chronic pulmonary disease, extra-cardiac arteriopathy, and left main coronary disease in the elderly group) are independent risk factors for mortality at 5 years.

The significantly lower rate of extracardiac arteriopathy reported in younger patient subgroups may also partly explain the significantly better stroke rates in patients under 60.

Of particular interest is that multivessel disease in patients of the ≥60 years group significantly prevailed over that of <60 years group that coincides with previous study [25]. Basing on our data results, ≥60 aged patients were conducted CABG 9.7% less in comparison to the patients' group of <60. This may be explained by the fact that the incidence of significant arterial calcification increases with age, raising the complexity of operation [26]. Due to severe diffuse coronary lesion, incomplete revascularization was higher in ≥60 years group that may consistent with a lower survival rate as demonstrated in the latest study [27].

Conclusion

To conclude, CABG is safe and effective for both groups. Nevertheless, to increase the durability (considering not only the survival rates, but also the influence of the outcomes of surgery on quality of life) of myocardial revascularization, a strict attention should be focused in order to design and improve preventive strategies aiming to reduce the impact of specific cardiovascular risk factors on younger patients, such as diet, lifestyle, weight control, and more aggressive medical therapy. On top of that more often elderly patients are not capable of being operated due their complicated coronary anatomy that induces us to work out the strategy and borderline of the need for surgery. The reasonable revascularization strategy, with its underscored threshold for elderly patients with multivessel and left main coronary artery diseases, concomitant pathologies determined as potential risk factors for death, should be also elaborated.

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