Rev Bras Cir Cardiovasc 2013;28(1):22-8

Impact of coronary artery bypass grafting in elderly patients

Impacto da cirurgia de revascularização do miocárdio em pacientes idosos

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DOI: 10.5935/1678-9741.20130005

RBCCV 44205-1438

Abstract

Objective: **To analyze the results of isolated on-pump coronary artery bypass graft surgery (CABG) in patients ≥ 65 years-old.**

Methods: **Patients undergoing isolated on-pump CABG from December 1st 2010 to July 31th 2012 were divided in two groups: GE (elderly ≥ 65 years-old, n=103) and GA (adults < 65 years-old, n=150). Preoperative data, intraoperative (as cardiopulmonar bypass time, aortic clamping time, time length of stay in mechanical ventilation - MV - and number of grafts), and postoperative variable (as morbidity, mortality and time length of stay in hospital) were analyzed during hospitalization.**

Results: **In GE, the morbidity rate was greater than in GA (30% *vs*. 14%, P=0.004), but there was no difference in the mortality rate (5.8% *vs*. 2.0%, *P*=0.165). In GA, there was higher prevalence DM (39.6% *vs*. 27%, *P*=0.043) and smoking (32.2% versus 19.8%, *P*=0.042); and in GE, higher prevalence of stroke (17% vs. 6.7%, *P*=0.013). There was no difference between the groups regarding intraoperative variables. After multivariate analysis, age ≥ 65-year-old was associated with greater morbidity, but it was not independent predictive factor for in-hospital mortality. Considering in-hospital mortality, stay in ward time length (*P*=0.006), cardiac (*P*=0.011) and respiratory complications (*P*=0.026) were independent predictive factors.**

Conclusion: **This study suggests that patients ≥ 65-year-old were at increased risk of postoperative complications when submitted to isolated on-pump CABG in comparison to patients < 65-year-old, but not under increased risk of death.**

Descriptors: **Myocardial revascularization. Elderly. Hospital mortality. Postoperative complications.**

Resumo

Objetivo: **Analisar os desfechos da cirurgia de revascularização do miocárdio (CRM) isolada com circulação extracorpórea em pacientes com idade ≥ 65 anos em comparação àqueles com < 65 anos.**

Métodos: **foram analisados 253 pacientes submetidos consecutivamente à CRM isolada entre 1º de dezembro de 2010 a 31 de julho de 2012. Os pacientes foram separados em dois grupos: GI (idosos ≥ 65 anos) e GA (adultos < 65 anos).**

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Supported by FUNADESP, Sao Paulo/Brazil, protocol number 5500255.

Article received on October 30th, 2012
Article accepted on December 18th, 2012

Abbreviations, Acronyms & Symbols	
AMI	Acute myocardial infarction
CABG	Coronary artery bypass grafting
CAD	Coronary artery disease
CAT	Coronary arteriography
CHF	Chronic heart failure
CPB	Cardiopulmonary bypass
CRF	Chronic renal failure
DM	Diabetes mellitus
GA	Group of adult (patients < 65years-old)
GE	Group of elderly (patients ≥ 65years-old)
ICU	Intensive care unit
MV	Mechanical ventilation
PVD	Peripheral vascular disease
SD	Standard deviation
SPSS	Statistical Package for the Social Science

Foram analisadas variáveis pré-operatórias, intraoperatórias (tempo de CEC, tempo de pinçamento aórtico, tempo de submissão à VM e número de enxertos) e pós-operatórias (morbidade, mortalidade e tempo de internação).

Resultados: **Dos 253 pacientes, 103 pertenciam ao GI (40,7%) e 150 ao GA (59,3%). A taxa de morbidade foi significativamente maior no GI quando comparada ao GA (30% *vs*. 14%, *P*=0,004), porém não houve diferença na taxa de mortalidade (5,8% *vs*. 2,0%, *P*=0,165). No GA havia maior prevalência DM (39,6% vs. 27%, *P*=0,043) e tabagismo (32,2% *vs*. 19,8%, *P*=0,042); e no GI, maior prevalência de acidente vascular encefálico prévio (17% *vs*. 6,7%, *P*=0,013). Não houve diferença entre os grupos quanto às variáveis intraoperatórias. Na análise multivariada: tempo de internação na enfermaria (*P*=0,006), complicações cardíacas (*P*=0,011) e complicações respiratórias (*P*=0,026) foram variáveis preditoras de risco para maior mortalidade intra-hospitalar. No entanto, a idade ≥ 65 anos não foi um fator preditor de risco associada a variável óbito.**

Conclusão: **Este estudo sugere que pacientes com idade igual ou superior a 65 anos possuem um maior risco de complicações intra-hospitalares no pós-operatório de CRM isolada com CEC em comparação com pacientes mais jovens.**

Descritores: **Revascularização miocárdica. Idoso. Mortalidade hospitalar. Complicações pós-operatórias.**

INTRODUCTION

The growth of the elderly population, in absolute and relative numbers, is a worldwide phenomenon and is occurring at an unprecedented level. Currently, one in ten people aged 60 or older. In year 2050, it is estimated that the ratio will be one to five in the world, and one to three in developed countries. In Brazil, life expectancy has increased more than ten years (62.57 years to 73.17 years) and it is estimated that in 2050, the Brazilian population over 15% of people have 70 years or older [1].

Advanced age is a risk factor for development of coronary artery disease (CAD), diabetes mellitus, hypertension, dyslipidemia, smoking, obesity and family history of CAD. Elderly population has greater prevalence of CAD, and more inclinable to major coronary procedures as coronary artery bypass surgery (CABG). Additionally, cardiovascular disease is the major factor contributing to death, especially in elderly [2-4].

CABG is a safe procedure performed around the world with low rates of mortality and morbidity in the general population. The number of octogenarians undergoing CABG increased from 0.13%, in 1986, to 3.5%, in 2001, at the Heart Institute of the Clinical Hospital of the Faculty of Medicine, University of São Paulo, the last 16 years (1986-2001) [5]. Thus, recent studies demonstrate the concern of evaluating the outcomes of CABG in elderly patients and comparison with younger individuals to verify the risks to which the elderly are more vulnerable because they are considered high risk patients for this surgery [6,7].

Another important fact is that in the last decade, there have been many changes in surgical techniques, such as the advent of minimally invasive surgery, off-pump CABG, and new devices. Thus, the indication of CABG for elderly patients is increasing because it provides better survival and quality of life [8-12].

The aim of this study was to analyze the outcomes of CABG in patients aged 65 years or older compared with younger patients (<65 years) at a regional reference hospital in Southern Brazil.

METHODS

The project was approved by the Research Ethics Committee of the Hospital Associação de Caridade Santa Casa Rio Grande (RS, Brazil) under protocol number 001/2011.

This is a prospective study in which all patients who consecutively underwent CABG alone between 1st December 2010 to 31th July 2012 were analyzed at the Cardiology Hospital Doutor Pedro Bertoni of the Associação de Caridade Santa Casa Rio Grande (RS / Brazil). Patients undergoing CABG or associated with other cardiac surgery were excluded from the study. We included patients who needed surgery elective and urgent or emergency according to the criteria of the American Heart Association and the American College of Cardiology. Patients were divided into two groups, the group of elderly (GE) consisted of patients aged greater than 65 years and the adult group (GA) with patients under the age of 65. Data were collected daily directly from medical records and interviews with patients since its admission to discharge through a pre-structured form. All patients were elucidated on the research and signed an informed consent form.

The variables collected from the medical records and through interviews with patients were: sex, age, weight, height, race, comorbidities, prior CABG, prior coronary angiography, angioplasty surgery, sedentary lifestyle, smoking, alcohol consumption, number of grafts, time CPB, aortic clamping time, time of submission to mechanical ventilation (MV), length of stay in the Intensive Care Unit (ICU) and in the ward, postoperative complications and progression to hospital discharge or death.

The data were analyzed with the Statistical Package for Social Science (SPSS, version 13.0, Inc., Chicago, IL, USA). Continuous variables were expressed as means and standard deviations (SD), while categorical variables by proportions. Normality was checked using the Kolmogorov-Smirnov test. In the statistical analysis we used the Student t test to compare the means, and the chi-square or Fisher exact test to compare proportions. To determine which factors independently influence the development outcomes of the study was analyzed using multivariate logistic regression "stepwise forward". To verify the correlation between risk factors preoperative, intraoperative variables, postoperative variables and mortality was used the Spearman test. In all analyzes were considered significant when $P < 0.05$.

RESULTS

During the study period, 253 consecutive patients submitted isolated on-pump CABG was assigned either Elderly Group (GE, n=103, 41%) or Adult Group (GA, n=150, 59%). The clinical and demographic characteristics of the patients are summarized in Table 1, which demonstrates a higher prevalence of males in both groups: GE = 61% and GA = 70%; no difference regarding gender, history of CAD in the family, hypertension, alcohol consumption, sedentary lifestyle, acute myocardial infarction (AMI), coronary angiography (CAT), previous angina pectoris, previous peripheral vascular disease (PVD), previous CABG, chronic renal failure (CRF) and failure chronic heart failure (CHF) and dyslipidemia. However, patients in the GA had a higher prevalence of diabetes mellitus (DM) (39.6% ***vs***. 27%, *P*=0.043) and smoking (32.2% *vs*. 19.8%, *P*=0.042), whereas the GE patients had a higher prevalence of stroke prior (17% *vs*. 6.7%, *P*=0.013).

Table 2 shows the results of the surgery. There was no significant difference in mortality between the groups (*P*=0.165), but the rate of hospital morbidity was significantly higher in GE (30% *vs*. 14%, *P*=0.004).

Table 1. Clinical and demographic preoperative characteristics.

	GA (150)	GE (103)	*P*
Male (%)	70	61	0.175
Age (mean ± SD years)	57 ± 6	72 ± 5	0.000
Hypertension (%)	81.2	79	0.745
DM (%)	39.6	27	0.043
CAD family history (%)	68	61.6	0.339
Smoking (%)	32.2	19.8	0.042
Alcoholism (%)	23.6	20	0.536
Sedentary Lifestyle (%)	68.2	67	0.890
Previous AMI (%)	49.7	45	0.518
Previous CAT (%)	27.7	24	0.558
Previous stroke (%)	6.7	17	0.013
Angina pectoris (%)	72.3	75	0.663
PVD (%)	12.2	10	0.685
Previous CABG (%)	3.4	3	1.000
CRF (%)	5.4	9	0.310
CHF (%)	13.5	8	0.221
Dyslipidemia (%)	42.9	50	0.299

GA= adult group; GE= elderly group; DM= diabetes mellitus; CAD= coronary artery disease; AMI= acute myocardial infarction; CAT= coronary arteriography; PVD= peripheral vascular disease; CABG= coronary artery bypass grafting; CRF= chronic renal failure; CHF= chronic heart failure

Table 2. Surgical outcomes.

	GA (150)	GE (103)	*P*
Mortality (%)	2.0	5,8	0.165
Morbidity (%)	14	30	0.004
Complications categories:			
Respiratory (%)	2	5	0.277
Cardiac (%)	8	13	0.191
Gastrintestinal (%)	0	3	0.066
Neurological (%)	0	2	0.165
Other (%)	4	7	0.389

GA= adult group; GE= elderly group

Complications were divided into five categories: (1) pulmonary complications: respiratory infection, (2) cardiac complications: arrhythmia, cardiac arrest, reinfarction, precordial pain and atrial fibrillation, (3) gastrointestinal complications: abdominal distension, (4) neurological complications: stroke, and (5) other complications: increased postoperative bleeding, mediastinitis, septic shock and sternal instability. There was no significant difference between the categories of complications comparing the groups.

Intraoperative data, MV and length of stay for both groups are shown in Table 3. There was no significant difference between groups in the time length of stay on MV <24 hours (*P*=0.096), MV between 24 and 48 hours (*P*=0.071) and MV> 48 hours (*P*=1.000); time of CPB (*P*=0.334) and aortic clamping (*P*=0.214), number of grafts (*P*=0.412), length of stay in ICU (*P*=0.140) and total time in hospital (*P*=0.144). However, the GE patients had more days hospitalized than patients in GA (*P*=0.036).

In Table 4, we analyzed the in-ICU and total in-hospitalization time in the two groups. In-ICU ≥ 5 days was greater in GE group (*P* = 0.010), but there is no difference in total in-hospital time between groups (*P* = 0.141).

After univariate analysis, the risk factors associated with hospital mortality were chronic renal failure, dyslipidemia, lin-ICU time ≥ 5 days, in-ICU time, in-ward time, MV for more than 24 hours, CPB time, cardiac and respiratory complications. However, the age ≥ 65 years was not a risk factor (Table 5).

After multivariate logistic regression analysis, the in-ward time (*P*=0.006), cardiac complications (*P*=0.011) and respiratory complications (*P*=0.026) were predictors of risk (*P*≤0.05) for hospital mortality (Table 6).

In GE, we found that hospital mortality was positively correlated with length of stay in ICU ≥ 5 days (*P*=0.008), MV ≥ 48 hours (*P*<0.001), postoperative complications (*P*<0.001) and cardiac complications (P=0.004). Already in GA, hospital mortality showed positive correlation with DM (*P*=0.031), chronic renal failure (*P*=0.030), dyslipidemia (*P*=0.044), MV ≥ 48 hours (*P*=0.029), postoperative complications (*P*<0.001) and respiratory complications (*P*<0.001).

Table 3. Intraoperative data, mechanical ventilation and length of stay.

		GA (150)	GE (103)	*P*
MV 24 hours (%)		80	70	0.096
MV > 24and ≤ 48 hours (%)		15	25	0.071
MV > 48hours (%)		5.3	5	1.000
CPB (mean ± SD, minutes)		63 ± 19	60 ±16	0.334
Aortic clamping time (mean ± SD, minutes)		40 ± 14	37 ± 12	0.214
Grafts (%)	1	12.7	7.8	
	2	40.7	36.9	0.412
	3	34	42.7	
	4	12.7	12.6	
Lenght of stay in ICU (mean ± SD, days)		3.74 ± 3,91	4.60 ± 5.27	0.140
Lenght of stay in ward (mean ± SD, days)		5.71 ± 2.57	6.48 ± 3.23	0.036
Total time in-hospital (mean ± SD, days)		10.28 ± 5.79	11.48 ± 7.09	0.144

GA= adult group; GE= elderly group; MV= mechanical ventilation; CPB= cardiopulmonary bypass; ICU= intensive care unit

Table 4. Results of the length of stay in the ICU and total time in-hospital.

	GA (150)	GE (103)	*P*
Lenght of stay in ICU ≥ 5 days (%)	14.8	28.7	0,010
Total time in-hospital ≥ 11 days (%)	22.1	30.7	0.141

GA= adult group; GE= elderly group; ICU= intensive care unit

Table 5. Univariate analysis.

Variable	OR	IC	*P*
Age ≥ 65 anos	3.031	0.740 – 12.407	0.123
BMI	0.941	0.789 – 1.124	0.503
Gender	1.610	0.421 – 6.157	0.487
CAD	1.064	0.191 – 5.931	0.943
Grafts			0.038*
DM	3.927	0.705 – 21.887	0.119
Smoking	2.797	0.550 – 14.212	0.215
Alcoholism	1.783	0.318 – 10.002	0.511
Sedentary lifestyle	0.951	0.171 – 5.305	0.955
Previous AMI	1.095	0.217 – 5.532	0.913
Previous CAT	1.421	0.254 – 7.945	0.689
Previous stroke	1.662	0.187 – 14.776	0.649
Angina pectoris			0.346*
PVD	4.154	0.725 – 23.795	0.110
Hypertension	1.231	0.141 – 10.781	0.851
Previous CABG			0.999*
CRF	5.675	1.020 – 31.578	0.047
CHF	4.154	0.725 – 23.795	0.110
Dyslipidemia			0.009*
Lenght of stay in ICU ≥ 5 dias	7.174	1.655 – 31.103	0.008
Lenght of stay in ICU	1.091	1.018 – 1.170	0.014
Lenght of stay in ward	0.499	0.337 – 0.737	< 0.001
Total time in-hospital	1.030	0.944 – 1.123	0.509
Total time in-hospital ≥ 11 days	1.800	0.418 – 7.754	0.430
MV > 24 hours	4.101	1.065 – 15.784	0.040
Time in CPB	1.047	1.014 – 1.081	0.005
Aortic clamping time	1.036	0.993 – 1.081	0.104
Cardiac complications	8.960	2.227 – 36.048	0.002
Respiratory complications	11.333	1.934 – 66.405	0.007
Other complications	2.417	0.279 – 20.920	0.423
Gastrintestinal complications			0.999*
Neurological complications			0.999*

*BMI= body mass index; CAD= coronary artery disease; DM= diabetes mellitus; AMI= acute myocardial infarction; CAT= coronary arteriography; PVD= peripheral vascular disease; CABG= coronary artery bypass grafting; CRF= chronic renal failure; CHF= chronic heart failure; ICU= intensive care unit; MV= mechanical ventilation; CPB= cardiopulmonary bypass; * Fisher exact test*

Table 6. Predictive factors of hospital mortality by logistic regression analysis.

	OR	IC95%	*P*
Lenght of stay in ward	0.542	0.350 – 0.840	0.006
Cardiac complications	10.580	1.722 – 64.999	0.011
Respiratory complications	12.819	1.352 – 121.586	0.026

DISCUSSION

This study in patients undergoing CABG alone suggests that patients aged ≥ 65 years are subject to greater risk of postoperative complications than patients under 65, but there was no difference between the mortality rate between the groups.

Regarding to mortality rate, a study examining predictors of hospital mortality in patients undergoing CABG in acute myocardial analyzed that advanced age is a risk factor related to mortality [13]. Rocha et al. [14] also reported on a study conducted at the National Institute of Cardiology of Rio de Janeiro that the variables: age ≥ 70 years, need for reoperation for revision of homeostasis,

sepsis and respiratory complications postoperatively were associated with hospital mortality. As well, in another study in Santa Catarina/Brazil, the authors found the same relationship [15]. In our study, we found that age ≥ 65 years was not a predictor of mortality, similar to other reported by Ng et al. [16] in a retrospective study with 1594 patients undergoing CABG alone, where no significant difference in hospital mortality between patients aged ≥ 70 years (5.4%) compared to those with less than 70 years (3.8%). Even after 30 days of surgery, the mortality of patients aged ≥ 70 years was 3.8% compared with 3.3% of patients aged <70 years (*P*<0.740).

The morbidity rate in hospital was higher in the GE compared to the GA. This data is in according to other study, which were also investigated the outcomes of CABG in elderly patients [14,17,18]. Pivatto et al. [19] observed that the morbidity rate was 34.4% in octogenarian patients undergoing CABG alone. We observed a morbidity rate of 30% in GE that was significantly higher compared to patients in the GA (14%). These data support the hypothesis that elderly patients have more postoperative complications.

In the GE, we founded that the prevalence of respiratory, cardiac, gastrointestinal, neurological, and other complications were higher compared to the GA, but there was no significant difference. Rocha et al. [14] observed that these complications were more developed for patients aged ≥ 70 years, which had more respiratory complications (21.4% *vs*. 9.1%, *P*<0.001), mediastinitis (5.1% *vs*. 1.9%, *P*=0.013), stroke (3.9% *vs*. 1.3%, *P*=0.016), acute renal failure (7.8% *vs*. 1.3%, *P*<0.001), sepsis (3.9% *vs*. 1.9%, *P*=0.003), atrial fibrillation (15.6% *vs*. 9.8%, *P*=0.016) and 3rd degree atrioventricular block (3.5% *vs*. 1.2%, *P*=0.023) in the postoperative period compared to patients < 70 years-old.

In a retrospective study, Machado et al. [5] reported 10% mortality rate in octogenarian patients undergoing CABG, and observed the occurrence of cardiac arrhythmias (especially atrial fibrillation), cerebrovascular, and respiratory complications in the postoperative period. In our study, the cardiac complications were also major postoperative complications (12.6%). However, it was followed by respiratory complications (4.9%), and a lower incidence of neurological complications (1.9%).

Anderson et al. [20] observed predictors of mortality in patients undergoing cardiac surgery comparing septuagenarians and octogenarians, there was no significant difference in mortality rate between the groups. As observed in our study, preoperative variables did not increase the risk to death, but researchers have shown that cardiopulmonary bypass time > 75 minutes has 3.2 times (CI: 1.3 - 7.9) greater chance of to death than patients with cardiopulmonary bypass time < 75 minutes, and postoperative variables such as prolonged mechanical ventilation above 12 hours, length of stay in ICU, reoperation, inotropic support more than 48 hours, and the need for blood products are associated with increased mortality. In this study, we found that postoperative variables such as length of stay in hospital, and cardiac and respiratory postoperative complications are associated with higher mortality, suggesting that patients who had postoperative complications remained more time hospitalized, increasing the risk of mortality hospital.

Recently, in a retrospective study [14] with 655 patients undergoing CABG, the authors observed that length of stay in ICU ≥ 3 days had positive correlation with death, but this study did not examine this relationship by age, and yes, total population sample. Our results show that length of stay ≥ 5 days had positive correlation with death in GE, emphasizing the importance of studies that evaluate the outcomes of CABG in elderly patients.

Analyzing the most recent data in the literature, there is disagreement about what age, in elderly patients, the morbimortality appears to be significantly higher compared to adult patients. We found studies that described their groups of elderly with age ≥ 65 years-old [12], ≥ 70 years-old [13-17], ≥ 75 years-old [6,21], ≥ 80 years-old [22] and ≥ 85 years-old [23]. Therefore we will suggest that more studies to be made in order to can to conclude in which age the risks factors of this surgery appear enlarged, whether preoperative, intraoperative or postoperative outcomes.

CONCLUSION

This study suggests that patients with 65 years old or more undergoing isolated on-pump coronary artery bypass surgery have a higher risk of postoperative complications in comparison with younger patients. The highest prevalence was heart complications, followed by respiratory complications; and lower prevalence of gastrointestinal and neurological complications.

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