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Risk factors in septuagenarians or elderly patients undergone coronary artery bypass grafting and or valves operations

Fatores de risco em septuagenários ou mais idosos submetidos à revascularização do miocárdio e ou operações valvares

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Abstract

Objectives: **Septuagenarians or older patients needing heart surgery has increased in whole world. The objective of study is to know the characteristics of this group of patients and determine the risk factors for operative morbidity.**

Methods: **We revised the medical records of 783 patients undergone heart valve surgery, myocardial revascularization or both between 2002 and 2007. The patients were divided in "control group" (<70 years) "septuagenarian group" (70 years old or more).**

Results: **One hundred ninety seven patients were at least 70 years old (mean age 74.1±3.9) and 61% were male. In the control group the mean age was 52.1±11.7 and 54% were male. In the septuagenarians group it was significantly higher the proportion of patients suffering from peripheral vascular disease (9% versus 5%, *P*=0.019), carotid artery obstruction (5% versus 2%, P=0.026), unstable angina (17% versus 9%, *P*=0.018). In both groups coronary artery bypass surgery prevailed. In the septuagenarian group 41% of the patients had a least one morbid event, versus 22% of the patients in the control group (*P*<0.001). Postoperative bleeding, pulmonary complications, mediastinitis, need of vasopressors, renal dysfunction and strokes were significantly higher in the septuagenarian group. The mortality was higher in the septuagenarian (19% versus 8.5%, *P*<0.001). The logistic regression revealed that COPD (OR: 8.6), EF < 35% (OR: 7,1), non-elective operation (OR: 17,2) and cardiopulmonary bypass time >120 min (OR: 3,4) were predictive of hospital mortality in septuagenarian or older patients.**

Conclusions: **The hospital mortality of septuagenarians or elderly is significantly higher than younger patients**

Descriptors: **Aged. Cardiac surgical procedures. Myocardial revascularization. Heart valves/surgery. Risk factors.**

Resumo

Objetivo: **Pacientes septuagenários ou mais idosos necessitando de cirurgia cardíaca vêm crescendo em todo mundo. O objetivo do estudo é conhecer melhor esse grupo de pacientes e determinar fatores de risco para morbidade operatória.**

Métodos: **Revisamos 783 pacientes submetidos a operações cardíacas valvares e de revascularização do miocárdio isoladas ou associadas no período de 2002 a 2007. Tais pacientes foram divididos em "grupo <70 anos de idade" e "grupo ≥70 anos de idade". Resultados: Cento e noventa e sete pacientes tinham 70 anos ou mais de idade (idade média 74,1 ± 3,9) e 61% eram do sexo masculino. No grupo ≥ 70 anos, foi significativamente maior o número de pacientes portadores de doença vascular periférica (9% versus 5%, *P*=**

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0,019), doença carotídea (5% versus 2%, *P*= 0,026) e angina instável (17% versus 9%, *P*= 0,018). Em ambos os grupos, a revascularização do miocárdio foi mais freqüente. No grupo ≥ 70 anos, 41% dos pacientes tiveram ao menos um efeito adverso, versus 22% do grupo <70 anos (*P*<0,001). A incidência de sangramento pós-operatório, complicações pulmonares, mediastinite, necessidade de vasopressores, disfunção renal e acidente vascular cerebral foi significativamente maior no grupo ≥ 70 anos. A mortalidade foi maior no grupo ≥ 70 anos (19% versus 8,5%, *P*<0,001). A regressão logística revelou que DPOC (OR: 8,6), FE (OR: 7,1), operação não eletiva (OR: 17,2) e tempo de circulação extracorpórea > 120 min (OR: 3,4) são preditores de mortalidade hospitalar no grupo estudado.

***Conclusões:* A mortalidade hospitalar em septuagenários ou mais idosos nas operações de revascularização miocárdica e valvares isoladas ou associadas é maior que nos pacientes mais jovens.**

***Descritores:* Idoso. Procedimentos cirúrgicos cardíacos. Revascularização miocárdica. Valvas cardíacas/cirurgia. Fatores de risco.**

INTRODUCTION

Considering the increase in life expectancy of the Brazilian and world population in general in recent decades, and the prevalence of cardiovascular diseases among the elderly [1], the percentage of this population who needs cardiovascular surgery is increasing [2], including those who have reached or exceeded the average life expectancy for Brazilians (72 years of age) [3]. Meanwhile, major surgeries in elderly populations, such as cardiac surgeries (especially those 70 years of age or older), are associated with high morbidity and mortality [4], while aging simultaneously results in the reduction of functional reserves of various organs and systems [5]. The prevalence of other comorbidities among the elderly is high [6-8].

We performed a preliminary analysis of age as a isolated risk factor for hospital mortality, and evaluated 227 patients who underwent heart surgery in the Clinics Hospital of the Ribeirão Preto Medical School of the University of São Paulo between January 2002 and December 2003 (data unpublished), and distributed these patients into 4 age groups (0 to 59 years, 60 to 64 years, 65 to 69 years and ≥ 70 years). The analysis showed us that only the age group with patients ≥ 70 years consisted of an isolated risk factor for death after cardiovascular surgeries (*P*=0007, odds ratio of 3.34). This age group accounted for 21.6% of patients in that period, with a mortality rate of 26.5%.

Therefore, as a result of the need to deepen the knowledge available about this age group, this study has been prepared in order to obtain demographic data of patients 70 and older undergoing cardiovascular surgeries and to determine risk factors for hospital mortality in the postoperative period by comparing them to younger patients.

METHODS

After approval by Research Ethics Committee of the Clinics Hospital of Ribeirão Preto Medical School (HCRP No 7223/2008), researchers analyzed clinical data from adult patients of both genders aged over 18 years who underwent cardiovascular surgeries from January 2002 to December 2007 at the HCFMRP-USP. The data for each patient are from the database of the Discipline of Thoracic and Cardiovascular Surgery and were prospectively collected. The study compared the morbidity and mortality of patients who were less than 70 years old to the morbity of patients aged greater than or equal to 70 years. We analyzed the risk factors for hospital death in the postoperative in patients 70 years of age or older who underwent isolated CABG using CPB and/or valve surgery. We performed a case-control study in which the patients who died were considered "cases" and the survivors were considered "control".

Statistical analysis

The data on demographic, clinics, intra-operative and postoperative characteristics are presented as mean ± standard deviation for continuous variables and as percentages for categorical variables. We verified whether the distribution of variables were normal or not using the Kolmogorov-Smirnov test. Comparisons between the 2 groups (≥ 70 years and <70 years) were performed using the Fisher exact test, the Student t-test or the Mann-Whitney test.

In order to find risk factors for postoperative hospital death, a univariate analysis using the Fisher exact test and multivariate analysis using logistic regression ("stepwise" with "backward-likelihood") were used. In addition, an ROC curve (Receiver Operating Characteristic Curve) was obtained for the predictive variables of hospital death, and the area under the curve was estimated, as well as the significance and confidence interval of the curve (95%).

The following variables were tested as isolated risk factors for postoperative mortality through logistic regression: gender, unstable angina, type of surgery (isolated CABG, isolated valve or association of both), obstruction of left coronary trunk ≥ 50% of the lumen, III/IV NYHA functional class, EF<0.35, diabetes mellitus, COPD, peripheral vascular disease (limbs and/or carotid),

prior ischemic stroke, renal failure, endocarditis, SAH, critical preoperative condition, smoking, myocardial infarction <30 days and > 30 days, systolic pulmonary arterial pressure ≥ 50 mmHg, CPB > 120 min, and previous non-elective heart surgery.

RESULTS

Clinical characteristics

In the aforementioned period, 783 patients underwent CABG, valve surgeries, or both surgeries during the same procedure. Of these patients, 197 (25%) were less than or equal to 70 years of age (≥ 70 years) and 586 were less than 70 years old (<70 years). Of the 197 patients in the ≥70 Group, 120 (61%) were male (versus 54% in <70 Group, *P*=0116). The mean age of the ≥ 70 Group was 74.1±3.9 years (versus 52.1 ± 11.7 in <70 Group, *P* <0001). The average BMI of the ≥ 70 Group was 25 ± 4 (versus 26±5 of the <70 Group, *P*=0005). Table 1 shows the clinical characteristics of each group. Isolated valve disease was significantly greater among the ≥ 70 Group. 65% of the older patients and 48% of the younger patients were in NYHA functional class III or IV (*P*=0041). 17% of the older patients and 5% of the younger patients had diabetes (*P*=0010). 10% of the older patients and 3% of the younger patients had COPD (*P*=0029). When we considered only coronary disease, we observed that it was significantly higher among the older group of patients. Among patients with coronary disease from both groups, 17% of the older patients and 9% of the younger patients had unstable angina (*P*=0028). 9% of the older patients and 4% of the younger patients had carotid disease (*P*=0028).

Table 1. Preoperative Clinical Characteristics of the Younger and Older Groups

	< 70 years 586(75%)	≥ 70 years 197(25%)	*P*
Age	52.1 ± 11.7	74.1 ± 3.9	< 0.001
Male	316 (54%)	120 (61%)	0.166
AF	92 (16%)	27 (14%)	0.728
Smoking	122 (21%)	21 (11%)	0.002
Diabetes	163 (28%)	58 (31%)	0.459
Renal failure	51 (9%)	20 (11%)	0.379
SAH	379 (65%)	130 (69%)	0.333
Stroke	38 (6%)	11 (6%)	0.864
COPD	24 (4%)	14 (7%)	0.080
Peripheral vascular disease	27 (5%)	18 (9%)	0.019
Obstructed carotid	13 (2%)	11 (5%)	0.026
Prior surgery	96 (16%)	16 (8%)	0.006
SAH	74 (12%)	15 (8%)	0.924
AMI<30 days*	20 (6%)	15 (10%)	0.084
AMI> 30 days*	152 (45%)	48 (34%)	0.025
Unstable angina*	31 (9%)	24 (17%)	0.018
LCT lesion*	45 (13%)	26 (18%)	0.161
EF	0.56 ± 0.14	0.53 ± 0.13	0.003
EF < 0,35	42 (7%)	12 (6,6%)	0.869
III/IV NYHA Class	164 (28%)	56 (30%)	0.642

**Only for patients with coronary disease*
AMI=acute myocardial infarction; AF=atrial fibrillation; LCT lesion= left coronary trunk lesion; PAH=pulmonary arterial hypertension; SAH=systemic arterial hypertension; Stroke; COPD=chronic obstructive pulmonary disease; IC=interventricular communication; Peripheral vascular disease; Carotid obstruction (carotid disease); LV=left ventricle

Operative Data

The types of heart surgeries performed in each group are summarized in Table 2. In both groups, isolated CABG was predominant, followed by isolated valve surgeries. However, the rate of isolated CABG associated with the correction of valve diseases was significantly higher in elderly group (< 70 years old). The proportion of patients who underwent non-elective surgery was higher among the older group: 11% in the older group versus 4% in the younger group (*P*=0011). But the rate of isolated valve surgeries was significantly higher in the younger group.

Table 3 shows the rate of non-elective procedures (urgent and emergency procedures) within the different types of surgery.

Table 2. Types of Cardiovascular Surgeries in the Younger and Older Groups

	< 70 years		≥ 70 years		
	N	%	N	%	*P*
CABG	309	53	122	62	0.026
Valve	250	43	53	27	<0.001
CABG+valve	27	4	22	11	0.002

Table 3. Distribution of Non-Elective Surgeries as Type of Surgery

	< 70 years Non-elective	≥ 70 years Non-elective	*P*
CABG	4%	11%	0.011
Valve	6%	2%	0.324
CABG+valve	11%	22%	0.440

Table 4. Time of CPB and Aortic Clamping in Heart Surgeries in Younger and Older Groups

	CPB time (min)			Aortic clamping time (min)		
	< 70 years	≥ 70 years	*P*	< 70 years	≥ 70 years	*P*
CABG	78.7 ± 56	77.1 ± 67	0.792	56.1 ± 38	55.3 ± 44	0.862
Valve	114.4 ± 52	111.6 ± 46	0.729	84.1 ± 39	81.7 ± 36	0.699
CABG+valve	149.8 ± 62	143.3 ± 38	0.673	107.2 ± 39	106.7 ± 47	0.971

As with the CABG surgeries, we noted that the use of the left internal thoracic artery was significantly greater in the younger group (86% versus 70% in the older group, *P*<0.001), as well as right internal thoracic artery (11% versus in the younger group vs. 1% in the older group, *P*<0.001) and left radial artery (48% in the younger group versus 32% in the older group, *P*=0002). The use of the saphenous vein grafts was predominant among the older group (81% versus 70% in the younger group, *P*=0.017).

Considering all surgeries involving CABG, we noted that the mean number of distal anastomoses was 2.7±0.9 anastomoses for younger group and 2.6±0.9 anastomoses for the older group (*P*=0.468, Mann-Whitney test). When we considered only isolated CABG, the mean number of distal anastomoses was 2.8± 0.9 for the younger group and 2.7±0.9 for the older group (*P*=0.766, Mann-Whitney test). In the older group, 22% of isolated CABG procedures were performed without CPB, but in the younger group, the proportion of off-pump CABG was 15% (*P*=0.118).

In surgeries to correct valve diseases - isolated or in combination with CABG - valve replacement was predominant in both groups (81% in the younger group and 83% in the older group, *P*=0.864). However, bioprostheses were predominant among older patients (73% versus 18% in the younger group, *P*<0001). Aortic valve replacement occurred in older patients at a rate of 50% versus 27% in younger patients, (*P*<0.001), with no differences in rate of patients who received mitral prosthesis (43% in the younger group versus 34% in the older group, *P*=0.214).

Table 4 presents the time of CPB and aortic clamping for each type of surgery in both groups. The comparison of time of CPB and aortic clamping by type of surgery also revealed no significant differences between the groups.

Postoperative Evolution

Regarding the postoperative evolution, we found that 41% of patients in the older group presented at least one postoperative adverse event, versus 22% in the group of patients younger than 70 (*P*<0.001). A significantly higher rate of patients in the older group presented bleeding that required a blood transfusion and/or re-operation (6% in the younger group versus 12% in the older group, *P*=0.018), as well as pneumonia (15% of older patients versus 6% of younger patients, *P*<0.001), ischemic stroke (6% of older patients versus 2.6% of younger patients, *P*=0.039), renal failure (10% of younger patients versus 19% of older patients, *P*=0.001), required invasive mechanical ventilation for a period longer than 48 hours (19% of the older group versus 7% of the younger gorup, *P*<0.001) and support from inotropic drugs (15% of the older group versus 9% of the younger group, *P*=0.030). There was no difference in the incidence of myocardial infarction around the time of surgery (5% in the younger group versus 7% in the older group, *P*=0.203) or infection in the operative site (2% in the younger group and 4% in the older group, *P*=0.314).

The overall mortality for the younger group was 8.5% and 19% for the older group (*P*<0.001). The mortality ranged depending on the type of surgery (Table 5).

Cardiac failure was the main cause of death in the younger group, because 46% of the deaths were related to such disease (*P*=0.012), followed by pulmonary causes 14% (infectious and non-pneumonic causes were at a rate of 12% and the failure of multiple organs and systems was at 10%). In the older group, respiratory complications were the main cause of death (24%), followed by cardiac causes (19%), infectious and non-pneumonic and neurological causes (13% each) and postoperative bleeding (11%).

Table 5. Mortality by Type of Surgery

	Mortality		
	< 70 years	≥ 70 years	*P*
CABG	6%	19%	<0.001
Valve	9%	13%	0.445
CABG+valve	29%	32%	1.0

Table 6 shows the isolated factors associated with hospital death (*P*<0.10, according to Fisher's test) tested by logistic regression. Table 7 shows the predictor factor of hospital death by logistic regression. The area under the ROC curve was 0.826 (*P*<0.001, 95% CI: 0.728-0.923).

Table 6. Isolated Risk Factors (Fisher's Exact Test)

	P	Odds ratio	Odds ratio Confidence interval 95%
Female	0.098	0.5	0.22-1.1
III/IV NYHA Class	0.083	2.1	0.93-4.8
Unstable angina	0.074	2.5	0.92-1.7
EF < 35%	0.079	3.4	0.89-13.0
Critical condition	0,.029	9.0	1.40-57.7
COPD	0.01	5.2	1.50-17.6
SAH	0.092	2.3	0.82-5.0
Late AMI	0.025	3.8	1.2-12.1
Non-elective surgery	<0.001	14.9	5.0-44.5

Table 7. Risk Factors by Logistic Regression

	Coefficient	Standard error	Wald test	*P*	Odds ratio	Odds ratio Confidence interval 95%
Female	1.267	0.574	4.878	0.027	3.5	1.15-10.9
COPD	2.157	0.866	6.207	0.013	8.6	1.6-47.2
EF < 35%	1.960	0.773	6.431	0.011	7.1	1.5-32.3
Non-elective surgery	2.844	0.721	15.557	<0.001	17.2	4.1-70.6
CPB higher 120 min	1.218	0.557	4.779	0.029	3.4	1.2-10.1
Constant	-3.377	0.545	38.402	<0.001	0.034	-

DISCUSSION

This study, in agreement with other studies [9,10] shows that both morbidity and postoperative mortality are significantly higher in patients 70 years or older. In our sample, we noted that, among the older patients undergoing CABG surgery for correction of valve diseases (isolated or combined), only the severity of atherosclerotic disease seems to be more significant among older patients when compared to a younger population.

This is because the incidence of unstable angina and arterial vascular disease affecting the inferior limbs and carotid arteries, as well as the rate CABG (isolated or combined with valve diseases) was significantly higher in this group. However, we believe that increased postoperative morbidity and mortality among older patients shows not only the greater severity of atherosclerotic arterial disease - a fact corroborated also by the greater incidence of postoperative ischemic stroke - but also the lower functional reserve of these patients.

The highest incidence of bleeding, respiratory complications and renal failure also shows greater tissue fragility and limited functional reserve. The decrease of hemostatic competence, changes in respiratory and renal function caused by aging are well known [11].

Thus, considering that the average life expectancy of the Brazilian is currently 72 years, the number of candidates for heart surgeries that are 72 or older may naturally increase. Thus, when considering surgery as a treatment option for heart disease in this age group, we must assess the risks and benefits of this procedure. We should consider not only the survival rates from the current group of older patients, but also the influence of the outcomes of surgery and patients' disease on quality of life. These factors should be discussed honestly. Although it is easier to make decisions about older patients at the highest degree of a risk scale, those in which a good general health condition is clear, as with the very ill and vulnerable patients, risk stratification requires additional considerations.

Although our mortality for CABG was significantly higher than that observed by authors from developed countries [12,13] or even other domestic studies [8], the rate of older patients who presented postoperative complications was also relatively high for these authors. However, the mortality rate for the older patients who underwent isolated valve operation was similar to that observed by other authors [14].

We believe that the major postoperative hospital mortality in cases with elderly patients is due to a higher occurrence of comorbidities, which are usually associated with higher surgical risk and lower functional reserve. However, to find explanations for the increased mortality in CABG in our study, we compared the experiences of other authors [8,12,13]. This was not simple, because many factors are involved. In addition, it should be considered that our surgeries were performed in a general hospital with a low quantity of heart surgeries (as opposed to the experiences reported above), which may adversely affect mortality [15] - although the subject is still controversial [16].

The study presented herein has clear limitations,

especially due to its retrospective nature and the limited size of the sample, which limits our ability to provide prediction models. However, although the logistic regression has provided a model whose accuracy is not large, the model can be used for exploratory analysis. Thus, these results help to indicate which comorbidities deserve attention in future research and evaluation of surgical risk. Moreover, although all models of risk stratification commonly used in heart surgery include age as a predictive factor, it would be interesting see the elderly as a special population, and not as individuals who have age as an additional risk factor.

CONCLUSION

The hospital mortality of elderly patients undergoing valve surgeries and coronary artery bypass grafting – isolated or combined - is significantly higher than that observed in relatively younger patients, and COPD, ejection fraction <35%, non-elective surgery and CPB time greater to 120 min are associated with higher mortality in this age group.

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