

Myocardial Revascularization without Extracorporeal Circulation in Patients Over 75 Years of Age. Analysis of Immediate Results

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Objective

To assess the immediate results of myocardial revascularization surgery without extracorporeal circulation in a group of patients over 75 years of age.

Methods

From January 2001 to December 2003, 193 (121 men and 72 women) patients with ages ranging from 75 to 94 years, corresponding to 100% of the coronary surgeries performed in patients over the age of 75 years, underwent myocardial revascularization without extracorporeal circulation. Their hospitalization data were retrospectively analyzed.

Results

Arterial hypertension was present in 174 (90%), dyslipidemia in 115 (59%), smoking in 89 (46%), and diabetes in 57 (29%). Ninety-six (49.7%) patients had had a previous myocardial infarction, 53 of whom (27.4%) had experienced an acute ischemic event in a period < 30 days after surgery. Critical obstructive lesions in 3 or more coronary vessels were present in 156 (80.95%) patients, while 30 (15%) patients had an important obstruction of the left main coronary artery, and 30 (15%) patients had an ejection fraction < 30%. The score obtained according to the EUROSCORE ranged from 3 to 18, with an expected mortality rate for the group of $7.54 \pm 2.69\%$. The total number of distal anastomoses was 639. Seven (3.62%) patients died, 3 due to bronchopneumonia, 1 due to mediastinitis, 1 due to metabolic causes, 1 due to cardiogenic shock, and another died suddenly after re-fixation of a sternal dehiscence. Reoperation due to bleeding, orotracheal reintubation, and prolonged mechanical ventilation were factors associated with an increase in mortality.

Conclusion

The surgery adopted for myocardial revascularization was associated with a low mortality rate, a low complication index, and a short length of stay at the hospital.

Keywords

elderly, myocardial revascularization surgery, extracorporeal circulation

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The increase in the elderly population in Brazil in recent years has led to a greater number of patients over the age of 70 years requiring myocardial revascularization surgery. However, over the years, advanced age has been considered a risk factor for morbidity and mortality in coronary artery surgeries^{1,2}. The recent advances in myocardial revascularization surgeries without extracorporeal circulation, the technique recommended by Buffolo et al³ and Benetti⁴ at the beginning of the 1980s, has aroused interest in this type of surgery, especially in high-risk patients⁵⁻⁷.

We retrospectively analyzed the immediate results of the myocardial revascularization surgery without extracorporeal circulation in patients over the age of 75 years.

Methods

Data of the present study were prospectively collected from the database used by the Society for Thoracic Surgery⁸ and according to the risk index developed by the European Association for Cardiothoracic Surgery, EUROSCORE^{9,10}. All patients over the age of 75 years, who underwent coronary surgery without extracorporeal circulation from January 2001 to December 2003 were analyzed.

The anesthetic technique used has been standardized and previously described¹¹. After anesthetic induction and graft obtainment¹¹, the patients were heparinized with a dose of 2.5 mg/kg. A 2-0 thread stitch fixed to a 3-cm-width cotton band was applied to the pericardial deflexion between the inferior vena cava and the right inferior pulmonary vein¹² for complete exposure of the heart. The distal anastomoses were performed first, and the artery approached was occluded in its proximal portion to the anastomosis with a 4-0 thread stitch. The area of the anastomosis was exposed and fixed with a suction stabilizer (Octopuss System, Medtronic Corporation, Redmond, WA). At the end of the distal anastomoses, systolic blood pressure was maintained at 100 mm Hg, the aorta was partially clamped, and the proximal anastomoses were performed. When the anastomosing process was finished, 2 mg/kg of heparin were reverted with protamine sulfate and the surgery ended. Whenever possible, the patient was awakened from sedation in the operating room, and orotracheal extubation was performed. Then, the patient was sent to the intensive care unit, where he received continuous infusion of nitroglycerin and electrolyte replacement for 24 hours. Erythrocyte concentrate was administered whenever the hematocrit was below 30%.

Results

The study comprised 193 patients aged 75 to 94 years (mean, 78.5 ± 3.14 years), who underwent myocardial revascularization without extracorporeal circulation, 121 (62.6%) being men and 72 (37.4%) women.

In regard to risk factors and associated diseases (tab. I), the patients were as follows: 29.5% were diabetic; 49.7% were smokers; 59.1% had elevated cholesterol levels; 90.1% were hypertensive; 4.1% had gastrointestinal disorders; 5.1% were chronic renal patients undergoing a dialysis program; 2.0% had had a previous vascular cerebral accident; 15.5% had chronic obstructive pulmonary disease; 15.5% had a peripheral vascular disorder; 1.5% had complete atrioventricular blockage; and 4.6% had chronic atrial fibrillation.

In regard to functional class, the patients were as follows: 15.5%, were in functional class I; 32.1%, in functional class II; 27.4%, in functional class III; and 24.8%, in functional class IV (fig. 1). Ninety-six (49.7%) patients had previous myocardial infarction and 27.4% had had a previous myocardial infarction within the 30 days preceding surgery. The ejection fraction was greater than 50% in 54.5% of the patients, between 30% and 50% in 30% of the patients, and lower than 30% in 15.5% (fig. 2).

Coronary cineangiography (tab. II) showed lesions in 1 vessel in 3% of the patients, in 2 vessels in 16% of the patients, and in 3 or more vessels in 81% of the patients. Twenty-two (17.4%) patients had a lesion in the left main coronary artery.

In regard to other preoperative antecedents, 32.1% of the patients had undergone previous angioplasty, 6.2% had undergone

thrombolytic therapy due to acute myocardial infarction, 7.7% had undergone myocardial revascularization surgery, and 1% had definitive pacemaker. In the immediate preoperative period, 31% were using intravenous nitroglycerine for controlling angina, 5.1% were receiving a vasoactive drug due to significant hypotension, and 1% had used preoperative intra-aortic balloon. Nineteen (9.8%) patients underwent surgery on an emergency basis. The EUROS-CORE score ranged from 3 to 18, with an expected mean mortality of $7.54 \pm 2.69\%$.

The total number of distal anastomoses was 639, with a mean of 3.26 ± 1.18 per patient. The left internal thoracic artery and the radial artery were used in 132 (68.4%) and 38 (19.6%) patients, respectively. The mechanical ventilation duration ranged from zero to 216 hours, with a mean of 3 hours and 45 minutes. Eleven (5.6%) patients remained under mechanical ventilation for more than 24 hours; 49 (25.3%) were awakened and extubated in the operating room; 5 (2.5%) required orotracheal reintubation, none of whom belonged to the group extubated at the end of anesthesia. Twenty-six (13.4%) patients developed bronchopneumonia, 6 (54.5%) of whom belonged to the group with prolonged ventilation and 3 (60%) of whom belonged to the group that required orotracheal reintubation.

Three (1.5%) patients required reoperation due to bleeding. The mean drainage volume through the thorax and mediastinal drains was 420 ± 155.4 mL (range, 50 to 1450 mL). Sixty-nine (35.7%) patients required no erythrocyte concentrate. Two (1%) patients had mediastinitis, and one had sternal dehiscence on the sixth postoperative day, and the patient was immediately referred for refixation. One (0.5%) patient experienced an ischemic cerebral vascular accident on the third postoperative day after an apparently normal recovery on the first days. Forty-three (22.2%) patients had acute atrial fibrillation in the postoperative period, 4 of whom required electrical cardioversion. Table III shows the major postoperative complications.

Disease	Nº	%
CAVB	3	1.5%
CVA	4	2.0%
AF	9	4.6%
CRD	10	5.1%
GID	10	5.1%
Vasc D	30	15.5%
COPD	30	15.5%
Diabetes	57	29.5%
Smoking	89	46.1%
Cholesterol	115	59.1%
Hypertension	174	90.1%

CAVB- complete atrioventricular block; CVA- cerebrovascular accident; AF- atrial fibrillation; CRD- chronic renal disease; GID- gastrointestinal disorders; Vasc D- vascular disorders; COPD- chronic obstructive pulmonary disease.

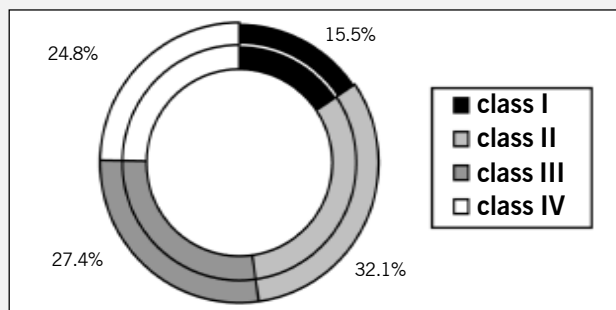


Fig. 1 – Functional class (NYHA).

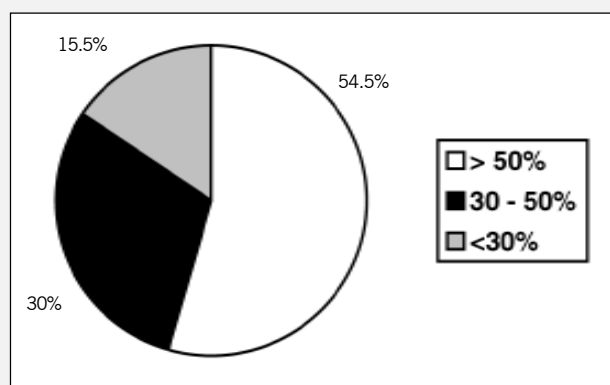


Fig. 2 – Ejection fraction.

Artery	Nº	%
1 vessel	6	3%
2 vessels	31	16%
3 vessels	156	81%
LMCA	30	17.4%

LMCA- left main coronary artery.

**Table III - Postoperative complications**

Complication	Nº	%
CVA	1	0.5
Mediastinitis	2	1.0
Dehisc	1	0.5
Reop	3	1.5
Reintubation	5	2.5
Prolonged ventilation	11	5.6
Bronchopneumonia	26	13.4
Atrial fibrillation	43	22.2

CVA - cerebrovascular accident; Dehis - sternal dehiscence; Reop - reoperation.

In this series, 7 (3.62%) patients died, one due to metabolic causes, one due to mediastinitis, one due to an unidentified cause on the second postoperative day of sternal refixation, one due to cardiogenic shock, and 3 due to bronchopneumonia. Death due to mediastinitis occurred in a patient who required reoperation due to bleeding. The other patient who required reoperation due to bleeding died because of bronchopneumonia on the eighth postoperative day. The third patient who required early reoperation for sternal refixation, died due to an unidentified cause. The other 2 patients who died required prolonged ventilation. The patient who died due to metabolic causes had been operated upon on an emergency basis. Table IV shows the causes of death.

The length of stay in the intensive care unit ranged from 22 to 216 hours; 49 (25.3%) patients stayed less than 24 hours; 102 (52.8%) stayed from 24 to 48 hours; 21 (11%) from 48 to 72 hours; and 21 (11%) stayed longer than 72 hours.

The length of stay at the hospital ranged from 4 to 26 days, and 143 (74%) patients were discharged on the sixth postoperative day.

Discussion

The increase in life expectancy of the population related to improvements in baseline health conditions, as well as the great advances in medicine worldwide in the past 15 years, allows cardiological management of patients over 70, and age has not been considered an obstacle for indicating any type of treatment. Recent studies have shown that life expectancy 10 years from now should be greater than 72 years¹³.

The statistics have shown that the major cause of mortality in the elderly is cardiovascular disease, coronary artery disease accounting for more than 70% of the deaths in that age group¹⁴, and congestive heart failure accounting for most hospitalizations^{15,16}. Should advanced age be considered a factor of elevated risk for indicating coronary artery surgery?

The first consistent reports about the effectiveness of myocardial revascularization surgeries without extracorporeal circulation date

Table IV - Causes of death

Metabolic	1	0.5%
Mediastinitis	1	0.5%
Nonidentified	1	0.5%
Cardiogenic shock	1	0.5%
Bronchopneumonia	3	1.5%

back to the 1980s, when Buffolo et al³ and Benetti⁴, working in parallel with each other, reported the results in significant groups of patients. These authors showed that, with the aid of some surgical maneuvers and the use of drugs to reduce heart rate and oxygen consumption, the surgeries without extracorporeal circulation were safe, effective, and reproducible, and had low mortality, low morbidity, low cost, and, mainly, were highly effective in high-risk patients.

With those results and the new ones reported by both groups with a large number of patients over the entire decade, the interest in myocardial revascularization surgeries without extracorporeal circulation has gradually increased. In addition, the development of new instruments has gradually increased the applicability of the technique; for example, intraluminal shunt developed by Rivetti and Gandra¹⁷ allows the performance of anastomoses without the need for occluding the vessel. Still, the great number of tissue stabilizers available on the market has also contributed to the increased interest in that type of surgery, making it increasingly reproducible. In our case series, we did not routinely use the intraluminal shunt, reserving it for the great arteries, especially the right coronary artery.

The Brazilian surgeon Gandra Lima¹⁸ contributed by proposing maneuvers for presenting the vessels of the lateral and posterior wall of the heart, which provide less hemodynamic instability. By using a stitch applied between the inferior vena cava and the right inferior pulmonary vein, the author showed that any vessel in the heart could be approached; therefore, interest increased in myocardial revascularization surgeries without extracorporeal circulation. Studies carried out during the 1990s responded positively to the 2 questions posed by the critics to this type of surgery, ie, the quality of the anastomosis and incomplete revascularization when performed without extracorporeal circulation.

Confirming that myocardial revascularization surgery without extracorporeal circulation has lower morbidity, especially in high-risk patients, several studies have shown its applicability in patients over the age of 70 years with better results than those expected according to the predictive mortality indices¹⁹⁻²³.

However, some aspects should be considered when the elderly undergo coronary artery surgery. In our case series, in agreement with observations of other authors²⁴⁻²⁶, the incidence of complications was relatively low, but the tolerance to complications of a patient older than 75 years is lower than that observed in younger patients. Three factors were important in this series in regard to mortality: prolonged mechanical ventilation, orotracheal reintubation, and early reoperation.

Of the 193 patients assessed, 4 (2%) required reoperation, one due to sternal dehiscence and 3 due to bleeding. Three of them died. The incidence of bronchopneumonia was elevated among the patients who remained under prolonged ventilation (54%) or those who required reintubation (60%). The complication rate was low, considering that the incidence of complications, such as renal failure, myocardial infarction, cerebral vascular accidents, mediastinitis, and bleeding, common in this type of procedure, either were not observed or were observed in a small number of patients (less than 2%). However, these complications, when occurring, had a less favorable evolution than usual.

Myocardial revascularization surgery without extracorporeal circulation has gained a large number of enthusiasts, reaching

28% of the cases operated on in the United States. That figure is expected to increase to 50% by 2005. The applicability of the technique in 100% of the cases became possible with the aid of new stabilizers and the use of the technique reported by Lima et al.¹⁸ standardizing the exposure of the vessels of the lateral and posterior walls of the heart. As new results are reported in the literature, we believe that the number of surgeries without extracorporeal circulation will increase, reaching 100%.

In conclusion, patients older than 75 years present for surgery with less favorable clinical conditions than younger patients do, due to associated diseases. The myocardial revascularization surgery without extracorporeal circulation, once again, proved to be safe and effective, resulting in its greater indication in this specific population. The occurrence of postoperative complications has led to a significant increase in mortality; therefore, their presence should be detected early and treated aggressively.

References

- Weintraub WS, Craver JM, Cohen CI et al. Influence of age on results of coronary artery surgery. *Circulation*. 1991; 84: 226-35.
- Loop FD, Lytle BW, Cosgrove DM et al. Coronary artery bypass surgery on the elderly. Indications and outcome. *Cleve Clin J Med*. 1988; 55: 23-34.
- Buffolo E, Andrade JCS, Branco JNR et al. Coronary artery bypass grafting without cardiopulmonary bypass. *Ann Thorac Surg*. 1996; 61: 63-6.
- Benetti FJ. Direct coronary surgery with saphenous vein bypass without either cardiopulmonary bypass or cardiac arrest. *J Cardiovasc Surg*. 1985; 26: 217-22.
- Mack MJ. Beating heart surgery for coronary revascularization: is it the most important development since the introduction of the heart-lung machine? *Ann Thorac Surg*. 2000; 70: 1774-8.
- Milani RM, Brofman PRS, Moutinho JA. Morbidity and mortality impact in the myocardial revascularization without extracorporeal circulation. 12th World Congress On Cardiothoracic Surgery. Luzern, Switzerland, 2002.
- Moshkovitz Y, Lusky A, Mohr R et al. Coronary artery bypass without cardiopulmonary bypass: analysis of short term and mid term outcome in 220 patients. *J Thorac Cardiovasc Surg*. 1995; 110: 979-87.
- Ciarke RE. The STS Cardiac Surgery National Database: an update. *Ann Thorac Surg*. 1995; 85:1841-4.
- Roques F, Nashef SA, Gauducheau E et al. Risk factors and outcome in European cardiac surgery: analysis of the EUROSCORE multinational database of 19,030 patients. *Eur J Cardiothorac Surg*. 1999; 15: 816-22.
- Nashef AS, Roques F, Michel P et al. European System for Cardiac Operative Risk Evaluation. *Eur J Cardiothorac Surg*. 1999; 16: 9-13.
- Milani RM. Análise dos resultados imediatos da operação para revascularização do miocárdio sem pinçamento total da aorta. Tese de mestrado, Universidade Federal do Paraná, 2000.
- Lima RC, Escobar M, Neto JW et al. Revascularização do miocárdio sem circulação extracorpórea: resultados imediatos. *Rev Bras Cir Cardiovasc*. 1993; 8: 171-6.
- Gus I. Expectativa de vida do idoso e fatores de risco coronariano. *Rev Soc Cardiol RS*. 1999; 8: 5-10.
- Zaslavsky C, Gus I. Idoso. Doença cardíaca e comorbidades. *Arq Bras Cardiol*. 2002; 79: 635-9.
- Family Heart Study Group; British heart study group: its design and method and prevalence of cardiovascular risk factors. *Br J Ger Pract*. 1994; 44: 62-7.
- Tresch TD. The clinical diagnosis of heart failure in older patients. *J Am Ger Soc*. 1997; 45: 1128-33.
- Rivetti LA, Gandra SMA. Initial experience using an intraluminal shunt during revascularization of the beating heart. *Ann Thorac Surg*. 1997; 63: 1742-7.
- Lima RC. Padronização técnica de revascularização miocárdica da artéria circunflexa e seus ramos sem circulação extracorpórea. Tese de doutorado. Escola Paulista de Medicina. São Paulo, 1999.
- Hirose H, Amano A, Takahashi A. Off-pump coronary artery bypass grafting for elderly patients. *Ann Thorac Surg*. 2001; 72: 2013-9.
- Hoff SJ, Ball SK, Coltharp WH et al. Coronary Artery Bypass in patients 80 years and over: is off-pump the operation of choice? *Ann Thorac Surg*. 2002; 74: 1340-3.
- Ghosh P, Holthouse D, Carrol I et al. Cardiac reoperations in octogenarians. *Eur J Cardiothorac Surg*. 1999; 15: 809-15.
- Horvath KA, Disesa VJ, Peigh PS et al. Favorable results of coronary artery bypass grafting in patients older than 75 years. *J Thorac Cardiovasc Surg*. 1990; 99: 92-6.
- Lobo F^o JG, Leitão MCA, Lobo F^o HG et al. Cirurgia de revascularização coronariana esquerda sem CEC e sem manuseio da aorta em pacientes acima de 75 anos. *Rev Bras Cir Cardiovasc*. 2002; 17: 208-14.
- Williams DB, Carrilo RG, Traad EA et al. Determinants of operative mortality in octogenarians undergoing coronary bypass. *Ann Thorac Surg*. 1995; 60: 1038-43.
- Ascione R, Rees K, Santo MH et al. Coronary artery bypass grafting in patients over 70 years old: the influence of age and surgical technique on early and mid-term clinical outcomes. *Eur J Cardiothorac Surg*. 2002; 22: 124-8.
- Craver JM, Puskas JD, Weintraub WW et al. 601 octogenarians undergoing cardiac surgery: outcome and comparison with younger age groups. *Ann Thorac Surg*. 1999; 67: 1104-10.