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Off-pump coronary artery bypass grafting with arterial grafts: analysis of 300 cases

Revascularização do miocárdio sem circulação extracorpórea com enxertos arteriais: análise de 300 casos

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Abstract

Objective: **The present study reviews our immediate results of off-pump coronary artery bypass grafting using only arterial grafts.**

Method: **Between June 2000 and December 2004, 300 patients were submitted to off-pump myocardial revascularization using only arterial grafts. The left internal mammary artery was the first-choice graft, followed by the radial artery and the right mammary artery.**

Results: **The ages of the patients ranged from 33 to 77 years, with 234 male and 66 female. In respect to risk factors for coronary disease, 77% had hypertension, 66% had a history of smoking, 53% had high levels of cholesterol and 21% had diabetes. Eighty-four patients (28%) had a history of myocardial infarction and 77 (25.6%) were using endovenous nitroglycerin in the preoperative period. The ejection fraction was less than 30% in 77 (25.6%) patients. A total of 189 patients had multi-vessel disease. The EuroSCORE ranged from 0 to 12 points with an expected mortality rate of 3.7%. The total numbers of distal anastomoses were 838, with a mean of 2.79 ± 0.97 anastomoses per patient. There were six deaths in this series, one caused by renal failure, one caused by metabolic disorders, two caused by mediastinitis, one caused by pneumonia and one caused by bleeding. Diabetes was the only factor associated with mortality.**

Conclusion: **The use of arterial grafts in off-pump myocardial revascularization did not increase the immediate morbidity or mortality in this series. The results were similar to the results predicted by the EuroSCORE. The use of only arterial grafts in diabetic patients must be carefully evaluated.**

Descriptors: **Myocardial revascularization. Extracorporeal circulation. Coronary disease, surgery. Internal mammary-coronary artery anastomosis.**

Resumo

Objetivo: **Recentemente, o uso de múltiplos enxertos arteriais nas cirurgias coronarianas vem conquistando grande interesse da comunidade médica diante da perspectiva de melhores resultados a longo prazo em relação às veias safenas. O presente estudo tem por objetivo analisar os resultados imediatos da associação da operação de revascularização do miocárdio sem circulação extracorpórea, com o uso exclusivo de enxertos arteriais.**

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Método: **Entre junho de 2000 a dezembro de 2004, 300 pacientes foram submetidos a operação para revascularização do miocárdio sem circulação extracorpórea, usando-se apenas enxertos arteriais. A artéria torácica interna esquerda foi o enxerto de primeira escolha, seguida da artéria radial do membro superior não-dominante, artéria torácica interna direita e artéria radial do membro dominante.**

Resultado: **A idade dos pacientes variou entre 33 e 77 anos. Duzentos e trinta e quatro pacientes eram do sexo masculino e 66 do sexo feminino. Com relação a fatores de risco coronarianos, 77% tinham história de hipertensão arterial, 66% história de tabagismo, 53% níveis elevados de colesterol e 21% eram diabéticos. Oitenta e quatro (28%) pacientes apresentavam antecedente de infarto do miocárdio e 77 (25,6%) necessitaram de nitroglicerina endovenosa no período pré-operatório. A fração de ejeção era inferior a 30% em 77 (25,6%) pacientes e a cineangiocoronariografia mostrou lesão em três ou mais vasos em 63% dos casos. O EuroSCORE variou de 0 a 12 pontos, com uma mortalidade esperada para este grupo de 3,7%. O número total de anastomoses distais foi de 838, com média de 2,79±0,97 por paciente. Houve seis (2%) óbitos nesta série, sendo dois por mediastinite, um por insuficiência renal após choque séptico, um por causas metabólicas, um por sangramento e um por broncopneumonia. Diabetes foi o único fator associado com aumento na mortalidade.**

Conclusão: **A utilização de enxertos arteriais nas operações para revascularização do miocárdio sem circulação extracorpórea não acarretou aumento da morbi-mortalidade imediata nesta série. Os resultados obtidos estão dentro do previsto através do EuroSCORE. O uso de enxertos arteriais em diabéticos deve ser realizado de maneira bastante criteriosa.**

Descritores: **Revascularização miocárdica. Circulação extracorpórea. Coronariopatia, cirurgia. Anastomose Mamário-Coronária.**

INTRODUCTION

In the early 1980s, pioneering works published separately by Buffolo and Benetti [1,2] presented less-invasive off-pump myocardial revascularization techniques. Recently, advances in tissue stabilizers, as well as significant technical contributions by Lima and Rivetti [3,4], greatly increased interest in off-pump coronary artery surgeries, with publications [5-7] showing the possible advantages of the method over the conventional technique. However, off-pump coronary artery bypass surgeries are technically harder and doubts arose in respect to the quality of the anastomoses, the type of grafts utilized and incomplete revascularization surgeries. The left internal thoracic artery is the graft of choice and its advantage over venous grafts is well known [8-10]. Many studies have been published demonstrating the benefits of a second arterial graft [11-14], but, few associate off-pump coronary artery bypass grafting with the use of arterial grafts.

METHOD

The data of the present study were collected by the model of database utilized by Society for Thoracic Surgery [15] and using the risk score developed by the European Association for Cardiothoracic Surgery, the EUROSCORE [16,17]. All patients, who underwent off-pump coronary artery bypass surgery utilizing only arterial grafts between June 2000 and December 2004 were analysed.

The anesthetic technique and the initial preparation have been previously described [18]. After induction of anesthesia and the grafts were obtained, the patients were heparinized at a dose of 2.5 mg/kg. After this, a suture with Ethibond 2-0 was applied and fixed to a 3-cm wide cotton strip at the pericardial deflection between the inferior vena cava and the right inferior pulmonary vein [12], to completely expose the heart. The distal anastomoses were performed first with the involved artery occluded proximally to the anastomosis with a suture of 4-0 thread. The area in which the anastomosis was performed was exposed and stabilized with a suction stabilizer (Octopuss System, Medtronic Corporation). When the distal anastomoses were completed the systolic arterial pressure was maintained in 100 mmHg, the aorta was partially clamped and the proximal anastomoses were performed. Subsequently, 2 mg/kg of heparin was reversed with protamine sulfate and the surgery concluded. When possible, the patient was awoken from anesthesia in the surgical center and orotracheal extubation was made.

On concluding the surgery, the patients were taken to the intensive care unit where they received continuous infusion of nitroglycerin during 24 hours and electrolyte replacement. Erythrocyte concentrates were administrated when the hematocrit was less than 30%. All patients, with the exception of patients who were operated on under emergency conditions, received calcium channel blockers starting 24 hours before the surgery. The use of aspirin in the preoperative period was not suspended for the surgery.

Statistical analysis

In this study, the continuous variables were expressed as means and standard deviations and the categorical variables as frequencies and percentages.

RESULTS

A total of 300 patients with ages varying from 33 to 77 years and a mean of 60.02 ± 12.3 years were submitted to off-pump coronary artery bypass grafting using only arterial grafts. Two-hundred and thirty-four (78%) were male and 66 (22%) were female.

In respect to the risk factors and associated diseases, 21% were diabetics, 66% were smokers, 53% presented high cholesterol levels, 77% were hypertensive, 28% had suffered previous myocardial infarctions, 23% had previously been submitted to angioplasty, 5.2% had undergone thrombolysis and 3.2% had been submitted to prior myocardial revascularization surgery.

The majority of the patients were in functional class III or IV with 12% in class I, 37% in class II, 31% in class III and 20% in class IV. Endovenous nitroglycerin was being administered to 77 patients (25.6%) in the preoperative period.

Echocardiography demonstrated an ejection fraction above 50% in 139 patients (46.3%), 84 (28%) patients had an ejection fraction between 30 and 50% and 77 patients (25.6%) an ejection fraction of less than 30%. The coronary cineangiography demonstrated 17% of the patients had lesions in only one vessel, 20% in two vessels and 63% presented with lesions in three or more vessels. Twenty-nine patients (9.6%) presented with a lesion of the left coronary artery trunk. Eight patients (2.6%) were operated on under emergency conditions. The values obtained using the EUROSCORE risk scale varied from 0 to 12 points with a mean of 3.7 ± 2.71.

The total number of distal anastomoses was 838 giving a mean of 2.79 ± 0.97 per patient. The left internal thoracic artery was used in 145 patients and anastomosed only to the anterior descending branch and in 151 patients it was used sequentially. The radial artery was utilized as a single anastomosis in 223 patients and in 24 patients it was utilized sequentially. One hundred and twenty patients received right internal thoracic artery grafts (Figure 1).

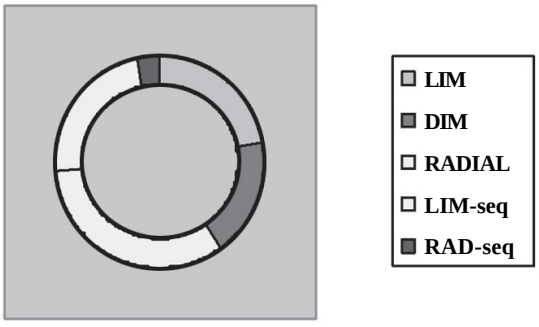

Fig. 1 - Grafts utilized

The mean time of mechanical ventilation assistance was 4.36 ± 0.94 hours varying from zero to 300 hours. Fifty-one patients (15.3%) were extubated in the surgical center after the effects of anesthesia wore off. The mean bleeding volume through pleural drains and from the mediastinum was 490.58 ± 135.3 mL, varying from 50 to 1750 mL. Seven patients (2.3%) required reoperations due to bleeding. The period of stay in the intensive care unit varied from 1 to 13 days, with a mean of 1.92 ± 0.43 days with 243 patients (81%) remaining less than 48 hours in the unit.

In respect to the complications observed, 37 patients (12.3%) presented with atrial fibrillation, four patients (1.3%) suffered mediastinitis, three patients (1%) had acute myocardial infarction, one patient (0.3%) presented with renal insufficiency after septic shock, six patients (2%) suffered bronchopneumonia and one patient had a brain stroke. Table 1 shows the complications observed.

Table 1. Post surgery complications.

Complication	Nº	%
Renal Insufficiency	1	0.3%
Acute myocardial infarction	2	0.66%
Bronchopneumonia	6	2%
Mediastinitis	4	1.3%
Reoperation due to bleeding	7	2.3%
Atrial fibrillation	37	12.3%

There were six deaths (2%) in this series, with two deaths (0.6%) due to mediastinitis, one (0.3%) due to renal insufficiency after septic shock, one (0.3%) due to metabolic causes, one due to bronchopneumonia (0.3%) and one due to bleeding (0.3%).

COMMENTS

Over the last four years, many publications from many services showed that off-pump coronary artery bypass grafting surgery has been accepted worldwide [19-21], which has been attributed to an improvement in the quality of the tissue stabilizers and intracoronary shunts, as well as maneuvers to expose the vessels that allow treatment of all the arteries of the heart.

The results presented by different works give support to off-pump coronary artery bypass surgeries as a safe and efficient alternative to the traditional procedure. The elimination of cardiopulmonary bypasses reduces the

inflammatory response associated with heart surgery, reducing the interstitial pulmonary edema, the adverse effects on the platelets and coagulation system, the microemboli attributed to cardiopulmonary bypass and the elimination of the continuous flow, leading to a better renal protection [22]. All these factors make off-pump surgeries more and more attractive.

The use of arterial grafts is continuously gaining more acceptability in coronary artery bypass surgeries with studies of 15 years of follow-up showing a superiority of this type of graft over saphenous veins [8-10], in respect to event-free survival and the mortality rate [11-14].

Among cardiovascular surgeons, the debate related to the use of arterial grafts over the use of a left internal thoracic artery graft associated with a saphenous graft is intense. There has not been, until now, a randomized study clearly showing the advantages of the use of two thoracic arteries or only arterial grafts over a single thoracic artery. The use of the left internal thoracic artery to the anterior descending branch is an operation considered ideal giving the best results in coronary artery surgery [23]. Rizolli et al. [24] presented an article with a broad review of publications through a metanalysis evaluating 16,362 patients and comparing the use of one or two internal thoracic arteries in coronary surgeries. The authors concluded that, generally, the long-term results show that using two internal thoracic arteries in coronary artery bypass grafting is better than using just one.

In the present study, we present the association of off-pump coronary artery bypass grafting surgeries using only arterial grafts. Three hundred patients were retrospectively analysed with emphasis on the postoperative complications.

The total number of distal anastomoses was 838, with a mean of 2.79 ± 0.97 per patient. This number is compatible with the number of lesions identified in the coronary cineangiography demonstrating the possibility of performing complete coronary artery bypass surgeries even without the use of cardiopulmonary bypasses. In this series, the second most common artery involved, after the anterior descending branch, was the marginal branch of the circumflex artery, demonstrating that revascularization of the lateral and posterior vessels of the heart are regularly performed without cardiopulmonary bypass.

The use of arterial grafts did not significantly increase the surgery time, time of mechanical ventilation and the time of stay in the ICU. Bleeding observed through drains was also similar to that observed in other patients who were operated on in the hospital.

With regards to the complications observed, the four patients that presented with mediastinitis were diabetics and for all of them, the two internal thoracic arteries were utilized. The number of diabetic patients in this series was 63 (21%) and the incidence of mediastinitis in this subgroup (diabetics) was 6.3% (four). With the reoperations for bleeding, in five patients, active bleeding sites were found, two in branches of the radial artery, two in the bed of the right internal thoracic artery and one in the proximal anastomosis of the radial artery. In the other two patients reoperated for bleeding, diffuse bleeding was verified without signs of specific active bleeding.

In respect to the other complications identified, with the exception of the atrial fibrillation, the incidences were very low, demonstrating that the use of arterial grafts does not lead to an increase in the morbidity.

In this series, there were six deaths, two patients due to mediastinitis, one due to septic shock and renal insufficiency, one due to metabolic causes, one due to bronchopneumonia and one due to bleeding. Among the two patients who presented mediastinitis, one of them presented acute myocardial infarction in the immediate postoperative period requiring an emergency reoperation. In the re-intervention, spasms of the radial artery were seen and a saphenous graft was performed distally to the anastomosis of the radial artery, and the patient presented with hemodynamic and electrocardiographic improvements after the procedure. The patient that developed septic shock and renal insufficiency had presented acute myocardial infarction six days previous to the surgery, developing with pain and hemodynamic instability and requiring vasoactive drugs, an intra-aortic balloon and emergency surgery. Arterial grafts were utilized because the patient had already been submitted to saphenectomy. In the postoperative period, the patient remained on prolonged mechanical ventilation, evolving with bronchopneumonia and septic shock.

CONCLUSION

Based on the results obtained with this series of patients, we concluded that the association of off-pump coronary artery bypass grafting with the use of arterial grafts has proved to be a safe and efficient procedure, without giving significant increases in the incidence of complications.

In the subgroup of diabetic patients, the use of both internal thoracic arteries coursed to an increase in the rate of complications related to the sternum.

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