Use Of Pedicled Internal Thoracic And Right Gastroepiploic Arteries For Myocardial Revascularization: Early Experience

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Citation

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Abstract

INTRODUCTION:

Several alternative techniques in coronary artery bypass grafting (CABG) have been developed to reduce high-risk patients postoperative morbidity and mortality (1-92). The use of pedicled arterial grafts have demonstrated to be safe and effective procedures in patients with atheromatous aorta, porcelain aorta, poor quality saphenous vein, complicated anatomy of the coronary artery disease (CAD), left ventricular dysfunction, redo CABG, concomitant lower extremities revascularization and elderly patients in which all those situations are associated (1-8, 10- 92). Despite of the introduction of these new technical alternatives for the surgical management of this group of patients, the challenge still persists. This report describes our initial experience with this approach.

PATIENTS AND METHODS:

Patients: 200 patients operated on in the Cardiovascular Surgery Center of Villa Clara between 1990 and 2000 with diagnosis of CAD tributary of surgery in which pedicled arterial conduits were used as conduits for CABG.

- Thoracic Approach: Median sternotomy in all the patients.
- Myocardial protection: Atenolol 100 mg PO in the morning of the surgery in all patients. Moderated systemic hypothermia and cardioplegic arrest with intermittent cold crystalloid cardioplegia administered antegradely and retrogradely (aortic root and coronary sinus respectively) in 140 patients (70%), hypothermic fibrillatory arrest with left ventricular decompression in 30 patients (15%), 5 patients were operated on under beating heart normothermic cardiopulmonary bypass (2,5%). Deep hypothermic circulatory arrest was used in 5 patients (2,5%) and off- pump CABG was performed in 20 patients (10%).
- Arterial cannulation: Ascending aorta was cannulated in 130 patients (65%), left femoral artery in 50 (25%) and off-pump CABG in 20 patients (10%).
- Venous cannulation: A cavoatrial 2 steps unique cannula was always placed through the right atrium (180 patients, 90%).
- Left ventricular venting: Through an aortic root cannula in 140 patients (70%), in 30 through the right superior pulmonary vein (15%) and 20 were undergone off-pump CABG (10%).
- Cardioplegia delivery: Combined antegrade and retrograde (through aortic root and coronary sinus respectively) in 140 patients (70%), exclusive retrograde in 40 patients (20%) and off- pump CABG in 20 (10%)
- Grafts harvesting technique: Internal mammary artery (IMA): Previous median sternotomy, and placing the Chaux's retractor, with low intensity coagulation fashion of the electrocautery the IMA pedicle was dissected between the first and sixth ribs, the pedicle was was 2 cm wide, containing the accompanying nerve and vein, collaterals were dissected and clipped, bifurcated left IMA (LIMA) was used in 10 patients (5%), previous heparinization of the patient, IMA pedicle was

distally ligated and transected, a Bulldog's clamp was proximally placed in the pedicle, the distal extreme was then prepared for the anastomoses, the pedicle was finally packed in a papaverine soaked gauze. Right IMA (RIMA) dissection was performed with the same technique as the LIMA. Skeletonized IMA was never used in this series. IMA blood flow was always tested before its use.

- Right Gastroepiploic Artery (RGEA): The abdomen was entered through a prolongation of the skin incision of the median sternotomy to 3 cm before the umbilicus, small sized Balfour's retractor with its valve was placed, previous gastric aspiration by means of a Levine's tube, Backobs clamps were placed on the anterior wall of the stomach to tract this organ cephalad and upwards, the gastroepiploic pedicle was identified at the greater curvature, and dissection started at the level of the pylorus, towards the gastrosplenic ligament, dissection finished at the level of the vassa brevia, gastric and epiploic collaterals were always ligated, previous heparinization of the patient, the pedicle was distally ligated and transected, a proximal Bulldog's clamp was then placed, previous dilation maneuvers the pedicle was packed in a papaverine soaked gauze, The RGEA was never skeletonized, the left triangular hepatic ligament was always transected, there are several ways to route this pedicle in our series it was routed pre- gastric, pre-hepatic and trans diaphragmatic in patients older than 60 years (10 patients), for younger patients retro-gastric (5 patients). Epiploplasty of the greater curvature of the stomach was always performed.

A 7/0 or 8/0 continuous polypropylene suture was always used to perform the anastomoses of the free grafts to the pedicled LIMA and for the distal anastomoses.

Proximal anastomoses in the ascending aorta were performed under beating heart and normothermic cardiopulmonary bypass, with tangential aortic clamping. The continuous suture was always performed with 5/0 polipropilene. Clinical and hemodynamic characteristics appear in table 1.

{image:1}

Legend: NYHA: New York Heart Association, LVEF: left ventricular ejection fraction, LVEDP: left ventricular end systolic pressure

VARIABLES STUDIED:

Modalities to use pedicled arterial grafts, coronary artery bypassed, CABG/ patient, arterial grafts/ patients, venous grafts/ patient, postoperative complications, mortality, and influence of pre, trans and post operatives variables in hospital mortality and influence of perioperative variables in mortality. A descriptive study was performed.

RESULTS:

Technical alternatives to use pedicled arterial grafts appear in table 2, single internal thoracic artery (SITA) was used in 185 patients (92,5%), in 10 of them bifurcated. Bilateral internal thoracic artery (BITA) was used in 15 patients (7,5%), in Y modality for BITA grafts was used in 10 patients (5%) pedicled BITA in 5 (2,5%), in 2 patients (1%) right internal thoracic artery (RITA) was routed through the transverse sinus to bypass the circumflex system and in 3 to revascularize the right coronary artery system. Pedicled RGEA was used in 15 patients (7,5%) this conduit was always routed via pre- gastric pre- hepatic trans-diaphragmatic because was used in patients older than 55 years without conditions for further elective elective abdominal surgery was present.

Table 3 shows the situations which aimed the use of pedicled arterial grafts for the different coronary artery systems in this series, the most frequent situation, common to all of the pedicled grafts were the presence of left anterior descending CAD (LADCAD), followed by the left main CAD (LMCAD) and atheromatous aorta. Previous saphenectomy and poor quality saphenous vein were also problems, which aimed the use of these grafts.

{image:2}

Legend: SITA: Single internal thoracic artery, LITA: Left internal thoracic artery, RITA: Right internal thoracic artery, BITA: Bilateral internal thoracic artery, RGEA: Right gastroepiploic artery, SV: Saphenous vein, LADCA: Left anterior descending coronary artery, Cx: Circumflex, RCA: Right coronary artery

{image:3}

Legend: LADCAS: Left anterior coronary artery system, LADCAD: Left anterior coronary artery disease, LMCAD:

Left main coronary artery disease, CxS: Circumflex system, RCAS: Right coronary artery system

The bypassed coronary arteries and the grafts used are shown in table 4: the most frequently bypassed was the left anterior descending coronary artery system (LADCAS); 200 anstomoses were performed on the LADCA and 50 on diagonal (Dg) branches, followed by the circumflex system (173 anastomoses), from this system the first obtuse marginal branch was the most frequently bypassed (202 anastomosis). The right coronary artery system received 142 grafts. LITA was the most frequently used conduit (284 anastomoses), followed by the greater saphenous vein (273) what demonstrates the importance of this conduit as the second for CABG in this series, the third conduit was the RITA (26 anastomosis), the fourth was the RGEA (15 anastomoses).

{image:4}

Total anastomosis 603 patients

Anastomosis/ Patients 3,015

Arterial anastomosis 325

Arterial anastomosis/ Patient 1,62

Venous anastomosis 282

Venous anastomosis/ Patient 1,41

Ascending aortic autologous pericardium covered woven Dacron patch 10 patients

Coronary artery venous patch 5

Coronary artery endarterectomy 29

Concomitant aorto- iliac bypass 2 patients

IABP 2 patients

Legend: LAD: Left anterior descending, Dg: Diagonal, OMB: Obtuse marginal branches, IDA: Intermediate descending artery, PLB: Posterolateral branches, RCA: Right coronary artery, Anast/ conduit: Anastomosis/ conduit, IABP: Intra aortic balloon counterpulsation

The most frequent use of LITA was as graft for LADCA system (LADCAS) (200 patients, 250 anastomoses), RITA was mainly used as graft for circumflex system (12 patients, 23 anastomoses: for the first OMB 10, for the second OMB 8 and 5 for posterolateral branches), RGEA was always used for right coronary artery system (RCAS) revascularization (15 patients, 15 anastomoses), saphenous vein grafts were mainly used for RCAS revascularization (124 anastomosis).

Table 5 shows the early postoperative complications, the most frequent were supraventricular dysrrhythmias (30 patients, 15%), followed by pleural effusions (20 patients, 10%) and low cardiac output (10 patients, 5%). Three patients died (1,5%) all of them were older than 60 years, with diagnosis of three vessels CAD, NYHA functional class IV, LMCAD, left ventricular dysfunction, suffered post operative myocardial infarction and died in low cardiac output state. Two of them required intra aortic balloon pump counterpulsation; no one received more than one pedicled arterial graft.

{image:5}

DISCUSSION:

It has been demonstrated that arterial grafts for CABG have the best long-term patency rates. This is directly related to post operative improved quality of life, prolongation of free myocardial ischemic events period and life expectancy (1-94). Since Kolessov reported the use of pedicled LITA as conduit for LADCA revascularization (74), multiple technical alternatives have been described for CABG (1-94). The use of BITA have demonstrated to prolong the period free of re do CABG necessity and ischemic heart events (3- 57), although immediate post operative morbidity slightly increases due to sternal wound complications (6-8).

Several technical alternatives to perform BITA grafts have been described (3-57): the most frequently of them is “in Y” BITA graft with pedicled LITA for LADCAS revascularization and RITA for circumflex system and distal RCAS (posterior descending artery), RITA has also been described as pedicled graft for RCAS, LADCAS revascularization, when the LADCAS receives RITA grafts LITA is used to revascularize the circumflex system (1, 3-57). Multiple ITA grafts is a technique that has proved to benefit more regions of ischemic myocardium with arterial grafts (1-3-57). The RGEA is another alternative conduit suitable for RCAS, posterolateral branches and distal large LADCA bypass, although its most frequent use is as graft for RCAS.

Several routes have been described to transfer the distal extreme of the RGEA to the thoracic cavity. For younger

patients it has been recommended to use the retro- gastric route to avoid any injury of this graft in further eventual abdominal surgery, for older patients it is possible to route pre-gastric the RGEA because of the lesser possibilities for further abdominal surgery. Several early complications after RGEA use for CABG have been reported. The most frequently are: RGEA vasospasms induced angina, gastroepiploic steal syndrome, gastric perforation in the area of RGEA dissection, diaphragmatic hernia after trans diaphragmatic routing of this conduit, gastric ischemic changes in secretion pH. However, their incidence is rather sporadic and in this series no one of them appeared (59- 66).

Severe aortic atheromatosis is an important issue to choice the alternative for bad aorta management, Robiscek's technique allows the use of saphenous vein grafts proximally anastomosed to an ascending aorta autologous pericardium Dacron patch , this method is particularly useful when arterial conduits as pedicled grafts availability in the patient are limited and saphenous vein segments are needed for myocardial revascularization (51) , 10 patients were undergone this method in this series. Despite of the numerous arterial grafts have been used as grafts for CABG, saphenous vein is still one of the most important conduit. Although this conduit has been widely used as free graft, Peigh reported its use in Y with pedicled LITA and RITA in patients with severe aortic calcifications with good results; this technique was used in this series in 10 patients (52). Composite arterial grafts with radial, inferior epigastric and free right gastroepiploic arteries in Y anastomosed to LITA are also alternatives for CABG in these cases(1, 44).

Another important issue is the role of CABG in patient with preoperative severe left ventricular dysfunction, multivessel CAD and extensive areas of stunned and hibernating myocardium, which contribute to the ventricular contractile dysfunction. It has been demonstrated that metabolic and contractile function of these areas are reestablished at intervals ranging from hours to months post CABG, low cardiac output and dysrythmias mark the early post operative course of these patients. This coincides with the results of this series in which supraventricular dysrythmias and low cardiac output were the most frequent early post operative complications (79-83).

Additional surgical problems constitute the elderly patients, atheromatous aorta, LMCAD and left ventricular dysfunction, and comorbid states that increase the morbidity and mortality rates in CABG under cardiopulmonary bypass such as chronic renal failure, cerebrovascular disease, hematological and hepatic disorders. These factors require alternative surgical strategies to perform CABG such as off-pump CABG to avoid the systemic inflammatory response secondary to cardiopulmonary bypass (79- 91), and use of no touch aortic techniques with use of multiple pedicled arterial grafts to avoid performing proximal anastomoses in the ascending aorta (49,50,52).

Adequate myocardial protection is an important surgical tool to reduce postoperative ventricular dysfunction, low cardiac output and dysrythmias. Buckberg's protocol of antegrade and retrograde cardioplegia delivery combines the advantages of these two methods. Its excellence has been demonstrated in several series. In patients with severe atheromatous aorta no touch aortic management is preferred. Hypothermic fibrillatory arrest with ventricular decompression, deep hypothermic cardiocirculatory arrest and off pump CABG with padicled grafts are the other alternatives that have been used in these cases to avoid catastrophic aortic disruptions that causes high mortality rates.

Numerous studies have reported risk- adjusted hospital mortality rates post CABG. Age, gender, previous history of acute myocardial infarction, pre operative congestive heart failure, left ventricular dysfunction, priority of the CABG, co-morbid states, advanced NYHA functional class and prolonged cardiopulmonary bypass are the most significative variables to predict high risk for post operative hospital mortality. Our results coincide with these factors (91- 94).

Despite of the numerous alternative techniques for CABG, high-risk patients constitute a current challenge in cardiac surgery. The use of pedicled arterial grafts offers a possibility for no touch technique aortic management, prolongs post operative free myocardial ischemic events periods, the necessity of redo CABG, increases long term quality of life and reduces long term mortality rates in this group of patients. In the present series the use of pedicled LITA was the first choice, followed by saphenous vein, RITA, RGEA, but the majority of anastomoses were performed with arterial grafts what shows the feasibility of this modality of grafts for CABG in high-risk patients.

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