Myocardial Revascularization Surgery with Regional Anesthesia Without an Endotracheal Tube in Conscious Patients

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Objective - *To report initial experience with myocardial revascularization surgery (MRS) performed on patients who were totally awake and without an endotracheal tube.*

Methods - *Between January 1994 and May 2001, 272 patients underwent MRS without extracorporeal circulation. In 24, the operations were performed without the use of an endotracheal tube and with the patients totally awake and breathing normally. The age ranged from 51-75 years with the predominant male sex. Epidural thoracic administratios of the anesthesia was performed. Surgery was performed through a habitual anterolateral thoracotomy. During the entire procedure, the left lung remained partially collapsed.*

Results - *The 24 patients progressed well through the surgery. Pneumothorax time ranged from 70-190 minutes. No electrocardiographic, echocardiographic, or enzymatic alterations occurred that characterized pre- and postoperative infarcts. Twenty-three patients were stable enough to be released after 24 hours.*

Conclusion - *This technique could be performed on an large number of selected patients. However, more experience is necessary.*

Key words: coronary artery leypass graft, epidural thoracic anesthesia.

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The development of coronary artery bypass graft surgery (CABG) has progressed throughout practically all of the twentieth century, with intervals of inactivity and progress. Alex Carrel [1], in 1910, reported the first experimental aorta-coronary graft performed, using a segment of the carotid artery to connect the coronary artery to the descending aorta. At that time, the pneumothorax created was a serious problem. Murray et al [2] developed a large number of anastomoses between the coronary arteries and the systemic arteries, including the internal thoracic arteries.

The experimental work of suturing with instruments began in Russia. Kahn et al [3] performed coronary anastomoses in calves with a Russian-American stapler and had promising results. Kolosov et al [4-6] in St. Petersburg was a pioneer in clinical work with left internal thoracic artery (LITA) anastomosis with the left anterior descending artery without cardiopulmonary bypass (CPB) similar to other types of grafts. Garrett et al [7] described a case of an aorta-coronary bypass with a saphenous vein graft, with the heart beating, with the graft patent after 7 years. This technique did not become popular and was not discussed.

In recent decades, the study of multiple organ dysfunction caused by CPB [8-12], the necessity of a longer hospital stay, the short- and long-term results, and the higher cost of this procedure have caused the scientific focus to change. The current trend is toward less aggressive surgery and the development of minimally invasive direct coronary artery bypass (MIDCAB) without CPB.

Reports of this new approach have been widely published including those by Trapp and Bisarya [13] in Canada, Ankeney [14] in the United States, Benetti et al [15] and Buffolo et al [16-18], Lima et al [19], and Lobo et al [20] in Brazil.

Subramanian [21], Robson et al [22], Calafiore et al [23,24], and Karagoz et al [25] have contributed to the progress of MIDCAB.

With further investigative thinking, we believed in the possibility of performing a MIDCAB using the ambulatory method, and so we performed the surgery on a small series of select patients, who were totally awake and without an endotracheal tube.

The objective of this article is to present our initial experience with myocardial revascularization performed on an ambulatory basis, with a conscious patient and to note some of the particularities observed.

Methods

Between January 1994 and May 2001, 272 patients underwent CABG, without the use of CPB. In 24, the surgery was performed without an endotracheal tube and with patients totally conscience. All had a lesion in the left anterior descending artery, and no important chronic pulmonary disease was present. The age ranged from 51-75 years with the predominant sex being males. All patients underwent routine preoperative examinations and psychological preparation before the procedure.

Epidural thoracic administration of the anesthesia was performed with 10 mL of solution, composed of 8 mL of bupivacaine, 0.5 % + 2 mg of morphine, injected by needle at the T4 level, with posterior collocation of an n°. We used an 18 G catheter to inject 1 mL of bupivacaine 0.5% to block the 2nd, 3rd, 4th, and 5th left intercostals spaces (LIS). During surgery, and in the postoperative procedure when necessary, we injected 4 mL of bupivacaine 0.5% into the catheter. To obtain 5 metameres of analgesia at T2 to T6, during part of the surgery the patient used an oxygen mask with two l/minute fluxes.

Monitoring of patients followed the protocol for CABG with CPB. It included continuous electrocardiography, access to the deep vein by puncturing the right jugular vein, arterial pressure by puncturing the radial artery, monitoring of arterial saturation with a pulse oximeter, arterial gasometry before opening the thorax and every 30 minutes after the thoracotomy.

The access used was a thoracotomy at the 4th LIS, with the patient in the dorsal decubitus position, slightly turned to the right at a ± 30° angle to the surgical table. The length of the incision ranged from 14 and 16 cm. The LITA was dissected through this incision until the subclavian artery was reached, sometimes it being necessary to remove the cartilage of the 4th rib and occasionally the 5th. The pericardium was opened longitudinally on the anterior fascia, approximately 2 cm from the diaphragm close to the pulmonary artery trunk, having its edges well fixed to the edges of the incision. A tourniquet was used close to the LAD zone, where the anastomosis (4/0 Prolene thread, anchored to a small segment of the silicone tube) would have been made, without tightening, with 2 types of stabilizers. After sectioning of the LITA, its extremity was prepared, the coronary was opened, with 1 assistant providing light compression by squeezing the coronary artery, and another assistant blowing CO_2, washing the site to keep the area blood-free and for the quick placement of the intracoronary shunt. The tourniquet was only tightened in cases of intense bleeding. The LITA-LAD anastomosis was performed with Prolene 7/0 with continuous sutures, and the intracoronary shunt was removed at the end of the anastomosis. During the entire time of surgery, the left lung remained partially collapsed.

Anticoagulation was achieved with heparinization of the patient with 2mg/kg of weight, before sectioning of the LITA. The neutralization of the heparin was achieved-with protamine in equal dosages. After the anastomosis, the pericardium was partially sutured, the pleural cavity was drained, and the thoracic wall was closed. Throughout the pneumothorax, we asked the patients to breathe deeply and provoke a cough until the total expansion of the lung was obtained.

After the patients entered the intensive care unit, we immediately initiated respiratory exercises and the oral use of aspirin. The drain was removed within 12 hours. After the removal of the drain, the patient was transferred to a ward.

Results

The 24 patients endured the surgery well. The mean time of LITA-LAD anastomosis was 9 minutes and the pneumothorax time ranged from 60-190 minutes. During the procedure, no hemodynamic instability or arrhythmias occurred. No important modifications occurred in blood saturation of PO_2 and PCO_2 (tab. I). One patient needed endotracheal intubation and a sternotomy with installation of CPB after a sudden cardiac arrest at the end of surgery when the thorax had already been closed. After the installation of the CPB, the heart began beating, and the ECG, obtained 15 minutes after the procedure, was normal. This arrest was attributed to the heart coming out of the pericardial sack with a twisting of the vessels at the base. In this case, the pericardium had not been closed. The flux of the LITA was confirmed by a postoperative arteriograph.

Another patient had a thermic lesion of the LITA during its dissection, at the incision angle. The wounded segment was resectioned and a termino-terminal anastomosis was performed, which increased the pneumothorax time to 190 minutes.

No electrocardiographic, echocardiographic, or enzymatic alterations revealed postoperative necroses. No neurologic or infectious complications or clinical pulmonary or radiologic alterations occurred.

All patients, with the exception to the ones that underwent CPB, were stable and released after 24 hours.

Discussion

During the last decade, percutaneous coronary balloon angioplasty and the implantation of a stent have emerged as the first-choice, offering quick myocardial revascularization and efficient and less aggressive surgery for patients with 1, 2, or 3 compromised vessels, in the absence of disease in the LAD and their indication seems to have expanded, but the use of CABG has been limited.

The literature shows that the benefits of surgery with LITA-coronary anastomosis is superior on a long-term basis [26]. Some surgeons have hesitated to indicate CABG as the first therapeutic procedure in these patients, in view of the mortality, morbidity, and cost associated with surgery

Table I - The first 20 patients: time of pneumothorax, saturation, and PCO_2; before opening the thorax and every 30 minutes

Patients	Age	Time of Pneum.	Sat (before)	PCO_2 (before)	Sat (30 min)	PCO_2 (30 min)	Sat (60 min)	PCO_2 (60 min)	Sat (90 min)	PCO_2 (90 min)	Sat (120 min)	PCO_2 (120 min)	Sat (150 min)	PCO_2 (150 min)	Sat, (190 min)	PCO_2 (190 min)
1º patient	51	92'	99%	37	98%	40	97%	41	97%	41						
2º patient	75	95'	98%	40	97%	41	98%	48	96%	55						
3º patient	69	85'	98%	40	97%	40	98%	44	97%	46						
4º patient	54	90'	100%	37	99%	38	98%	39	98%	40						
5º patient	56	80'	99%	37	97%	40	97%	42								
6º patient	66	190'	97%	39	98%	41	98%	41	97%	44	98%	45	97%	48	96%	48
7º patient	64	70'	98%	38	98%	43	98%	43								
8º patient	66	72'	98%	39	98%	42	97%	42								
9º patient	73	75'	97%	40	96%	42	96%	46								
10º patient	60	81'	98%	39	96%	40	98%	49	97%	40						
11º patient	72	95'	98%	40	98%	42	99%	46	98%	42						
12º patient	45	84'	98%	37	98%	38	98%	39	97%	39						
13º patient	68	100'	97%	38	97%	43	97%	42	98%	41						
14º patient	43	68'	100%	40	99%	39	98%	44								
15º patient	41	60'	100%	40	99%	39	98%	42								
16º patient	52	68'	99%	40	98%	40	98%	43								
17º patient	52	77'	99%	39	97%	43	97%	44								
18º patient	71	71'	100%	40	96%	44	97%	46								
19º patient	65	68'	98%	37	97%	42	96%	47								
20º patient	52	65'	100%	39	96%	43	95%	45								

Pneum. - pneumothoral; Sat - saturation of O2.

combined with CPB and a median sternotomy. On the other hand, with a relatively high incidence of restenosis after angioplasty and stent implantation [27], the need arose for surgeons to simplify CABG. These simplified techniques have resulted in less aggression against the patient, lower cost, and more effective results.

The technique of myocardial revascularization without CPB has allowed an even greater advance in MID CAB. Initially, limiting factors for the expansion of MIDCAB were the lack of innovations in instrumentation and the discrepancy between the wish of cardiac surgeons to develop minimally invasive technology and the reception of such technology by the industry. Nowadays, new instruments are available, such as retractors for dissection of the mammary artery, stabilizers, internal shunts, CO_2 blowers that keep the area stable and blood-free and the heart perfused, making it easy to perform the anastomosis of the coronary arteries, assuring a high rate of pervious flux. The development by Heigmen et al [28] of a new stapler for coronary anastomosis reduced surgical time. The introduction of a video-assisted manual technique by Mack et al [29] and Benetti et al [30], and the recent emergence of robotics [31] have expanded the MID CAB technique.

Although CABG with the heart beating is already an established reality [20], its use for intramuscular coronaries and for posterior arteries in large hearts with low ejection fractions is still limited. The lack of determination and preparation of surgical teams are handicaps that should be overcome.

The technique used in our series of patients is different from the mini-thoracotomy technique already established, because of the thoracic epidural block used and the specific psychological preparation of the patients for this procedure. The patient is kept awake the entire time and can talk.

The pneumothorax provoked by the thoracotomy has not caused any problems. The maximum time the thorax was open was 190 minutes, and no important alterations occurred in saturation of O_2, in arterial pressure or in PO_2 and PCO_2, through all the surgeries. The incision of the thoracotomy was larger, ranging from 14 to 16 cm, to permit complete dissection of the LITA to the subclavian artery. The time of 190 minutes that the thorax was open in 1 patient was because of the inadequate exposition of the LITA leading to a lesion and posterior reconstruction. This illustrates that the patient can withstand a long pneumothorax without major alterations in ventilation and without postoperative pulmonary complications.

The tourniquet was used only in cases of intense bleeding that could cut and fracture arterial wall plaques, which could be dissected and compromise the anastomosis. The partial collapse due to pneumothorax makes the dissection of the LITA easier and also serves the surgical treatment for pulmonary and mediastinal diseases.

One patient, although having previous psychological preparation, got tired of lying in the same position and moved, causing the surgeon certain discomfort. When the patient breathes deeply, the heart tends to dislocate to below the sternum. This fact becomes less significant when the pericardium is well fixed at the edges, principally on the sternum side, which does not permit dislocation. At the time of anastomosis, the anesthetist asks the patient to cooperate and avoid deep breathing and moving.

Respiratory exercises are done as soon as the patient arrives in the ICU, which is made easier by the type of anesthesia used permitting the exercises to be pain free, avoiding respiratory complications. Before the end of 24 hours after surgery, the patients were already in conditions for hospital discharge. The epidural catheter was removed 72 hours after surgery.

The case of reversion to sternotomy and installation of CPB, because of sudden cardiac arrest, was not believed to be in relation to the proposed operative techniques.

We believe that we can expand revascularization to more vessels (LAD and diagonal). Possibly in the future, like Benetti et al [32], we can perform a complete revascularization of the left side of the heart with the patient fully awake, without an endotracheal tube and with normal breathing.

The use of epidural anesthesia and heparinization did not cause complications. We have been using this procedure on a large number of our patients, having operated on more than 560 patients with the epidural and CPB, without any problems. The formation of hematomas in the epidural catheter placement is very rare [33].

We avoided using drugs that could depress respiration. In this way, the patient maintained normal function keeping CO_2 blood levels in acceptable limits. Epidural anesthesia can also reduce the incidence of graft thrombosis by preserving its fibrinolytic system [34], which can reduce the tendency toward coagulation that exists in patients who undergo CABG without CPB [35] decreasing the incidence of postoperative arrhythmias [36]. Hospital discharge 24 hours after surgery and release of the patient into a home care regime for several days is the ideal, because it avoids the inconveniences of atrial fibrillation that could eventually occur.

Karagoz et al [25] in October 2000 were pioneers in CABG with fully awake patients; however, they used an 'H' radial artery graft, with LITA in situ and the ADA without opening the pleura. In our study, it was different. We opened the pleural cavity without consequences to the patient, eliminating the inconvenience of a possible spasm of the radial artery and blood steal because of dissection from the mammary artery to the subclavian and making the anastomosis of the LITA directly to the LAD.

In general, the progress of CABG began with the elimination of the heart-lung machine and performance of CABG with the heart beating, followed by the reduction of the size of incision. The last important obstacle for comparison with percutaneous techniques, such as an angioplasty or stent implantation, was to maintain the patient fully awake during the procedure. MIDCAB allows elimination of this obstacle making this procedure efficient and safe.

In relation to the anxiety of the patient at the beginning of this procedure, we offer psychological preparation, which permits, in a pain-free environment, acceptance of the surgical procedure without hostility toward the form. We have had no refusals so far.

Concluding, even though the number of cases is small, the procedure is assuredly safe and viable. The pneumothorax did not cause postoperative morbidity and allowed the creation of a good anastomosis. The surgery could be useful for a large number of patients, and we believe that in the future, with more experience, it can be performed as a routine ambulatory procedure.

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