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Research Article

Repeated Coronary Bypass Surgery by Thoracotomy: Patient Selection and Operative Technique

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Abstract

Background: Re-operative coronary artery bypass grafting (CABG) in patients with contraindications to sternotomy presents a technical challenge. In this study we retrospectively reviewed our experience in a selected group of patient selection, operative technique, and early results in patients having redo-CABG by a thoracotomy with cardiopulmonary bypass (CPB) and without CPB.

Methods: The purpose of this message is to provide immediate results re-myocardial revascularization through thoracotomy of 39 patients, who have return angina after previously CABG and design our algorithm for repeated operations.

Results: Left thoracotomy is used in 32 (82%) patients: with CPB (n = 14) and without CPB (n = 9), (Figure 1 and 2). Right thoracotomy is used in 7 (18%) patients: with CPB (n = 2) and without CPB (n = 5). The CPB was carried out with the cannulment of the femoral artery and veins in conditions of normothermia. Multivessel CABG (2 or more) performed in 18 (46,1%) patients, CABG 1 arteries - in 21 (53,9%) patients. Intraoperative angiography, in the absence of contraindication, performed bypass (37 (94.8%) patients). There were 57 distal anastomoses performed for a mean of 1.5 grafts/patient. Targets approached included branches of the circumflex coronary artery (n = 20), diagonal (n = 3), RCA (n = 8) and the LAD (n = 25). Conclusion: Redo CABG via thoracotomy in patients with return angina after CABG lead to better direct results of surgical treatment: a decrease in the frequency of AMI, AHF, stroke, hospital mortality, reoperation about the bleeding, of post-operative transfusions, reducing the time of mechanical ventilation and bed-days.

Keywords: *Repeat Coronary Bypass Surgery; Thoracotomy; MICS; MIDCAB*

Introduction

Repeated operations of CABG is a huge independent section of coronary surgery. Although interest in this section of coronary surgery has always been sufficient, it still attracts researchers, and many aspects of re-surgery are still unresolved. The results of the redo CABG have improved significantly over the past decade, but they are still short-term and long-term inferior to the primary operation of CABG. Redo CABG requires great professional skills of the surgical team, accompanied by significant technical difficulties, not typical for the primary CABG. The number of patients who need of repeated operations on coronary arteries in connection with dysfunction shunts or progression of atherosclerosis is constantly increasing throughout the world and in Russia, due to the constant growth of population the operated patients. Repeated coronary artery bypass surgery remains difficult and associated with a higher risk of morbidity and mortality compared to primary CABG. High risk redo CABG largely due to technical difficulties. Many publications show a significant risk of injury

during the repeated access to the heart, where the incidence of intraoperative trauma mediastinum organs and structures occur in 5% - 10% of cases [1-5]. The listed disadvantages resternotomy have led to the development of alternative approaches to heart, including the execution of redo CABG. Injuries of functioning shunts in resternotomy, especially LIMA anaesthetized with LAD, can have catastrophic consequences. This graft must be preserved without any damage during re-surgery. The frequency of intraoperative damage to LIMA, according to the literature, is about 4% of cases. According to Subramanian VA [6], alternative surgical access should be considered if there is no safe resternotomy and a high risk of damage to a functioning LIMA. These shortcomings of the median resternotomy in re-operations led to the development of alternative access to the heart, including for the execution of redo CABG: left-sided thoracotomy, right-sided thoracotomy, subxyoid access, parasternal access, various variants of the lower partial sternotomy [7-10]. In our many works, the principle possibility of grafting all the vessels in repeat patients through alternative accesses has been presented [11-13]. These approaches have the advantage of access to the chest on an unoperated route. However, the downside is that they offer only limited access to the heart, which can jeopardize the complete revascularization of the myocardial.

Materials and Methods

Between January 2015 and January 2020, 23 off-pump CABG and 16 on-pump CABG (peripheral extracorporeal circulation) re-operations via a lateral thoracotomy were performed at the Department of Cardiac Surgery of Bakulev NMRCCS in Moscow, Russia. There were 34 men and 5 women, aged 67.61 ± 8.63 years. Co-morbidity factors of the patients were pre-operative hyperlipidaemia, family history, smoking, hypertension, diabetes mellitus, chronic obstructive pulmonary disease and cerebrovascular disease. The period between the first and redo operation via thoracotomy was 86.13 ± 43.16 months. All patients underwent redo off-pump CABG via thoracotomy with general anaesthesia after insertion of a double-lumen endotracheal tube. The saphenous veins (SV) or radial arteries (RA) or LIMA were prepared as grafts at the same time as the thoracotomy. The step-by-step plan for the re-operation was developed in advance. A lateral thoracotomy was performed through the fifth intercostal space and adhesions of the collapsed lung were dissected. After mobilisation of the lung, the pericardium was opened above the target area, taking care with the phrenic nerve and LITA graft, which was patent (n = 12). We limited dissection of the adhesive tissues because extensive dissection may cause increased venous bleeding and a decrease in the natural stabilisation provided by the adhesions in redo CABG patients. After graft preparation, the proximal anastomosis was performed by placing a side-biting clamp on the descending aorta (n = 18), ascending aorta (n = 4), subclavian artery (n = 6) (Figure 1), old graft (n = 3), reuse LITA (n = 8) in a continuous fashion with a 7-0 polypropylene suture. When the target vessel was identified, four stabilising sutures were placed at each corner. After arteriotomy, to achieve a comfortable distal anastomosis, a fine vascular occlusion clamp was used to stop bleeding and the distal anastomosis was performed continuously with an 8-0 polypropylene suture.

Results

Now in our clinical practice for the treatment of patients with the return of myocardial ischemia after CABG, in situations requiring a coronary bypass (THE system of LCA or PCA) are widely used operations MICS (Minimally Invasive Coronary Surgery) and MIDCAB (Minimally Invasive Direct Coronary Artery Bypass). Left thoracotomy is used in 32 (82%) patients: with CPB (n = 14) and without CPB (n = 9) (Figure 1). Right thoracotomy is used in 7 (18%) patients: with CPB (n = 2) and without CPB (n = 5) (Figure 2). The CPB was carried out with the cannulment of the femoral artery and veins in conditions of normothermia. Multi-vessel CABG (2 or more) performed in 18 (46,1%) patients, CABG 1 arteries - in 21 (53,9%) patients. Intraoperative angiography, in the absence of contraindication, performed bypass (37 (94.8%) patients). There were 57 distal anastomoses performed for a mean of 1.5 grafts/patient. Targets approached included branches of the circumflex coronary artery (n = 20), diagonal (n = 3), RCA (n = 8) and the LAD (n = 25). We used 49 (86%) venous, and 8 (14%) arterial grafts. Recently, we favored using arterial conduits when possible. The duration of the operation averaged 143.90 ± 36.93 minutes, the total blood loss was 350.6 ± 70.74 ml and the time of the ventilation 6.28 ± 1.18 hours, the stay in the intensive care unit was 18.3 ± 3.21 hours, the hospital stay 6.06 ± 2.74 days. There were one hospital death. There were no reoperations for bleeding. Three major complications occurred. These included one non-Q wave myocardial infarction defined by a CK-MB fraction of more than 40 mg/

dL as detailed above, one respiratory failure defined as requirement for assisted mechanical ventilation for longer than 48 hours, and the need for postoperative intra-aortic balloon pump support in patient.

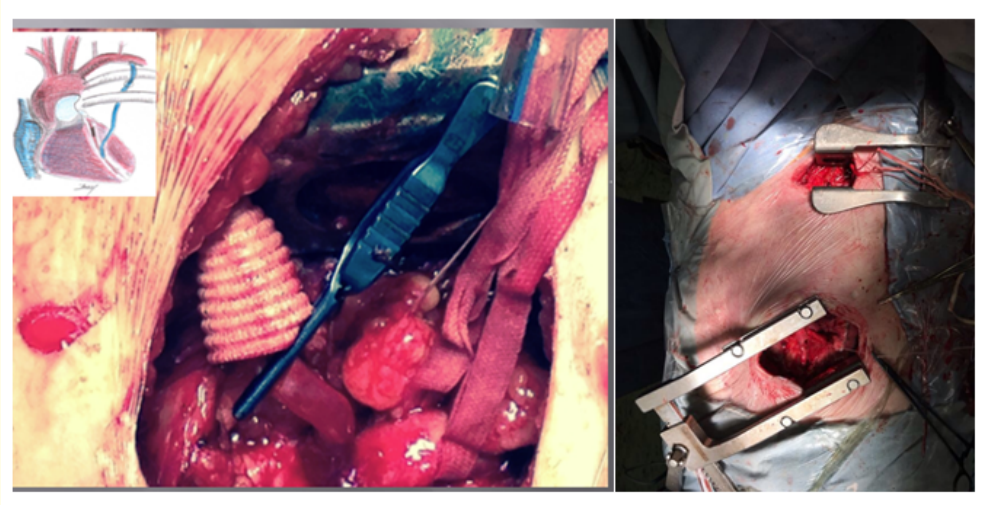

Figure 1: *Proximal anastomosis shunt from the subclavian artery, protected by vascular prosthesis.*

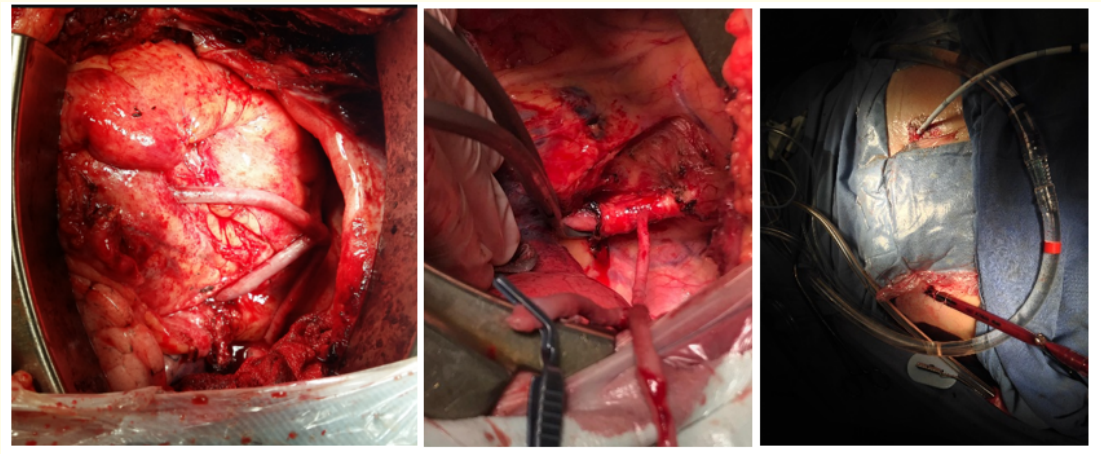

Figure 2: *Left anterior thoracotomy: distal anastomosis, proximal anastomosis and CPB technique.*

Analyzing the data obtained with numerous studies, we can conclude that the immediate results of re- CABG through thoracotomy leads to a significant improvement in hospital outcomes. Table 1 provides a comparative analysis of our results with other sources.

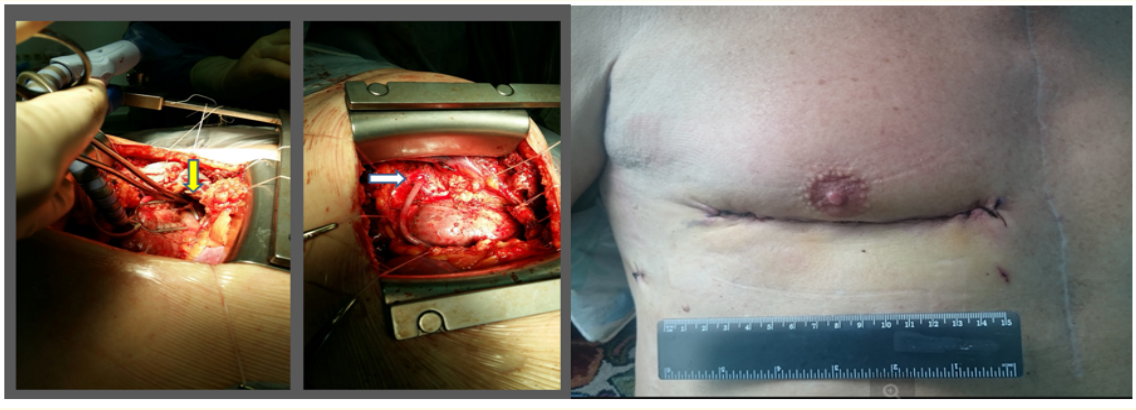

Figure 3: *Right anterior thoracotomy. An old and new venous shunt to the PCA and the final kind of operation.*

Authors/year	Bockeria L.A. Sigaev I.Y.	Odeaa Al J. 2015	Duvan I. 2015	Puskas J. 2015	Denisuk DO. 2014	Duarte C. 2007	Fouad M. 2001	Ancona D. 2000
Patients (n)	39	11	32	51	7	8	21	67
Operation time (min)	143.90 ± 36.93		163.90 ± 36		252,5 ± 47			
Number of anastomosis	1,5	1	1,2	1,27	1.26 ± 0.5	1	1,1	1,3
Grafts	49 SVG, 8 ITA	11 SVG PAS-Port	38 SVG+RA			8 SVG	14 SVG 10RA	83 SVG, 4 ITA
CPB (min)	49 (20 - 129)							
Intraoperative angiography	37 (94,8%)							
Drainage (ml)	350.61 ± 70.74	550	497.651 ± 291		464.34 ± 188			
The need for transfusion	8 (20,5%)				14,3%			
Respiratory assist (h)	6.281 ± 1.18		5.08 ± 1.88	5,4	9.4 ± 1,8			
ICU stay (h)	18.3 ± 3.21		21.3 ± 4.41	47	24			
Myocardial infarction	1 (2, 5%)		0	3,9%		0	5%	4,4%
AHT	0		1	3,9%		0		
Use of IARP	1 (2,5%)		0	3,9%		0	5%	1,4%
New Atrial fibrillation	0					0	5%	
Stroke	0		1			0		
Revision for bleeding	0			0		0	0	0
Thoracotomy Incision infection	0	0	0			0	0	0
Pleurisy	2 (5%)					1	0	0
Pneumonia	0		1			0	0	0
Hospital stay (days)	6.06 ± 2.74	7	5.06 ± 2.74		9	8	6	
Mortality	1 (2,5%)	0	0	3,9%	0	0	0	4,4%

Table 1: *Comparative analysis of the own direct results of re-CABG operations with world experience (other clinics).*

Discussion

Recurrent coronary artery patients who are candidates for re-operation tend to be affected more negatively by the deleterious effects of CPB because of their decreased capacity for cardiac contractility. Although a tailored approach for selected patients, the prevalence of coronary reoperation through a thoracotomy is increasing [14-22]. This growing popularity is explained by the increased need for reoperation in patients who have undergone previous CABG, the growing familiarity, confidence and recognition that the thoracotomy approach is advantageous in patients at particular risk for resternotomy. We believe that, despite significant technical difficulties, the use of thoracotomy in repeated operations, allows to successfully perform the operation of myocardial revascularization, minimizing the risk of complications. Applying peripheral conductor CPB can achieve adequate exposure to coronary arteries and safely impose distal anastomosis. The findings allow us to consider the MICS and MDCAB method as an alternative to traditional re- CABG through sternotomy.

Conclusion

In selected patients re-operative CABG via a thoracotomy can be performed with lower rates of morbidity and mortality in addition to cost-effective consequences.

Conflict of Interest

Conflict of interest is not declared.

Financing

The study did not have sponsorship.

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