Comparative Study between Flow Capacity in Skeletonized Versus Pedicled Internal thoracic Artery in Myocardial Revascularization Surgery

Thesis

Submitted for the partial fulfillment of MD degree
in Cardiothoracic Surgery

By

Mahmoud Ghareeb Aboeid Seleem Alzohairy
M.B.B.Ch., MSc General Surgery
Ain Shams University

Under Supervision of

Prof. Dr. Ahmed Abdel Rahman Hassouna
Professor of Cardiothoracic Surgery
Faculty of Medicine – Ain Shams University

Prof. Dr. Mohammed Attya Hussein
Professor of Cardiothoracic Surgery
Faculty of Medicine – Ain Shams University

Prof. Dr.Hany Abdel Maboud Metwaly
Professor of Cardiothoracic Surgery
Faculty of Medicine – Ain Shams University

Dr. Ahmed Helmy Ali Omar
Assistant Professor of Cardiothoracic Surgery
Faculty of Medicine – Ain Shams University

Faculty of Medicine
Ain Shams University
Cairo, Egypt
2018

بسم الله الرحمن الرحيم

سورة البقرة الآية: ٣٢

Acknowledgments

First and foremost, I would like to Thank Allah, the Passionate and Merciful for without His help this work could have not been completed.

Second, I would like to express my deepest gratitude to ***Professor Ahmed Abdel Rahman Hassouna****, Professor of Cardiothoracic Surgery, Faculty of Medicine, Ain Shams University, for his untiring and priceless effort and for his scientific and technical support. I really have the honor to complete this work under his supervision.*

I would also like to extend my deep appreciation to ***Professor Mohammed Attya Hussein****, Professor of Cardiothoracic Surgery, Faculty of Medicine, Ain Shams University, for his continuous encouragement and supportive advice.*

I would like also to thank ***Professor Hany Abdel Maboud Metwaly,*** *Professor of Cardiothoracic Surgery, Faculty of Medicine, Ain Shams University, who honored me by his supervision.*

I would like also to thank ***Assistant Professor Ahmed Helmy Omar,*** *Assistant Professor of Cardiothoracic Surgery, Faculty of Medicine, Ain Shams University, for his untiring and priceless effort and for the efforts and time he has devoted to accomplish this work.*

Last but not least, I can't forget to thank all members of my Family, especially my ***Parents*** *and my* ***Wife****, for their care and support.*

Mahmoud Ghareeb Aboeid Seleem Alzohairy

List of Contents

List of Abbreviations

Abbrev.	Full-term
AF	: Atrial Fibrillation
ATN	: Acute Tubular Necrosis
BIMA	: Bilateral Internal Mammary Artery
BMI	: Body Mass Index
CABG	: Coronary Arteries Bypass Grafting.
CPB	: Cardiopulmonary Bypass
CX	: Circumflex
EDCFs	: Endothelium Derived Contracting Factors
EDHF	: Endothelium Derived Hyperpolarizing Factor
EDNO	: Endothelium Derived Nitric Oxide
EDRFs	: Endothelium Derived Relaxing Factors
FGF	: Fibroblast growth factor
GEA	: Gastro-Epiploic Artery
IEA	: Inferior Epigastric Artery
ICURSS	: Intensive Care Unit Risk Stratification Score
KCO	: Potassium channel openers
LAD	: Left Anterior Descending Artery
LCA	: Left main Coronary Artery
LCO	: Low cardiac output
LIMA	: Left Internal Mammary Artery
LOS	: Length of Hospital Stay
LVEF%	: Left Ventricular Ejection Fraction Percent
MI	: Myocardial Infarction

MV : Mechanical ventilation
OM : Obtuse Margin coronary artery
PCP : Post CABG Pain syndrome
PDA : Posterior Descending Artery
PDE : Phosphodiesterase
PGI2 : Prostacyclin
PI : Pulsatile index
PLIMA : Pedicled left internal mammary artery
PNX : Pneumothorax
PTCA : Percutaneous Transluminal Coronary Angioplasty
RA : Radial Artery
RCA : Right Coronary Artery
RIMA : Right Internal Mammary Artery
ROC : Receiver Operating Characteristic curve
SIMA : Single Internal Mammary Artery
SLIMA : Skeletonized left internal mammary artery
SWI : Sternal wound infection
SVG : Saphenous Vein Graft
TACR : Total Arterial Coronary Revascularization
TISS : Therapeutic Intervention Scoring System
TTF : Transit Time Flow
TTFM : Transit time Flow Measurement
TxA2 : ThromboxaneA2

List of Tables

List of Figures

Abstract

Object: Myocardial revascularization is performed preferentially with internal mammary artery grafts. Pedicled or Skeletonized preparation and pharmacologic vasodilator treatment vary greatly. Objective measurements are difficult since peripheral and later coronary vascular resistance and possible competitive flow of the native bypassed coronary artery will influence the results significantly.

Our objectives were: (1) Measurement of internal mammary artery (IMA) graft flow and pulsatile index with the transit time flow technique; (2) comparison of two surgical take-down techniques (skeletonizing vs. standard pedicle preparation); (3) quantitation of transit-time flow and pulsatile index during bypass and after coming off bypass.

Method: Consecutive elective cases of coronary artery bypass grafting, performed by two surgeons using routinely either skeletonizing of the internal mammary artery (group S, n = 40) or classical pedicle preparation technique (group P, n = 30), were studied prospectively. Anesthesia, cardiopulmonary bypass, operative and post-operative results were collected compared between the two groups using Transit- time flow (TTF), pulsatile index (PI) and both TTF and PI difference using Medi-Stim® flowmeter where the measurements done after anastomosis of distal end at the following time points: (1; during bypass and (2) after coming off cardiopulmonary bypass.

Results: (1) After coronary grafting, transit-time flow showed significant differences in flow between the two groups (2) No significant differences in pulsatile index between two groups as all cases PI was<5 except one reading in one case during bypass where the PI was 6.6 and (3) Logistic regression analysis for mortality showed that reduced flow after protamine was an independent predictor of mortality (OR 1.269: CI at 95% 1.035-1.556). (4) Receiver Operating Characteristic curve (ROC) analysis showed that a flow after protamine 26 or less is 100% sensitive and 97% specific for occurrence of mortality (area under the curve 0.977; P=0.001) while a flow after protamine 61 or less is 88.2% sensitive and 38.9% specific for occurrence of low cardiac output (LCO) (area under the curve 0.843; P=0.001).

Conclusion: (1) Intraoperative transit time flow measurement is a reliable method for assessing quality of grafts. (2) Flow after protamine and PI value< 5 can be used as independent predictor of morbidity and mortality. (3) Skeletonization of IMA has better outcome.

Key words: coronary bypass graft, internal mammary artery, blood flow measurements.

Introduction

Coronary artery disease (CAD) is nowadays considered one of the leading causes of death in the developed and underdeveloped countries. Revascularization of stenotic coronary arteries greatly contributes to the treatment of CAD. [1]

Currently, two well-established revascularization techniques are practiced. One is Coronary Artery Bypass graft (CABG) surgery in which autologous arteries and/or veins are used to supply blood to the coronary artery downstream to the stenotic lesion, and the other is percutaneous trans luminal coronary angioplasty (PTCA) in which catheter-borne devices, including balloon, stent, atherectomy cutter, and LASER, are used to open stenosis from within the coronary artery. [1]

The clinical and prognostic benefits of CABG for certain anatomical patterns of coronary artery disease are well accepted. Most patients undergoing CABG require three or four bypass grafts and the "standard" operation uses a single left internal mammary artery (LIMA) to the left anterior descending coronary artery, and supplemental saphenous vein (SVGs) and/or radial artery (RA) grafts to the other coronary vessels. [2]

The excellent early results of CABG are limited in the long term by vein graft failure. Ten years after CABG three

quarters of vein conduits are blocked or severely diseased, whereas more than 90% of IMA grafts are patent and disease free. Vein graft failure leads to reduced survival, recurrent angina, late myocardial infarction, and the need for further intervention. [1]

Recently, total arterial coronary revascularization (TACR), is the procedure of choice in young adults and those having porcelain aorta, bilateral saphenectomy, etc. TACR is possible with maximum grafts using bilateral IMAs (BIMA) in situ or as free grafts. [3]

In the past, the main reasons cited against arterial revascularization using BIMA were, inadequate evidence of benefit and that it increased perioperative mortality and/or morbidity, nowadays, there are several large studies that have recently reported that multiple IMA grafts offer survival advantages (decreased death reoperation & PTCA) over a single IMA graft. [4]

Internal thoracic artery grafting is particularly important for patients with diabetes because survival is significantly higher in patients with diabetes after CABG compared with percutaneous transluminal angioplasty. [5]

Unfortunately this technique is limited due to increase risk of deep sternal wound infection associated with conventional pedicled IMA (PIMA) harvesting. Indeed,

diabetes is a well-recognized risk factor for sternal infection even in patients receiving a single IMA graft. [6]

Pedicled harvesting of both IMA grafts may impair sternal wound healing by decreasing sternal blood flow, resulting in an increased risk of sternal wound infection and dehiscence. [6]

The skeletonization procedure, first described by Keeley 7 in 1987, involves the harvest of only the IMA without any surrounding tissue, whereas the traditional IMA harvesting technique involves the dissection of a rim of tissue (1 to 2 cm) around the ITA. [7]

Skeletonization involves meticulous dissection of the IMA conduit away from the chest wall with preservation of the collateral sternal blood supply and the internal thoracic veins. [8]

On the other hand, when skeletonized, the vessel loses its "milieu," which theoretically may adversely affect its long-term resistance to arteriosclerosis. [3]

This coupled with the lack of long-term patency studies of the skeletonized IMA and meticulous follow-up and confirmation by angiography raises concerns about whether this technique sacrifices the superior longevity of the conduit. [8]

Aim of the Work

The aim of this work is to (1) compare the flow capacity and pulsatile index between skeletonized and pedicled internal thoracic artery used in two different groups of patients' are undergoing CABG and its relation to mortality and complication.(2) comparison of IMA flow capacity and pulsatile index in patients underwent CABG on two different time points:

- On cardiopulmonary bypass (CPB).
- After coming off CBP.

Chapter 1
Histology And Characteristics of Arterial Grafts Used For Coronary Artery Surgery

I. The Internal Mammary Artery

Expanded use of the internal mammary artery for myocardial revascularization is based on the accumulating data of superior patency of the internal mammary artery compared with venous conduits. [9]

The primary consideration that has led to the gradual transition of use of the internal mammary artery as the conduit of choice is its relative freedom from atherosclerosis with follow up of up to 20 years. [10]

The long-term event-free survival after coronary bypass surgery is related to the preoperative status of the patient, progression of atherosclerotic disease in the native coronary arteries and patency of the conduits used. [4]

In comparison to the saphenous vein, it has been shown that the left internal mammary artery has a superior patency and widely accepted as the standard conduit for making an anastomosis with the left anterior descending artery (LAD). [11]