

**Evaluation of Mitral Valve Replacement on
Beating Heart in Patients with Chronic
Severe Mitral Regurge and Left Ventricular
Dysfunction; Safety and Potential Benifit**

Thesis

*Submitted for Partial Fulfillment of MD Degree in
Cardiothoracic Surgery*

By

Hani Mahmoud Soliman Albatrek

M.B.B.Ch, M.Sc

Supervised by

Prof. Dr. Ahmed Baheg Hosny EL Kardany

Professor of Cardiothoracic Surgery

Ain Shams University

Prof. Dr. Osama Abass Abdelhameed

Assistant Professor of Cardiothoracic Surgery

Ain Shams University

Prof. Dr. Hosam ELdein Ashor Abdelhamed

Assistant Professor of Cardiothoracic Surgery

Ain Shams University

Prof. Dr. Sherif Abdelhady Mostafa

Professor of Cardiothoracic Surgery

National Heart Heart Institute

Faculty of Medicine

Ain Shams University

2016

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

قالوا

لسبب انك لا تعلم لنا
إلا ما علمتنا إنك أنت
العليم العظيم

صدق الله العظيم

سورة البقرة الآية: ٢٢

Acknowledgment

*First and foremost, I feel always indebted to **ALLAH**, the Most Kind and Most Merciful.*

*I'd like to express my respectful thanks and profound gratitude to **Prof. Dr. Ahmed Baheg Hosny EL Kardany**, Professor of Cardiothoracic Surgery, Ain Shams University for his keen guidance, kind supervision, valuable advice and continuous encouragement, which made possible the completion of this work.*

*I am deeply thankful to **Prof. Dr. Osama Abass Abdelhameed**, Assistant professor of Cardiothoracic Surgery, Ain Shams University, for his great help, active participation and guidance.*

*I wish to introduce my deep respect and thanks to **Prof. Dr. Hosam ELdein Ashor Abdelhamed**, Assistant professor of Cardiothoracic Surgery, Ain Shams University, for his kindness, supervision and cooperation in this work.*

*I am also delighted to express my deepest gratitude and thanks to **Prof. Dr. Sherif Abdelhady Mostafa**, Professor of Cardiothoracic Surgery, National Heart Heart Institute for his kind care, continuous supervision, valuable instructions, constant help and great assistance throughout this work.*

*And last but not least I would like to express my sincerest thanks to every one who helped me to accomplish this work and special gratitude to **Prof. Dr. Al Sayed Mahmoud Mohammed Salem, Dr. Ahmed Mohammed Hasanin Elshimi and Dr. Waleed Abbass Kamel**, for their great assistance inside and outside the operating theater.*

Hani Mahmoud Sofiman Albatrek

List of Contents

Title	Page No.
List of Tables	1
List of Figures.....	3
Introduction	1
Aim of the Work	3
Review of Literature	
▪ Pathophysiology of Mitral Regurgitation	4
▪ Diagnosis of Chronic Mitral Regurgitation	10
▪ Management of Chronic MR.....	16
▪ Mitral Valve Replacement	27
▪ Myocardial Protection.....	43
Patients and Methods.....	59
Results	74
Discussion.....	103
Summary	114
Conclusion & Recommendations	117
References	120
Arabic summary	

List of Tables

Table No.	Title	Page No.
Table (1):	Related researches	58
Table (2):	Age distribution between the two groups.	74
Table (3):	Sex Distribution between the two groups.	75
Table (4):	Preoperative NYHA Class Distribution between the two groups.	76
Table (5):	Preoperative rhythm in the studied two Groups.....	77
Table (6):	Preoperative end diastolic diameter, end systolic diameter, fraction shortening, ejection fraction in the two Groups:	78
Table (7):	Preoperative left atrial diameter and pulmonary artery pressure in the studied Groups:.....	81
Table (8):	Ischemic Cross clamp time (groups I) and mitral surgical time (group II)	83
Table (9):	Need for Support in the studied groups.	84
Table (10):	Mechanical ventilation hours, ICU stay and hospital stay.....	85
Table (11):	Total CK, LDH 3, 6, 12 hours postoperatively in the studied groups.	86
Table (12):	Low cardiac output in the studied groups.	87
Table (13):	Early postoperative end diastolic diameter, end systolic diameter, fractional shortening, and ejection fraction in the studied groups.	88
Table (14):	Late postoperative end diastolic, end systolic diameters, fractional shortening and ejection fraction in the studied groups.	92
Table (15):	Left Ventricular end diastolic diameter in each group separately.	95
Table (16):	Comparison of Left Ventricular end systolic diameter in each group separately.....	97

List of Tables cont...

Table No.	Title	Page No.
Table (17):	Comparison of preoperative and postoperative (early and late) FS% in each group.	99
Table (18):	Comparison of preoperative and postoperative (early and late) EF% in each group.	101
Table (19):	Rhythm late (after 6 months).....	102

List of Figures

Fig. No.	Title	Page No.
Figure (1):	Ventricular rupture after mitral valve replacement classified by location.....	26
Figure (2):	Exposure and cannulation through median sternotomy.....	28
Figure (3):	A schematic drawing illustrates a surgeon's view of the "upside-down" mitral valve exposed through a fifth intercostal space, left posterolateral thoracotomy approach using the on-pump beating heart technique. the location of the longitudinal left atrial incision and the cardiotomy suction kept positioned through the valve.....	30
Figure (4):	Right minithoracotomy and video access.....	31
Figure (5):	Port-Access system with transfemoral artery endoaortic balloon occluder (A), percutaneous internal jugular retrograde coronary sinus cardioplegia catheter (B), pulmonary artery vent (C), and femoral venous drainage catheter (D).....	32
Figure (6):	Conventional left atriotomy.....	33
Figure (7):	Extention of the incision inferiorly to the back of the heart.....	34
Figure (8):	Modifications of the Usual Right Lateral Left Atriotomy	35
Figure (9):	Superior approach.....	36
Figure (10):	Superior septal approach.....	37
Figure (11):	Right atrial traseptal approach.	38
Figure (12):	Transverse trans septal biatrial approach.....	39
Figure (13):	Methods of delivery of cardioplegia:.....	54
Figure (14):	Cannulation for CPB in beating heart; aortic, bicaval, PA vent and double way aortic root cannulae.....	66

List of Figures cont...

Fig. No.	Title	Page No.
Figure (15):	Monitoring of cardiac state during beating heart technique; beating non ejecting under normothermic conditions.....	67
Figure (16):	Testing the feasibility of valve repair on beating heart.....	67
Figure (17):	Age distribution between the two Groups.....	74
Figure (18):	Sex distribution between the two Groups.....	75
Figure (19):	Preoperative NYHA Class Distribution.....	76
Figure (20):	Preoperative rhythm between the studied two groups.....	77
Figure (21):	Preoperative end diastolic diameter.....	78
Figure (22):	Preoperative end systolic diameter in the two Groups.....	79
Figure (23):	Preoperative fractional shortening.....	79
Figure (24):	Preoperative ejection fraction.....	80
Figure (25):	Preoperative left atrial diameter.....	81
Figure (26):	Preoperative pulmonary artery systolic pressure (PASP).....	82
Figure (27):	Ischemic Cross clamp time (groups I) and mitral surgical time (group II).....	83
Figure (28):	Need for inotropic support.....	84
Figure (29):	Mechanical ventilation hours, ICU stay and hospital stay.....	86
Figure (30):	Serial cardiac enzymes in early postoperative period.....	87
Figure (31):	Low cardiac output.....	88
Figure (32):	Early postoperative end diastolic diameter.....	89
Figure (33):	Early postoperative end systolic diameter.....	89
Figure (34):	Early postoperative Fractional Shortening.....	90
Figure (35):	Early postoperative ejection fraction.....	91
Figure (36):	Late postoperative end diastolic and end systolic diameters.....	92

List of Figures cont...

Fig. No.	Title	Page No.
Figure (37):	Late postoperative Fractional Shortening and ejection fraction.	93
Figure (38):	Mean pre op. EDD, Mean early post op. EDD,.....	95
Figure (39):	Mean pre op. ESD, Mean early post op. ESD,	97
Figure (40):	Comparison of preoperative and postoperative (early and late) FS% in each group.	99
Figure (41):	Comparison of preoperative and postoperative (early and late) EF % in each group	101
Figure (42):	Rhythm late (after 6 months).....	102

Abstract

There was significantly longer mechanical ventilation time and ICU stay in cold group I compared to beating group II.

Both the early (in hospital) and late (6 months) postoperative echocardiography showed a similar improvement in the two groups regarding left ventricular end diastolic diameter (LVEDD) and left ventricular end systolic diameter (LVESD) but a significant difference in left ventricular function in favor of the beating technique as the left ventricular ejection fraction (LVEF) and left ventricular fraction shortening (LVFS) were better in beating group II than cold group I.

The significant differences in EF and FS which was in favor of beating group II over cold crystalloid cardioplegic technique in early and late postoperative echocardiographic results, explains the generally better course of patients of this group in hospital and during the early follow up period, this together with the absence of related perioperative mortality and the major complications suggests that it is safe and beneficial to LV function.

Keywords: LV end-systolic volume - ejection fraction- LV end-systolic volume-

INTRODUCTION

After the initial compensatory phase of chronic mitral regurgitation, left ventricular (LV) systolic contractility becomes progressively impaired ^[1]. The calculated ejection fraction (EF) is usually falsely high. LV End-systolic dimension or LV end-systolic volume (LVESV) is less dependent on preload than is ejection fraction and can be used as a better measure of left ventricular systolic contractile function ^[2].

When LV systolic function is affected, the attention is directed to the myocardial protection during mitral valve surgery. The term "myocardial protection" refers to strategies and methodologies used either to attenuate or to prevent post ischemic myocardial dysfunction that occurs during and after heart surgery, which is attributable, in part to a phenomenon known as ischemia/reperfusion-induced injury ^[3].

Most of the current myocardial protective strategies utilizing cold cardioplegia have withstood the test of time, providing safe and effective myocardial protection during various cardiac operations. Nevertheless, all cardioplegic myocardial protective strategies devised to date subject the heart to a period of the so called "mandatory ischemia", where the heart is without circulation. This subsequently leads to reperfusion injury when the aorta is de-clamped ^[4].

Then the concept of warm heart surgery with the use of continuous warm blood cardioplegia as a mean of myocardial protection and prevention of ischemia evolved. Since its introduction, multiple studies have shown that warm heart surgery is comparable to cold cardioplegia in its safety record. From a metabolic standpoint, it provides superior myocardial protection. As well, high-risk patients who may have metabolically compromised hearts show greater benefit from reduced ischemic damage of the myocardium ^[5,6].

As a natural extension of warm heart surgery, beating heart valve surgery was born. Fundamental question was posed: why arrest the heart if technically adequate valve procedures could be accomplished with continuous warm perfusion? ^[7].

Preliminary data suggest that beating heart valve surgery is safe and that there may be a benefit to high risk patients ^[8].

AIM OF THE WORK

The aim of this work is to evaluate mitral valve replacement on beating heart in patients with chronic severe mitral regurgitation and left ventricular dysfunction.

PATHOPHYSIOLOGY OF MITRAL REGURGITATION

The functional competence of the mitral valve relies on the interaction of the mitral annulus and leaflets, chordae tendineae, papillary muscles, left atrium, and left ventricle. Dysfunction of any one or more components of this valvular ventricular complex can lead to mitral regurgitation ^[11].

Chronic mitral regurgitation is a volume overload lesion of the left ventricle. With gradual development of a regurgitant orifice, an abnormal orifice develops between the left ventricle and the left atrium during systole, allowing blood to regurgitate backwards into the left atrium. This regurgitated volume in the next diastole returns to the left ventricle, thus increasing the left ventricular end diastolic volume by the Frank Starling mechanism, there is an increased force of contraction, thus increasing total left ventricular stroke volume ^[12].

Since the regurgitant mitral orifice is in parallel with the aortic orifice, the resistance to ventricular emptying (left ventricular afterload) is reduced in mitral regurgitation. Left ventriculoatrial regurgitation occurs not only during ejection but during isometric contraction as well ^[13].

The large left ventricular end diastolic volume increases resting left ventricular wall tension, stimulating myocardial hypertrophy, which allows the left ventricle to grow larger to

accommodate the large diastolic volume (so, called eccentric hypertrophy). This enlargement of the ventricular capacity allows for greater diastolic volume without raising left ventricular diastolic filling pressure ^[12].

The reduced load on the ventricle allows a greater proportion of the myocardium contractile energy to be expended in shortening than in tension development and explains how the left ventricle can adapt to the load imposed by chronic mitral regurgitation. Thus it appears to be the reduction in left ventricular tension in mitral regurgitation that allows the left ventricle to increase its total output and ultimately accounts for the fact that patients with moderately severe mitral regurgitation can sustain large regurgitant volumes for prolonged periods, while maintaining forward cardiac output at normal levels for many years ^[14].

Factors which Influence Volume of Mitral Regurgitation Blood Flow

The volume of mitral regurgitant flow depends on the size of the regurgitant orifice as well as on the pressure gradient between the left ventricle and left atrium ^[14].

However, it is obvious that regurgitant orifice and heart rate are more influential in determining regurgitant volume than the gradient across the valve, since during systole, flow can occur out of the left ventricle in two directions, normally into