

Echocardiographic Assessment of the Results of Aortic Repair in Cases of Mild to Moderate Aortic Regurge Associated with VSD

Thesis

Submitted for the Complete Fulfillment of the
Requirements of M.D Degree in
Cardiothoracic Surgery

By

AHMED ABDEL-RAHMAN MOHAMED

(M.B., B.Ch.; M.Sc. General Surgery)

Under the Supervision of

Prof. Dr. Mohamed Abdel-Raouf Khalil

*Professor of Cardiothoracic Surgery,
Faculty of Medicine, Cairo University*

Prof. Dr. Fatma Al-Zahraa Mostafa

*Professor of Pediatrics,
Faculty of Medicine, Cairo University*

Dr. Mohamed Abdel-Hadi

*Lecturer of Cardiothoracic Surgery,
Faculty of Medicine, Cairo University*

Faculty of Medicine
Cairo University
2007

||

||

(:)

ACKNOWLEDGEMENT

*"At first, I thank **God**, the most gracious and merciful"*

*Thanks to the eminent Prof. Dr. **Mohamed Abdel-Raouf Khalil**, Professor of Cardiothoracic Surgery Department, Faculty of Medicine, Cairo University. I owe my deepest and sincere gratitude to Prof. **Mohamed Abdel-Raouf**. Throughout my years as a resident and assistant lecturer, Prof. **Mohamed** was not only my mentor but also the father who provided me with support that sustained me through hard times and gave me the hope to face the many challenges doctors like myself encounter regularly. Without his help and support, I would not be where I am today. May God bless him.*

*I would also like to express my thanks to Prof. Dr. **Fatma Al-Zahraa Mostafa**, Professor of Pediatrics, Faculty of Medicine, Cairo University, for her kind support and continued encouragement along the years.*

*Lastly but by no means least, my deepest thanks are also due to Dr. **Mohamed Abdel-Hadi** who shared with me the heavy burden of completing this thesis in its final form. Without his meticulous and thorough supervision of this manuscript and unending support in times of stress to meet deadlines even past deadlines, this thesis would not be as it is.*

Thanks are also due to Unit 24. My friends and colleagues they always supported me, sharing with me good and bad times. I owe them many moments of happiness and the breath of fresh air during the most difficult times.

Ahmed Abdel-Rahman
April 2007

CONTENTS

| | Page |
|---|------|
| Introduction | 1 |
| Aim of the Work | 4 |
| Review of Literature: | 6 |
| ◦ Embryology | 7 |
| ◦ The Natural History of Ventricular Septal Defects | 31 |
| ◦ Diagnosis of VSD with Aortic Insufficiency | 37 |
| ◦ Management | 53 |
| Patients and Methods | 70 |
| Results | 77 |
| Discussion | 88 |
| Summary and Conclusion | 96 |
| References | 99 |
| Arabic Summary | 114 |

LIST OF TABLES

| Table | Title | PAGE |
|-------|---|------|
| I | Segments of the cardiac tubes | 9 |
| II | Prevalence of additional cardiac abnormalities in patients with ventricular septal defect with a comparison of frequencies between the adult and pediatric groups | 24 |
| III | Association of VSD with other cardiac abnormalities | 26 |
| 1 | Sex and age of the studied children | 78 |
| 2 | Distribution of the studied children according to type of VSD | 78 |
| 3 | Distribution of the studied children according to type of aortic cusp prolapse | 79 |
| 4 | Distribution of the studied children according to aortic regurgitation grading | 79 |
| 5 | Distribution of the studied children according to NYHA | 80 |
| 6 | Impact of AR grading on NYHA status | 81 |
| 7 | Impact of AR grading on pulmonary to systemic flow ratio (Qp/Qs) | 82 |
| 8 | Comparison of echocardiographic parameters pre- and postoperative | 83 |
| 9 | Changes in NYHA class postoperative | 84 |
| 10 | Comparison between the operative durations of grade I and II versus III and IV | 84 |
| 11 | Result of aortic valve repair | 85 |
| 12 | Incidence of cardiac arrhythmias in the immediate and intermediate postoperative period | 86 |
| 13 | Incidence of tricuspid regurgitation in the preoperative and intermediate postoperative period | 87 |

LIST OF FIGURES

| Fig. | Title | Page |
|-------------|--|-------------|
| 1 | Fusion of the two cardiac loops | 7 |
| 2 | Constrictions of the cardiac loops | 8 |
| 3 | Looping of the cardiac tube | 9 |
| 4 | Formation of the interventricular septum | 10 |
| 5 | Components of interventricular septum | 11 |
| 6 | Left lateral view of the left ventricle after completion of septation, but before valve formation | 13 |
| 7 | Right ventricular view of ventricular septal defects | 17 |
| 8 | Left ventricular view of ventricular septal defects | 17 |
| 9 | Flow chart showing the natural history of the 68 ventricular septal defects | 32 |
| 10 | Kaplan-Meier survival curve comparing spontaneous closure rates of perimembranous and muscular ventricular septal defects | 35 |
| 11 | VSD seen in the transverse plane of the left ventricular outflow tract | 47 |
| 12 | Echocardiogram of the long parasternal axis | 48 |
| 13 | Parasternal short-axis echocardiogram view with color Doppler showing proximity of the ventricular septal defect jet to the aortic and pulmonic valves | 49 |
| 14 | Echocardiographic picture of muscular VSD at RV sinus apex | 50 |
| 15 | Parasternal long-axis echocardiogram view for supracristal VSD | 51 |
| 16 | Subcostal "right ventricular inflow/outflow" view | 52 |
| 17 | (a) Central aortic regurgitation originating from the center of coaptation. (b) Eccentric right AR originating from the commissure between the right and the non-coronary cusp. | 60 |
| 18 | Evolution of the moderate aortic regurgitation group | 62 |

| | | |
|----|--|-----------|
| 19 | Kaplan-Meier analysis of freedom from progression of aortic regurgitation in patients with eccentric (closed circle) and central AR (open circle). | 62 |
| 20 | Method of measuring the right coronary cusp deformity index | 64 |
| 21 | Freedom from aortic regurgitation \geq slight | 67 |
| 22 | Impact of surgery on aortic regurgitation | 68 |
| 23 | VSD closed with patch | 75 |
| 24 | Bicuspid aortic valve repair | 76 |

ABSTRACT

Background: Aortic valve insufficiency with ventricular septal defect is usually treated by plication of the commissures. However, long-term deterioration is common. **Aim of the Study:** To assess the results of aortic repair with VSD closure in patients with VSD and mild to moderate aortic regurgitation and its effect on post operative course, postoperative LV dimensions and functions, this is to decide which degree of aortic regurgitation needs to be repaired in association with VSD closure.

Patients and Methods: The current study included 25 patients having VSD associated with mild to moderate aortic regurgitation who will undergo surgical closure of the VSD with repair of their aortic valve. All cases were subjected to clinical, radiological, echocardiographical assessment and surgical repair followed by postoperative assessment of LV changes.

Results: All children were subjected to patch closure of VSD except for severe cases of AI where VSDs were closed and aortic incompetence were treated by valvuloplasty. Postoperatively, there was no peri-immediate or late postoperative mortality. There was successful drop in pulmonary systolic pressure in addition to a significant improvement of left ventricular echocardiographic data in all groups regarding LVESD, LVEDD, EF, SWT (though statistically insignificant), PWT and LV muscle mass. **Conclusion:** Early detection and management of VSD associated with Aortic valve incompetence is helpful in management of these children with best results.

Keywords:

Aortic valve

VSD

Echocardiographic

INTRODUCTION

INTRODUCTION

Ventricular septal defect and aortic valve incompetence is a well-known association (*Van Praagh and McNamara, 1968*). Prevention of the aortic valve incompetence is commonly obtained by early closure of a sub-pulmonary VSD (*Chung and Manning, 1974; DeLeval et al., 1988; Dimich et al., 1973; Moreno-Carbal et al., 1977*).

However, the management of serious aortic valve insufficiency is still controversial, especially during childhood and for adults (*Okita et al., 1988*).

In 1973, Trusler and associates described a surgical technique that was widely used; the prolapsed cusp was plicated on the commissural areas with intra-aortic and extra-aortic wall pledgets (*Trusler et al., 1973*).

Other techniques were described, the basic concept was folding of the free edge of the prolapsed leaflet by a continuous suture (*Soyer et al., 1975; Spencer et al., 1973*).

Despite improvements in surgical management, the method of choice remains unclear because of early and late failures (*Ohkita et al., 1986*). Another approach for aortic valve repair was used since 1977 by triangular resection of the prolapsed cusp, reinforcement of the aortic wall and an aortic annuloplasty (*Carpentier, 1988*).

Aortic cusp prolapse is considered a risk factor for progressive aortic regurgitation in patients with a doubly committed sub-arterial VSD (*Komai et al., 1997*). It also occasionally complicates perimembranous VSD.

In both types of VSD, aortic regurge deteriorates slowly or remains mild for a long time following detectable aortic cusp prolapse.

Early surgery to prevent progressive aortic regurge is commonly recommended for a VSD complicated by aortic cusp prolapse.

Recently, the number of patients requiring aortic valve repair for aortic regurgitation associated with VSD has been markedly decreased because the mechanism of its occurrence is well understood, and the patients are immediately referred for closure of VSD when progression of prolapse of the aortic cusp or aortic regurge is detected (*Tatsuno et al., 1973; Tohyama et al., 1997; Schmidt et al., 1988*).

Patch closure alone for this type of VSD if the grade of the associated aortic regurge is mild or less has been found to prevent further progression of aortic regurge in several recent postoperative follow up studies (*Komai et al., 1997; Backer et al., 1991*).

AIM OF THE WORK

AIM OF THE WORK

The aim of this study is to:

1. Assess the results of aortic repair with VSD closure in patients with VSD and mild to moderate aortic regurgitation, and
2. Assess its effect on post-operative course, post-operative LV dimensions and functions, and
3. This is to decide which degree of aortic regurgitation needs to be repaired in association with VSD closure

REVIEW OF LITERATURE

EMBRYOLOGY

The heart forms as a specialized pump portion of the vascular system, rather than as a pumping organ in itself (*Wenink, 1987*).

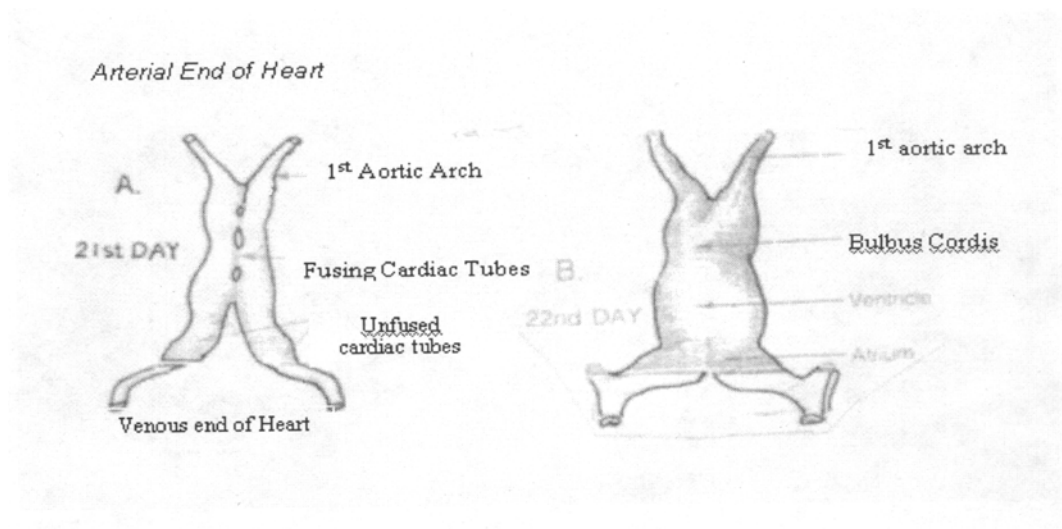


Fig. (1): Fusion of the two cardiac loops (*Amplatz and Castneda, 1986*).

Development of a vascular system is an early necessity in human embryology. So, at **18th day** of gestation a special site of blood vessel formation is found in *the mesoderm* at the anterior edge of the embryonic disc. This is the *cardiogenic area* where many small vessels unite to form two distinct heart tubes (right and left) which fuse to give rise to a single straight endocardial heart tube. This process of fusion begins cranially and progress caudally (**at 21 day of gestation**) (*Amplatz and Castneda, 1986*) (Fig. 1).