EVALUATION OF VALVE PROSTHESES AT AORTIC POSITION

THESIS

SUBMITTED IN PARTIAL FULFILLMENT

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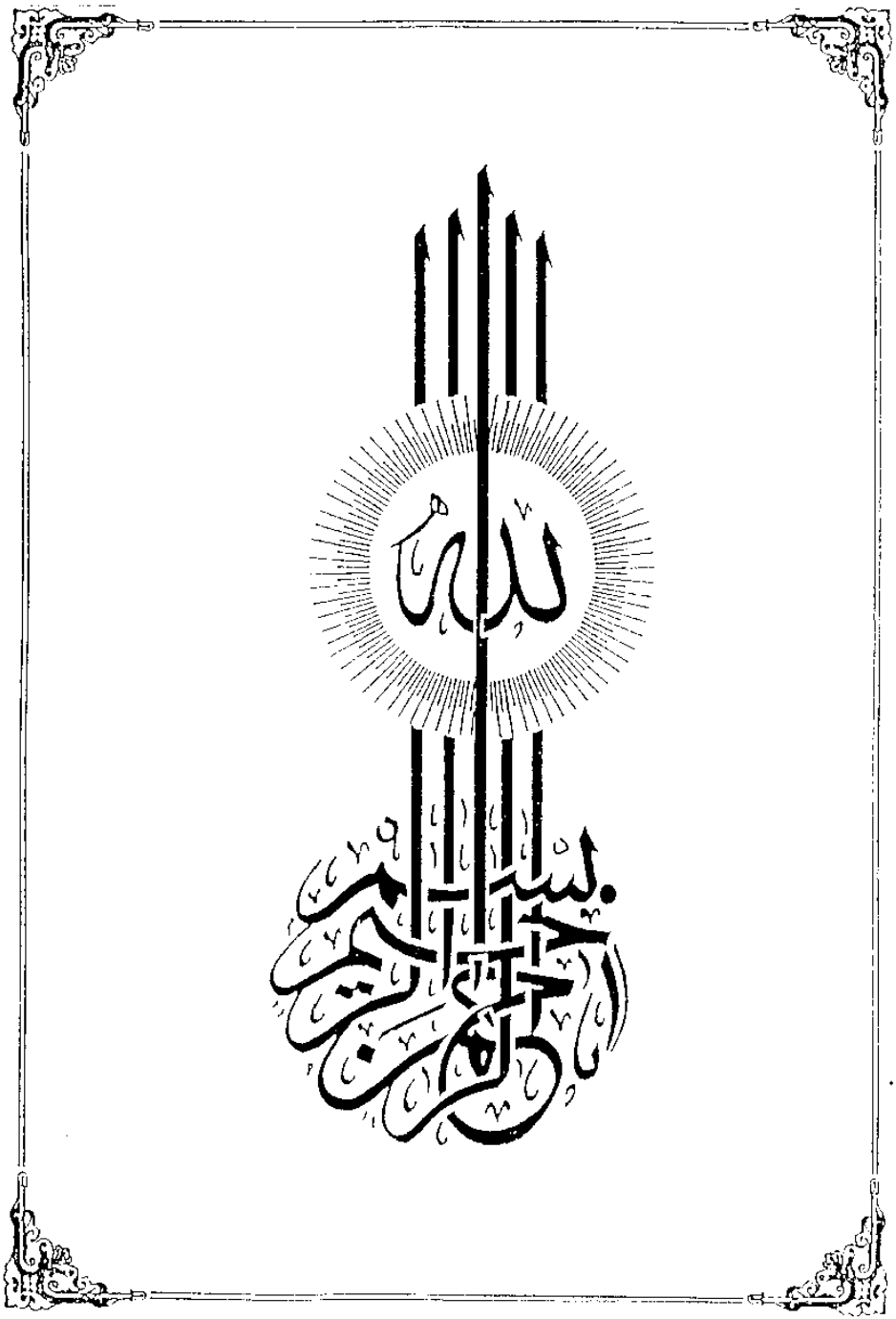
بسم الله الرحمن الرحيم

قالوا سبحـــانك لا عـــلم لنـا إلا ما علمتنـــا

إنك أنت العليم الحكيم

صدق الله العظيم

(سورة البقرة الآية ٣٢)



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CONTENTS

TO MY MOTHER

AND THE MEMORY OF MY FATHER

THIS WORK

IS DEDICTED

INTRODUCTION

INTRODUCTION

Artificial valve replacement did not seriously begin until 1952. Before this time, closed valve operation had had good results in cases of mitral stenosis, results were poor in aortic valve disease and mitral incompetence (Herr et al., 1965) and surgeons did many trials to improve their procedures for these lesions.

Hufnagel lighted the way of prosthetic valve replacement by successfuly inserting a caged ball valve into the descending thoracic aorta in patient with severe aortic regurgitation (Hufnagel et al 1953).In 1956 Lillehei revitalised the surgical approach to chronic valvuler disease by performing the first successful open mitral commissurotomy. Also in the same year Lillehei performed open annuloplasty operations for sever mitral regurgitation. Good results were in those patient in whom the leaflets pliability was perserved but poor results occured in patients with loss of valve tissue due to fibrosis and contraction of the leaflets. Also during this period, open heart operation were performed on the aortic valve similar to the mitral valve (Lillehei et al., 1958).

In 1960 Harken designed an aortic ball valve prosthesis that could be inserted below the origin of the coronary arteries. This valve was nylon-silicone rubber covered

poppets as ball in a stainless steel double caged prosthesis (Harken et al., 1960).

Harken's first aortic valve replacement was unsuccessful. His second patient, a 32 years old woman, did successful aortic valve replacement on March 10, 1960. This patient developed later on periprosthetic leakage and the prosthesis was replaced in 1963.

The second successful operation was performed in June 1960. The patient developed endocarditis and the prosthesis was replaced in 1985 (Editor et al., 1985). Thus, the initial prosthesis was in place for 25 years, the longest duration for any valve replacement recorded.

Neither of Harken's first two successful aortic replacements received anti coagulation and nor has embolic complications. The first successful mitral valve replacement was performed by Albert Starr in September 1960. Starr used also a caged ball prosthesis. His first patient died after operation by an air embolus but the second patient survived for 15 years later.

This device later on was modified several times because of several problems with ball valve variance and the high incidence of embolic episodes as well as disproportion between the size of the prosthetic valve apparatus and the

diameter of the left ventricular cavity. Several valves were designed to circumvent some of the problems seen with Starr-Edwards valve for examples. Magovern device, Smelloff-Cutter prosthesis, Braunwald-Cutter valve and De-Bakey Surgitool valve. In 1966, the Starr-Edwards valve was modified so that its performance had been satisfactory. Later on problems with patients having small left ventricular cavity were met because the low profile valve which were more suitable.

Hufnagel in 1965 introduced the first low profile valve. From this time, a number of low profile valve had entered the scene. Later on another class of prosthesis that are categorized by disc tilting valves were appeared. The advantage of these valves lies in that their larger orfices area and the presences of more physiologic flow pattern down stream from the valve.

THE AIM OF WORK

This study was done to clarify and delineate the various methods of assessment of various types of prosthetic valve function with particular stress in the most easy and non-invasive methods. It is certainly that orientation of different types of prosthetic valve particularly in the aortic position and evaluation of its functions will be of great help for the purposes of follow up of these patients.

CARDIAC VALVE PROSTHESES

CARDIAC VALVE PROSTHESES

A) Mechanical prostheses

(a) Caged ball design

1- Starr-Edwards valve, this prosthesis has many models. In the mitral position models 6000, 6120, 6300, 6310, 6320, 6400. In the aortic position models 1000, 1200, 1260, 2300, 2310, 2320, 2400.

2- Smeloff-Cutter valve.

3- Magovern-Cormie valve.

4- Braunwald-Cutter valve.

5- De-Bakey Surgitool valve.

(b) Central disc occluder prostheses (Non tilting disc)

1- Kay Shiley valve.

2- Beal-Surgitool valve models 102, 103, 104, 105, 106.

3- Starr-Edwards disc valve models 6500, 6520.

4- Cooley-Cutter valve.

(c) Tilting disc valves

1- Björk-Shiley disc valve, it passed many modifications:

- Björk-Shiley with derlin disc.
- Björk-Shiley with pyrolyte carbon disc.
- Björk-Shiley convexo concave model.
- Björk-Shiley integral monostrut model.

2- Lillehei-Kaster valve.

3- Omniscience valve.

4- Medtronic-Hall valve (Hall-Kaster).

5- St. Jude Medical bileaflets device.

B) Bioprostheses

1- Aortic valve homografts.

2- Autologus pulmonary valves.

3- Dura mater homografts.

4- Porcine valve xenografts, there are many types of the porcine xenografts :

i) Hancock porcine xenograft standard orifice.

ii) Hancock porcine xenograft modified orifice.

iii) Carpentier-Edwards porcine xenograft.

iv) Carpentier-Edwards Supra annular model xenograft.

v) Angell-Shiley valve.

5- Bovine pericardial xenografts, these include :

i) Ionescue-Shiley valve.

ii) Carpentier-Edwards pericardial xenograft.

iii) Unicusp pericardial Meadox xenograft.

MECHANICAL PROSTHESES

Here we will discuss the models used in aortic position only

A- Caged-Ball Valves

1) Starr-Edwards Ball Valves

Aortic prosthesis

Model 1000

This model was introduced in 1962 (Lefrac et al., 1979). It was a three-strut stainless steel device containing a silicon rubber ball. Three metal projections or feet were extended from the inflow orifice to form a secondary seat for the poppet. This double cage effect allowed the use of a smaller ball to increase the orifice to ball ratio to 0.91.

Ball variance (changes in ball size)

Marked changes were seen in the silastic balls of model 1000. This was first reported by Kornisch and Ablaza (Kornisch et al., 1965 & Ablaza et al., 1971). University of Oregon reported that there were 9 cases of ball variance among 860 aortic valve prosthesis returned to Edwards laboratory.

The problem of ball variance was eliminated in all subsequent models of aortic Starr-Edwards prosthesis, and is only present with the model 1000 prosthesis. However,

prophylactic replacement of model 1000 prosthesis is not necessary, and regular close checking of valve function, to detect the problem early, is only required.

Model 1200

Changes from the model 1000. were directed at minimizing the risk of ball variance, these changes are :

1- Elimination of the projecting feet from the inlet surface.

2- Conversion of the seat from a spherical to convex configuration.

3- Reduction of the poppet stroke distance.

4- Reshaping of the sewing ring to eliminate the possibility of cloth or Knots interfering with the ball pathway.

5- The fabric margin was extended to the inflow orifice to reduce the amount of exposed metal (Lefrac et al., 1979).

Model 1260

This model was introduced in 1968 and it is the same as-model 1200 except for :

1- The metal ring on the inflow aspect of the orifice was scalloped at the level of the struts to further reduce the amount of the bare metal.

2- The silastic ball were impregnated with barium sulphate to become radio opaque.