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Evaluation of the use of bileaflet versus tilting disc prosthetic valves in the mitral position

THESIS

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﴿بسم الله الرحمن الرحيم﴾

* قالوا سبحانك لا علم لنا إلا ما علمتنا إنك أنت العليم الحكيم *

البقرة – ٣٢

بسم الله الرحمن الرحيم

TO:

My Parents.

My Wife Dr / Mona.

My Daughter / Eman.

My Brother Dr / Mahmoud.

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Wael Abd El-Aziz

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Introduction and Aim of the Work

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The history of valve replacement is one of continual changes, both in prosthetic design and materials, and in selection and management of patients. Many prosthetic valves have been developed, initially widely used, and yet ultimately discarded when clinical performance did not meet initial, often intuitive predictions. Prostheses presently in use may be superior to those used in the past, but are not trouble free.

The evaluation process for new prosthetic valves should hold patient safety as a primary objective *(Gersh et al., 1986).*

Heart valve prostheses in current use can be divided into two classes: Mechanical and tissue, and each class into three types. Mechanical valves include caged ball, tilting disc, and hinged bileaflet valves. Representatives of currently available ball valves have been used clinically since 1960, disc valves since 1969, and bileaflet valves since 1977. Tissue valves include aortic homografts, stent-mounted porcine heterografts, and valves fabricated from bovine pericardium. Aortic homograft valves have been used clinically since 1962, and glutaraldehyde preserved porcine bioprostheses since 1965 *(Grunkemeier and Rahimtoola, 1990).*

Valve replacement continues to remain the dominant therapeutic modality in the management of patients with severe symptomatic valve lesions *(Rahimtoola, 1989).*

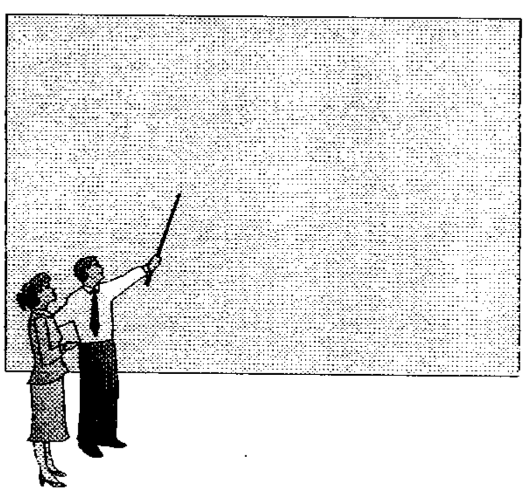
However, it must be realized that placement of prosthetic valve is an iatrogenic disease in itself as prosthetic valves are inherently susceptible to thrombosis, embolism, endocarditis, valve deterioration and frequently the complications of anticoagulation. Before deciding to take this step, one must compare the natural history of the patient's disease with the history of a patient with a prosthetic valve *(Morgan et al., 1985).*

The use of Doppler echocardiography in the evaluation of prosthetic heart valves was first described in 1979 *(Labovitz, 1989).*

The aim of this study is to:

- Evaluate the haemodynamic performance of bileaflet and tilting disc valves in the mitral position both clinically and by echo Doppler examination.
- Estimate the incidence of various valve related complications in bileaflet and tilting disc valves in the mitral position.
- Compare the haemodynamic performance of bileaflet and tilting disc valves in the mitral position, as well as the incidence of valve related complications in both tilting disc and bileaflet valves in order to find out if there is any significant difference between these two classes of mechanical prostheses.

Review of the literature



EMBRYOLOGIC CONSIDERATIONS OF THE MITRAL COMPLEX

The pericardial cavity can be identified before the head fold is formed or while it is in the process of formation at a stage when the embryo possesses only two somites.

At this stage, the heart is represented by groups of angioblasts which lie between the pericardium and the endoderm of the yolk sac. The ventral or yolk sac wall of the pericardium, which is destined to form both the epicardium and myocardium is thicker than the dorsal wall and it is called the myoepicardial mantle. When the head fold is formed, the mantle becomes the dorsal wall of the pericardium and lies ventral to the foregut.

While this reversal of pericardium is taking place, the cardiogenic angioblastic tissue gives rise to two paramedian endothelial tubes which rapidly fuse to give the tubular heart. The fusion is gradual, commencing at the bulbar (arterial) end and extending to the venous end. Fusion is complete at the seven somite stage (Van Mierop et al., 1963).

Except at its venous end, the tubular endothelial heart is separated from the myoepicardial mantle by the formless cardiac jelly.

The dorsal aortae arise as two endothelial tubes extending caudally within the body stalk where they establish continuity with the umbilical arteries which precede them in the time of appearance. At their cranial ends, the dorsal aortae curve ventrally round the sides of the foregut to reach the pericardium and become continuos with the cranial end of the endothelial heart tube forming the first pair of aortic arches.

A transverse groove appears on the surface of the heart tube, about its middle, which indicates the junction of the bulbus cordis (outlet portion) with the ventricle (inlet portion). The bulbus is situated cranial to the groove and is continuos with the first pair of aortic arches. The ventricle shows a second groove at its caudal end, where it opens into a common atrium, which lies at first in the floor of the pericardium and is disposed transversely. On each side, the common atrium is joined caudally by a short venous trunk formed by the union of the corresponding umbilical vein with the veins issuing from the vitelline (yolk sac) plexus. These trunks represent the right and left horns of the sinus venosus so that the common atrium may justifiably be termed a common sinoatrial chamber (Davis, 1973).

Early in the fourth week, the heart tube undergoes a striking change, while the pericardial cavity and embryo itself do not grow appreciably in size, the intrapericardial portion of the heart tube elongates rapidly and of necessity bends forming a U-shaped loop of which the bulbus cordis forms the right limb, and the ventricle the left. Normally, the convexity of the loop just formed is anteriorly and to the right (Van Mierop et al., 1963).

A number of developmental features have been discussed as possible factors in the mechanism of this dextral looping of the embryonic heart. These factors include features of early asymmetry of the embryo, skewness and right dislocation of the plane in which the heart primordia fuse, mechanical factors acting upon the heart from movements of adjacent tissues, differential elongation of pericardial cavity and heart tube, caudal movement of the whole heart, mechanism of cell redistribution in the heart mesoderm, different patterns of differentiation in the two heart rudiments, asymmetries in the number of cells contributed to the rostral and caudal parts of the conoventricular loop from the two heart primordia, and asymmetry in the initiation of the heart beat (Stalsberg, 1970).

On account of this loop, a deep bulboventricular notch or groove is apparent on the outside of the heart, a corresponding bulboventricular ridge, flange, or crest projects into the interior. Towards the end of the fourth week, the connection between the bulbus cordis and the first pair of aortic arches lengthens to form the truncus arteriosus and the cranial end of this vessel becomes connected to the dorsal aortae by the remaining five pairs of aortic arches (Davis, 1973).

Development of The Ventricular Mass and A-V Connections:

The development of the ventricular mass is intimately related to the process of looping. Looping results in reorientation of the ventricular component so that the inlet and outlet components are placed sided by side, with the outlet component to the right. Following such rightward looping, the heart tube still has smooth walls, with little evidence of trabeculations, and lined throughout by cardiac jelly, further growth occurs by outpouching of trabecular pouches, one from the inlet, and the other from the outlet components. The cardiac jelly persists in the A-V and ventriculoarterial junctions as the A-V and arterial cushions (Anderson, 1991).

It is the pouches that form the basis of the definitive ventricles. The trabecular component of the morphologically left ventricle grows from the inlet component and that of the right ventricle from the outlet component of the primary heart tube. Following pouch formation, the atrial chambers, by now septated, still connect to the left ventricular pouch (Via the ventricular inlet component), while the arterial component is connected exclusively to the right ventricular pouch (Via the ventricular outlet component). Normal development, therefore, requires effective transfer to the right ventricle of the ventricular inlet component connected to the right atrium and transfer of the outlet component connected to the aorta to the left ventricular trabecular pouch. The precise mechanisms of these processes remains controversial (Anderson, 1991).

As these connections are produced, the three components of the developing muscular ventricular septum (inlet septum, trabecular septum, and outlet septum) are brought into line one to the other. The outpouching of the trabecular components produces the primary ventricular septum which is the trabecular septum. The inlet septum (between the inlet components connected to right and left atria), is produced by active growth within the inlet component of the ventricular loop. It fuses inferiorly with the primary ventricular septum and superiorly with the underside of the atrioventricular endocardial cushions. The outlet septum is produced at the site of the outlet arterial endocardial cushions, and is brought into line with the primary septum after the aorta has become connected to the left ventricle. The A-V endocardial cushions initially fuse together at the center of the A-V junction. This then permits the right and left A-V orifices to develop in spectacle fashion and permits the aortic orifice to be transferred between the lenses of the spectacles to give a clover-leaf pattern.

Development of The A-V Valves:

At the completion of septation of the atria and ventricles, the greater part of the valve leaflet tissue has not begun to develop.

This is because the valves do not, as often presumed, differentiate from A-V cushion tissue. Instead, most of the valve tissue is produced by ingrowth by the fibro-fatty tissue of the A-V groove, together with delamination from the subendocardial layers of the developing myocardium, the latter process also produces the tension apparatus of the valves. The A-V groove tissue also separates the atrial from the ventricular myocardium and produces the fibrous annulus (Anderson, 1991).