The Role of Transoesophageal Echocardiography In The Choice & Evaluation of The Procedure of Relief of Mitral Stenosis

Thesis

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M.D. Degree In Cardiology

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Introduction & Aim of The Work

Rheumatic heart disease and its sequelae stays to be one of the major handicaps of the productive Egyptian community. Balloon mitral valvuloplasty blossomed forth as a promising alternative to surgical commissurotomy or valve replacement sometimes. It is thus expected to cut short the long lists awaiting surgery and meanwhile offer far less postoperative morbidity.

The initial enthusiasm by success was however frustrated by the unexpected occurrence of embolic strokes and disasters. The procedural consequences e. g ., atrial septal defects, mitral incompetence, failure and other difficulties needed to be better foreseen or detected.

Transesophageal echo is now proving its merits in many fields in Cardiology e. g ., aortic disease, congenital and ischemic heart disease, intraoperative monitoring... etc., where some unique achievements are now published.

The structures in question for a percutaneous balloon commissurotomy (PMC) procedure are almost those revealed best in a TEE image namely; left atrium and its appendage, atrial septum, right atrium and mitral valve complex.

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The perfect ability to detect atrial masses has already been declared. Hopefully one major frustration has finally come to an end i.e., fragmentation of a hidden appendage thrombus anticipated by preparatory TEE examination. Whether more insight will be provided into the procedure - its difficulties and complications should they occur is our target. How essential is TEE to a PMC procedure and at which stage(s) should it be done.

In summary, we were thus determined to assess:

1- Ability of TEE to predict the outcome, difficulty and complications.
2- Value in detection of complications.
3- Validity compared to conventional TEE.
4- Validity compared to reality.

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Review
Of
Literature

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I. Embryology and Anatomy of The Mitral Valve

Development of The Mitral Valve

The cardiac jelly is an acellular wide fluid layer which separates the cardiac tube lined by endothelium from the outer myoepicardial cover. By 34 days of gestation, 4 mounds of mesenchymal cells accumulate within the cardiac jelly. These are superior, inferior, right and left endocardial cushions.

The superior and inferior cushions protrude into the tube growing towards each other. They finally fuse together forming the left and right atrioventricular canals with separate mitral and tricuspid orifices. They also form the lower IAS and serve to close the ostium primum; form the membranous interventricular septum and the atrioventricular valves.

By the 8th week blunt tabs of valvular tissue project from fused superior, inferior, and lateral cushion into the left atrioventricular orifice.

The anterior leaflet develops first as follows: 50% from the superior and 50% from the inferior cushion. The posterior leaflet soon follows. It totally develops from the left lateral cushion. The leaflets originally are completely muscular. They are anchored on the entire undersurface by trabecular muscle to the ventricular wall.

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Gradually, the leaflets are invaded and replaced by collagen. Continuous cutting, absorption and undermining proceed in the trabecular muscle. As a result, the muscle is transformed into fibrous tissue "chordae tendinae" attached only at or near the edge of the leaflets ***(Silverman and Hurst, 1968)***.

The atrial septum:

The primitive sinuatrium is divided into right and left atria by a downward growth from its roof "septum primum". It creates an inferior ostium primum opening. Multiple perforations form in its anteroposterior portion as the septum secundum starts to develop on its right. When these perforations coalesce, they form the ostium secundum. The septum secundum completely separates the atrial chambers except for a central "fossa ovalis". This is covered by tissue of the septum primum forming the valve of foramen ovale. The integrity of atrial septal depends on growth of septum primum and septum secundum and proper fusion of the endocardial cushions ***(Friedman, 1992)***.

The atrial septum is found in the posteroinferior portion of the medial wall of right atrium and extends obliquely forwards from right to left. Near its center, there is a shallow depression, the fossa ovalis, which often has a prominent fold or limbus anteriorly.

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Anatomy of The Mitral Complex

The mitral complex is an intricate structure requiring the interaction of its components. It contrasts to the relatively uncomplicated aortic valve mechanism which does not require such a framework for opening and closure. These components are:

1) The valves leaflets, 2) Chordae tendinae, 3) Papillary muscles, 4) Mitral annulus ***(Rusted et al., 1952; Silverman and Hurst, 1968 and Walmsley, 1978)***. In some sense; 5) The left atrial wall, and 6) Left ventricular wall were both considered also as components by ***Perloff and Roberts (1972)***. Pathologic changes in these 2 components disintegrate the harmony of the mitral mechanism.

The left atrial wall:

1- Normally, the vigorous atrial contraction, then relaxation, causes a ventriculo-atrial gradient and mitral valve closure before ventricular systole (a mechanism lost in A.F.).
2- Left atrial dilatation draws the posterior mitral leaflet backwards and downwards preventing good coaptation.

The left ventricular wall:

Basically, the left ventricular wall is a non separable part of the papillary muscle and mitral annulus. In systole, the deep bulbospinal muscle contracts the mitral annulus significantly reducing its circumference. Left ventricular dilatation counteracts the sphincteric

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action at the ring and causes lateral or vertical migration of papillary muscles with subsequent M.R.

The mitral annulus:

The mitral annulus is a part of the fibrous skeleton of the heart which gives attachment to the valves, atrial and ventricular muscle. In a top view, atria removed, the fibrous skeleton is seen as adjoining rings surrounding a central core the "central fibrous body". The right trigone passes posteromedially from the central fibrous body between the anterior mitral leaflet, septal tricuspid leaflet and posterior aortic cusp. The left fibrous trigone is thinner, passes anteriorly from the right fibrous trigone curving between the anterior mitral leaflet and left coronary aortic cusp. From the left and right trigones, fibroelastic tissue passes around the atrioventricular orifices. These are the annuli fibrosi. The mitral annulus measures 8-12 cm in circumference ***(Chiechi et al., 1956 and Rusted et al., 1956)***. The anterior third is continuous with the left coronary and non coronary aortic cusps. The posterior 2/3 completes the ring extending laterally from the left fibrous trigone in front to the right fibrous trigone posteromedially and may be incomplete or ill defined ***(Silverman and Hurst, 1968)***. However, it appears that still others see the ring discontinuous anteriorly and refuse to call it "ring" ***(Chiechi et al., 1956 and Walmsley, 1978)***.

The annulus serves as a fulcrum for the leaflets, has a sphincteric action to narrow the mitral orifice in systole helped by deep bulbospinal

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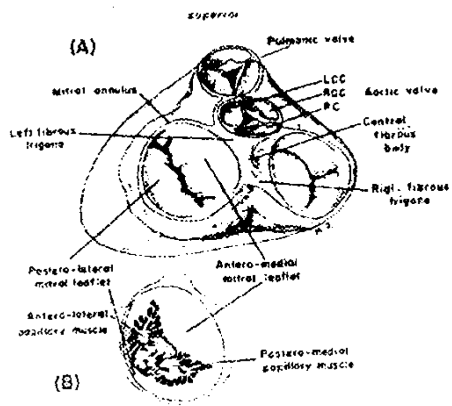
muscle, provides both toughness to offense dilatation and pliability to help sphincteric action.

Fig. (1):
Fibrous skeleton interconnections as seen from the base of the heart *(Van Der Spuy, 1958).*



As seen by others, the ring looks kidney shaped. The anteromedial half is biconcave. It is formed of the common fibrous origin of: 1) the anteromedial cusp, 2) the postero-lateral half of the aortic root, 3) the major part of 2 aortic cusps.

As the base of the mitral cusp is attached to the origin of 2 adjacent aortic cusps from the aortic root, it is biconcave.

The posterolateral half of the mitral ring is semiovoid, convex. It is formed by the common fibrous origins of the posterolateral cusp, posterior LA wall and base of left ventricle. (N.B. the anterior half of LA arises by a fleshy origin from the upper surface of the base of the anteromedial cusp close to the mitral ring).

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As the base of left ventricle accommodates the circular aortic root and the kidney shaped mitral ring posterior to it; systolic contraction of the base of the ventricle is associated with maximum ejection force inside the elastic aorta which expands; thus, the mitral ring has to flatten with consequent approximation of mitral cusps ***(Van Der Spuy, 1958)***.

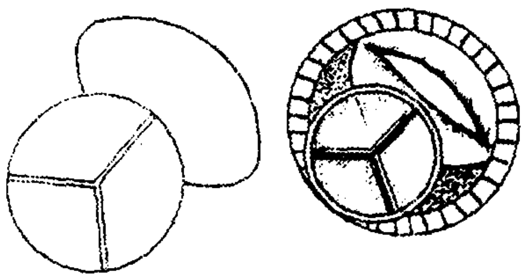

Fig (2): Base of left ventricle accomodates the circular root of the aorta and the kidney shaped mitral valve *(Van Der Spuy, 1958).*

Leaflets and commissures:

Mitral leaflets hang between the mitral annulus and the 2 papillary muscles. They form a veil of fibroelastic tissue that completely surrounds the annulus. The valve looks like a cone shaped funnel being 1 cm longer at its annular attachment than its free edge.

Commissures:

Two indentations divide this cone into an anteromedial and posterolateral leaflet. These indentations never reach deeply to the valve ring leaving bridging "commissures".

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Definition:

Commissure: areas joined together or junctional zone.

In other words, the orifice never extends to the ring and there is a cuff a valvular tissue all around ***(Rusted et al., 1952 and Walmsley, 1978)***. These commissural areas may be prominent enough to form accessory leaflets ***(Silverman and Hurst, 1968)***. These were found only in 5% of specimens in one group ***(Rusted et al., 1952)***. If present they are usually smaller (1/2 - 2/3 the depth of the posterior leaflet) ***(Harken et al., 1952 and Chiechi et al., 1956)***. Yet, the presence of accessory leaflets was totally denied and instead, all tissue posterior to the commissures were defined as posterior leaflet ***(Ranganathan et al., 1970)***. ***Rusted et al. (1952)*** reasoned that some may have considered scallops of posterior leaflet as commissural leaflets, hence an overestimated incidence was deduced. They found the commissure to be 7-8 mm deep normally. If depth is increased ≥ 1 cm "artificial" or "pathological" commissure should be now spoken of. This was partly made of fused leaflets, on top of original commissures. Older works have claimed that a commissure is a pathologic finding never brought to reality except by mitral valve disease ***(Chiechi et al., 1956 and Glover et al., 1950)***.

The commissural area is defined by the spread of insertion of commissural chordae (1.5 cm females - 1.8 cm males) in posteromedial commissure, (0.9 cm females-1.2 cm males) in anterolateral one. Inter-

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