The Value of Transthoracic Echocardiography for Assessment of Left Atrial Volume before and after Percutaneous Balloon Mitral Valvuloplasty

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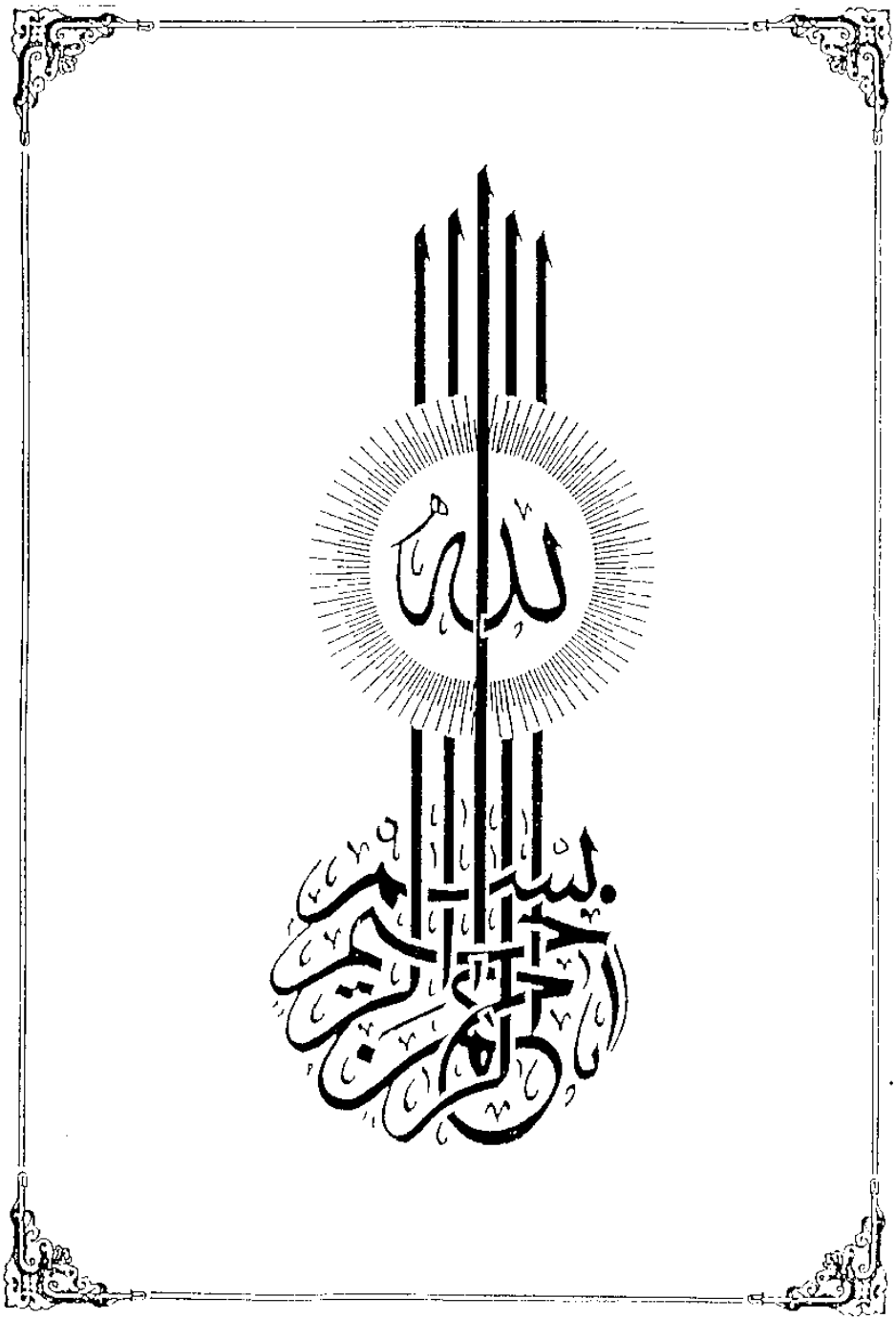

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Rheumatic fever and rheumatic heart disease still form a major health problem in developing countries including Egypt, where socioeconomic factors predispose to its occurrence. Unfortunately, Egypt is located in the geographical belt of rheumatic fever and rheumatic heart disease with other Asian and African countries.

Percutaneous balloon mitral valvuloplasty (PBMV) is a new and promising technique for treatment of patients with rheumatic mitral stenosis. Two-dimensional and Doppler echocardiography provide an excellent opportunity for the evaluation of both the anatomy and function of the diseased mitral valve before and after percutaneous balloon mitral valvuloplasty (Mckay et al, 1987).

The aim of this work is to study the changes in the left atrial volume before and after PBMV by transthoracic echocardiography.

Review Of Literature

The Commissural Areas:

The extent of the commissural area is defined by noting the spread of the fan-like commissural chordal branches. In some instance, especially on the posteromedial commissure, the chordal branches have a very wide insertion to portion of the adjoining leaflets.

The Leaflet Area:

Anterior Leaflet:

The anterior leaflet has also been called the aortic,septal, greater,or anteromedial leaflet (*Chiechi et al, 1956*). It is large, either semicircular or triangular and has a free margin with few or no indentations. The anterior leaflet forms an important boundary of the left ventricular outflow tract. It has a common attachment to the cardiac skeleton with the left coronary cusp and half of the non-coronary cusp of the aortic valve. The mitral valve differs from the tricuspid valve in this respect, the later does not share a common attachment to the pulmonary valve, which is separated by the infundibulum of the right ventricle. To a certain extent, this relationship limits the degree of dilatation of the mitral ring that would result just from ventricular dilatation. While right ventricular dilatation would necessarily result in a complete tricuspid ring dilatation, this is not necessarily the case with the mitral valve.

Posterior Leaflet:

The posterior leaflet is also called the ventricular leaflet, mural leaflet, smaller leaflet, or the postero-lateral leaflet *(Chiechi et al, 1956).* It comprises all leaflet tissue posterior to the commissural areas. It has a wider attachment to the atrioventricular annulus than the anterior leaflet.

Chordae Tendinae of The Mitral Leaflets:

The chordae tendinae are fibrous strings that originate from tiny nipples on the apical portion of the two left ventricular papillary muscles or directly from the ventricular wall. Those that insert into the valve are true chordae tendinae, those that insert elsewhere, for example, into the muscle are false chordae tendinae. The majority of true chordae tendinae branch either soon after their origin or just before their insertion into the leaflet. A small number branch at mid-distance. Chordae tendinae passing to the anterior leaflet insert obliquely on either side of the anterior leaflet, but those that insert into the posterior leaflet are aligned parallel to each other.

The Papillary Muscles:

They originate from the ventricular wall and lie between the major mitral leaflets directly inferior to the valve junctional zone. Their location is anterolateral and posteromedial in the inflow tract of the left ventricular cavity.

Each chordal fan originates mainly from the apex of each papillary muscle

and extends to the corresponding halves of the mitral leaflets. The papillary muscles may be single, double, triple, or even formed by more than three muscles.

Arterial Supply Of the Left Ventricular papillary Muscles:

The anterolateral papillary muscle receives branches from the anterior descending coronary artery and either the diagonal left ventricular arteries or the marginal branches of the left circumflex artery.

The posteromedial papillary muscle receives a variable supply from the left circumflex artery and / or branches of the right coronary artery. The epicardial branches of the coronary arteries course from base to the apex of the heart, giving penetrating intra myocardial branches.

Anatomic physiologic properties of the mitral apparatus:

The mitral apparatus is a complex, finely co-ordinated mechanism that requires for its normal performance the functional integrity of six anatomic elements working in delicate harmony.

These elements are :

1. Left atrium.
2. Annulus.
3. The leaflets.
4. The chordae tendinae.
5. The papillary muscles.
6. The left ventricular wall.

1. Left atrium:

The left atrium contributes to the competence of the mitral valve by two things : contraction and atrial dilatation. Although it has been confirmed that atrial contraction and relaxation influence mitral valve closure in man, the loss of effective atrial contraction (for example atrial fibrillation) does not necessarily cause mitral regurgitation (*Levy et al, 1962*).

However, left atrial enlargement can contribute to incompetence of the mitral valve. As the chamber enlarges, its posterior wall is displaced posteriorly and downward.

2. Mitral annulus:

The mitral annulus serves two important functions:

1. The true annulus is an essential part of the basal attachment or fulcrum of the posterior leaflet (*Levy et Al, 1962*).

2. The size of the annulus plays an important role in preserving competence of the mitral orifice, albeit a role that relates less to dilatation than to a lack of systolic decrease in circumference *(Perloff et al, 1972)*. Annular tissue is pliable, permitting sphincteric contraction during left atrial and left ventricular systole. This contraction diminishes the area that the leaflet must bridge by an estimated 20 - 40 % (*Perloff et al, 1972*). Abnormalities causing a decrease in basal left ventricular circumferential fiber shortening oppose systolic annular

contraction. Similarly, with calcification of the annulus, the mechanism of regurgitation is believed to stem from a loss of sphincteric action.

3. Leaflets :

Proper closer of the leaflets represents an important goal of the mitral mechanism. The areas of the two are nearly identical, but their shapes differ considerably and conform to their functions (*Perloff et al, 1972*).

The basal attachment of the anterior leaflet is comparatively short since it is in direct continuity with the aortic wall, which serves as a fulcrum. The basal attachment of the posterior leaflet is comparatively long, since it attaches to the entire length of the true annulus. However, the basal to free edge length of the anterior leaflet is two or more times that of the posterior. Consequently, the anterior leaflet is intrinsically more mobile, while the posterior leaflet moves towards its anterior mate chiefly because of movement imparted by the contracting annulus (*Perloff et al, 1972*).

4. Chordae tendinae

Chordal abnormalities that disturb the function of the mitral apparatus include abnormally long chordae, abnormally short chordae, ectopically inserted chordae, fusion of chordae, and ruptured chordae.

5.- 6. Papillary muscles and left ventricular wall :

The papillary muscles and left ventricular wall represent the muscular component of the mitral apparatus. The papillary muscles emerge as single bodies from the left ventricular wall and divide into four to six heads, each serving as an anchor for two primary chordae tendinae, sudden loss of continuity causes acute severe mitral regurgitation.

Anatomy Of The Left Atrium

The left atrium is a posterosuperior midline chamber that receives pulmonary venous blood and expels it across the mitral orifice and into the left ventricle. The body of the left atrium, by virtue of its posterior position, does not contribute to the frontal cardiac silhouette roentgenographically; however, the lateral left atrial appendage, when enlarged, may form the portion of the left cardiac border between the left ventricle and the pulmonary trunk.

Interposed between the midline left atrium and the vertebral bodies are the esophagus, rightward, and the descending thoracic aorta, leftward. The left pulmonary artery and left bronchus contact the superior surface of the left atrium, and the left and posterior aortic sinuses may slightly indent the atrial wall, just superior to the area of fibrous continuity between mitral and aortic valves. The left