The Use of Doppler Echocardiography in the Assessment of the Mitral Valve Before and After Closed Commissurotomy

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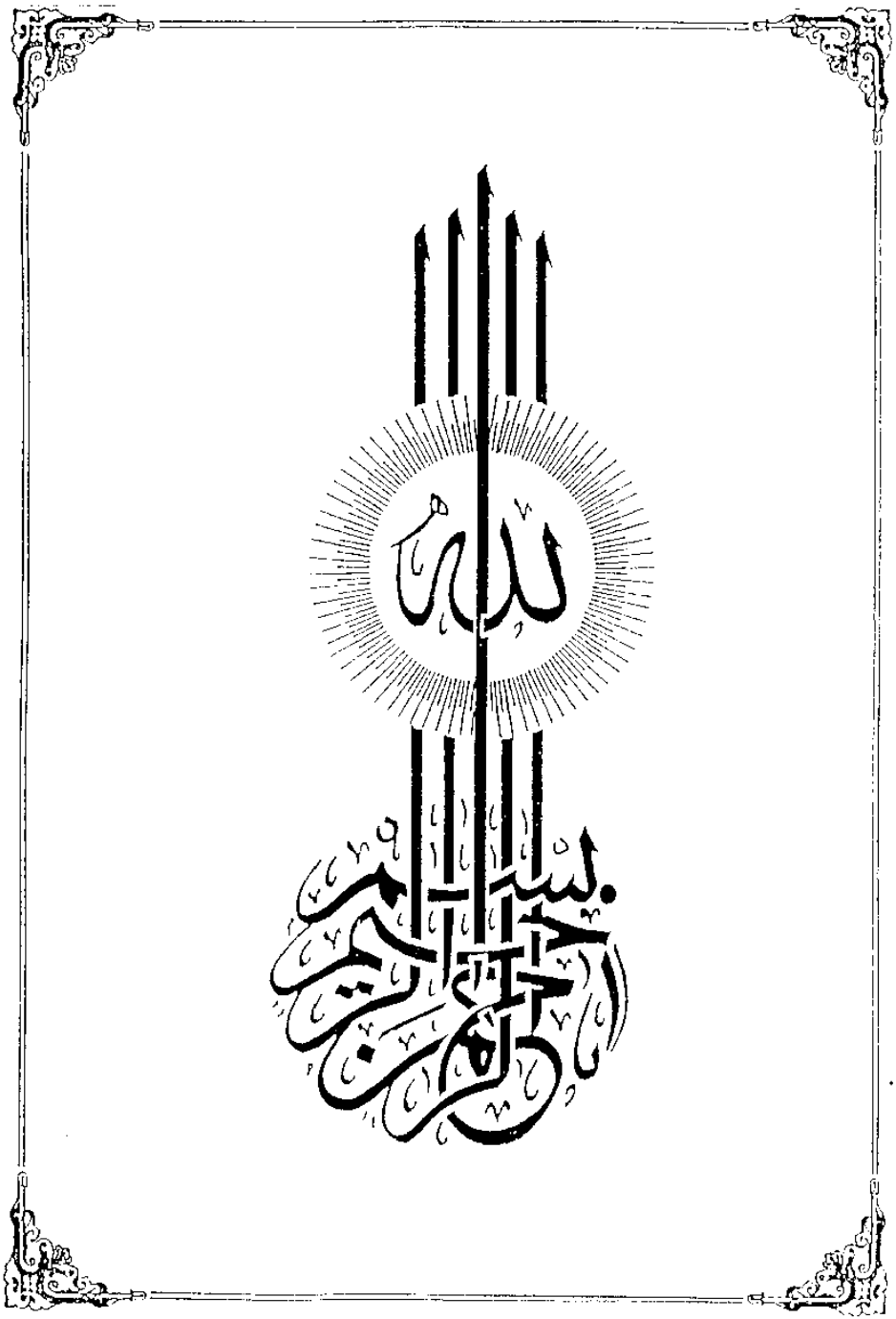

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LIST OF ABBREVIATIONS

2D	:	Two-dimensional.
AF	:	Atrial fibrillation.
AR	:	Aortic regurgitation.
C	:	Calcification.
CMC	:	Closed mitral commissurotomy.
M	:	Mobility.
max PG	:	Maximum pressure gradient.
Mean PG	:	Mean Pressure Gradient.
MR	:	Mitral regurgitation.
MS	:	Mitral stenosis.
MVA	:	Mitral valve area.
NYHA	:	New York Heart Association.
Op	:	Optimal.
PAP	:	Pulmonary artery pressure.
PHT	:	Pressure half-time.
S	:	Subvalvar affection.
Sb	:	Suboptimal.
T	:	Thickening.
TR	:	Tricuspid regurgitation.

INTRODUCTION

Worldwide the highest mortality for rheumatic heart disease is found in Egypt where it is 27.5/100,000 *(Majeed, 1989).*

Some may argue against the above statement in view of the absence of reliable medical statistics in the 3rd world, however, the fact remains that there is a high incidence of rheumatic fever and rheumatic heart disease in Egypt as well as in other developing countries.

Rheumatic heart disease may be viewed as a disease of the mitral valve and Aschoff bodies have never been found in hearts without anatomic disease of the mitral valve and the functional lesions affecting the mitral valve is usually stenotic (with or without regurge) *(Robert, 1983).*

From the two above statements, we can conclude that rheumatic mitral stenosis constitutes a major health problem in Egypt.

Closed instrument surgical mitral commissurotomy (CMC) has a long and honorable history in Egypt as well as in many parts of the developing world where mitral stenosis in young patients with pliable valves is abundant, and has remained the procedure of choice in spite of a shift towards the open procedure in the developed world in view of the older population of patients seen there and the more rigid and less pliable valves *(John et al., 1983).*

Recently the technique of percutaneous balloon mitral valve valvuloplasty (PMBV) has been described by *Inoue et al. (1984)* as an alternative approach for dilating pliable mitral valves following, this, there was a

huge international interest in this new closed technique using the same principle of blunt pressure to separate the fused commissures. However, in view of its low cost, efficacy, safety and large experience with, CMC is likely to remain the procedure of choice in our country to dilate stenotic mitral valves in addition to PMBV in selected cases and centers with better economic abilities.

The diagnosis of mitral stenosis has been one of the first application of echocardiography and remains a major use for this tool, from the early days of M-mode *(Edler et al., 1957)* signs of mitral stenosis were described, then with the advent of 2 dimensional real time echocardiography (2DE) improved assessment of the mitral valve become possible and accurate morphologic description of stenotic mitral valve was done and for the first time accurate non-invasive objective assessment by measuring the mitral orifice area become possible *(Henry et al., 1975).*

With Doppler echocardiography, the accurate assessment of mitral stenosis and its associated conditions reached new dimensions and Echo and Doppler is used to measure the gradients across stenotic mitral valve, *Holen et al. (1979)* measure the mitral valve area by the pressure half-time method (PHT) *(Hatle et al., 1979),* detect associated mitral and aortic regurge with high levels of precision, measure pulmonary artery pressure non-invasively by a variety of Doppler methods *(Abascal et al., 1988; Berger et al., 1985; Bradly et al., 1988; Dabestani et al., 1987; Dittman et al., 1987; Zabagliota-Reyes, 1986).*

Then with the advent of color coded Doppler echo and of transoesophageal echo (TEE) the degree of precision in diagnosing mitral stenosis has become very high, trace mitral regurgitation can be seen by color, left atrial appendage thrombi by TEE, spontaneous contract echo, a sign described to herald the presence of LA thrombi has been seen well by TEE and

seems linked to thrombi. Ultrasound has also been used for a variety of uses in relation to mitral stenosis from prediction of maintenance of sinus rhythm after cardioversion up to the newly descried techniques of decalcification of calcific valves in vivo by ultrasound *(Khanderia et al., 1986; Dethy et al., 1988; Daniel et al., 1988; Eguaras et al., 1988; Parris et al., 1988; Schweizer et al., 1981; Shah, 1987).*

In this work it was attempted to examine patients with mitral stenosis before and after CMC with several aims.

The first aim was to assess the types of valves which would benefit most from this procedure specially in view of the recently published 2D echo scores for PMBV *(Wilkins et al., 1988).*

A second aim was to reassess the efficacy of the operation itself with the newly available sophisticated echo technology which permits 2D visualization of intracardiac structures and Doppler evaluation of flows and pressures in a way not previously possible, this aim of reassessing the operation itself became even more important with the advent of PMBV, another closed technique for dilating stenotic mitral valve and the recent reports by authors performing it about lack of published data providing objective non-invasive data about the results the CMC *(Palacios et al., 1989).*

Another aim was to compare between the 2 most widely used non-invasive methods for measuring the mitral valve area 2DE and Doppler PHT, specially with reports by some authors about the inaccuracy of either method either in the post PMBV setting *(Thomes et al., 1988)* or in the post commissurotomy patients *(Smith et al., 1986).*

A full Pre- and postoperative echocardiographic evaluation of patients who underwent CMC was attempted, this was done in an attempt to reach more understanding of when and how to interfere to relieve mitral stenosis hoping to prevent the morbid sequaele of untreated mitral stenosis using echocardiography the modern day gold standard for assessing the stenotic mitral valve before or after dilatation be it by the Tubbs transventricular dilator, the balloon or the open surgical technique.

RHEUMATIC FEVER AND MITRAL STENOSIS

Mitral stenosis is one of the sequelae of rheumatic fever which could follow untreated or improperly treated streptococcal throat infections.

In recent years rheumatic fever and rheumatic hearts disease even though still rampant in the developing world have become almost extinct in the developed world.

However, several recent reports *(Congeni et al., 1987; Kaplan and Hill, 1987)* have indicated the return of rheumatic fever to certain developed areas particularly in the USA in what was described by *Kaplan and Hill (1987)* is an "epidemic" of reports. *Dajani et al. (1988)* pointed out that during epidemics of streptococcal infections as many as 3% of untreated acute streptococcal throat infections may be followed by rheumatic fever and that appropriate antibiotic management of these infections prevents acute rheumatic fever in most cases.

Dajani et al. (1988) also pointed out that unfortunately it is not uncommon for episodes of acute rheumatic fever to results from inapparent streptococcal infections for which patients do not seek medical care which would make those episodes unpreventable.

In analysing the implications of the return of rheumatic fever of certain areas of the USA. *Kaplan and Hill (1987)* pointed out that the fact that the incidence of streptococcal infections in the USA have not decreased in spite of the marked drop in the incidence of rheumatic fever has led some physicians to beli-eve that the accurate clinical management of pharyngitis is not as important

as it once was and how the recent outbreaks emphasized the fallacy of this reasoning.

Kaplan and Hill (1987) emphasized the importance of avoiding complacency in the clinical management of streptococcal pharyngitis emphasizing the importance of throats cultures and the necessity of 10 full days of adequate oral antimicrobial therapy (if IM repository penicillin was not used).

Kaplan and Hill then pointed out that one of the most important implications of the resurgence of rheumatic fever in the USA is for the developing countries of the world where rheumatic heart disease is the most common cardiovascular cause of death in the first 5 decades of life causing very significant mobility and mortality not to mention the social and economic impact on countries which can least offered it.

They pointed out that those responsible for establishing health care programs in countries with limited health care resources have been led to believe that rheumatic fever will cease to be a problem when standards of living improve. Kaplan and Hill pointed out to the inaccuracy of this supposition and they emphasized the fact that even when standards of living are high and medical care is accessible the potential for the disease remains and that until the factors involved in the pathogenesis of rheumatic fever are fully understood. It will remain a public health hazard.

They also pointed to the interesting hypothesis about the presence of a rheumatogenic strain of group A streptococcus which are extremely mucoid.

Finally they pointed out that until the future development of an effective group A streptococcal vaccine the importance of good clinical management of streptococcal throat infections cannot be overimphasized and that physicians

should not forget the importance of what *Wannamaker (1973)* described as the chain that links the (streptococci) the heart to the throat to produce this most potentially devastating disease.

Marcus et al. (1988) pointed out that mitral stenosis usually follows a single or a few number of episodes of rheumatic carditis and is the result of the ongoing fibrosis, while repeated and frequent attacks of rheumatic carditis may lead to predominant mitral regurgitation.

ANATOMY AND PATHOLOGY

Roberts in a relatively recent publication (1983) reviewed the anatomic findings in both the normally and abnormally functioning mitral valves.

The Normal Mitral Valve

The mitral valve, in comparison with the semilunar valves, is a complex structure consisting of 4 major components: leaflets, chordae tendinae, papillary muscles and annulus. Unlike the other 3 cardiac valves, each of which has 3 cusps, the mitral valve consists of only 2 leaflets. The anterior one has a much longer basal-to-margin length than does the posterior leaflet, but the length of the annular attachment of the posterior leaflet (about 6 cm) is about twice that of the anterior leaflet (about 3cm). Although the basal-to-margin lengths and the lengths of the basal attachments of each mitral leaflet are quite different, the surface area of each leaflet is virtually identical. The posterior leaflet has a true bundle of fibrous tissue (the annulus) separating the myocardium of left atrium from the myocardium of left ventricle. The posterior leaflet, in a large sense, is simply an extension of mural endocardium from the free walls of the left atrium. In contrast to the posterior mitral leaflet, the anterior leaflet does not have a true annulus but is continuous with the wall of the ascending aorta, aortic valve, membranous ventricular septum, and atrial septum. The area of the leaflets is about 2.5 times that of the area of the mitral orifice at the level of the mitral annulus. In contrast to the semilunar cusps, which are independent or discontinuous of each other, the 2 mitral leaflets are continuous with each other, being connected at the commissures.

Chordae tendinae from both mitral leaflets insert into both papillary muscles. About 5 times as many chordae are attached to the leaflets as to the papillary muscles. On an average, 24 chordae tendinae are attached to the papillary muscles (12 to each), and 120 chordae are attached to the leaflets. The chordae insert onto the undersurfaces - that is, the ventricular surface - of both leaflets. The chordae subdivide as they progress from papillary muscle to leaflet. The subdivisions may be viewed as primary (first order), secondary (second order), and tertiary (third order) chordae. The spaces between the chordae serve as secondary orifices between LA and LV. Obviously the major orifice is the area between the leaflets, but much blood passes between the interchordal spaces. Therefore, fusion of chordae tendinae may narrow the mitral inlet.

The two left ventricular papillary muscles are preferably designated anterolateral and posteromedial. There is considerable variation in the appearance of these structures in the same person, and comparison of corresponding structures in different persons disclosed considerable variation. The anterolateral papillary muscle is generally the more uniform of the two. It usually consists of a single trunk that protrudes more into the cavity then does the posteromedial one. The posteromedial papillary muscle is generally smaller than the anterolateral structure and often consists of 2 or 3 smaller pillars rather than a large pillar. The posteromedial muscle usually has several connections to the left ventricular wall *(Roberts and Cohen, 1972).*

In addition to the base of the major trunk, both papillary muscles are attached to the left ventricular free wall roughly at the junction of the caudal third and middle thirds.

Pathology of Rheumatic Mitral Stenosis and Features of the Stenotic Mitral Valve

Isolated mitral stenosis is, with rare exception, always rheumatic in origin, while isolated mitral regurgitation is usually non-rheumatic in origin, anatomically isolated aortic valve disease is never rheumatic in origin while anatomic disease involving more than one valve is usually rheumatic in origin *(Roberts, 1983),* Roberts pointed out that this above statement is only describing valves from the anatomical point of view, for example, in pure MS the aortic valve may be anatomically abnormal but functionally normal.

Roberts emphasized the fact that rheumatic heart disease may be viewed as a disease of the mitral valve, other valves may be involved anatomically and functionally but the mitral valve is always anatomically involved.

Microscopically Aschoff bodies, the only pathognomonic lesion of rheumatic heart disease have never been found in hearts without anatomic disease of the mitral valve, the functional lesion in large series of autopsies studied with Aschoff bodies found is usually mitral stenosis *(Virmany and Roberts, 1977; Roberts and Virmany, 1978).*

The healing of acute rheumatic endocarditis may results in mitral valve stenosis which is observed frequently in the young and middle aged with females showing a greater tendency to deformity of the mitral valve than males ratio of about 3 : 2 *(Gould, 1968).*

Rheumatic heart disease is not only a disorder of the cardiac valves, but it also affects mural endocardium, pericardium and myocardium and in histologic