

Outcome of
Balloon valvuloplasty in patients with
mitral valve stenosis in Sudan

Thesis submitted for fulfillment
of master degree of cardiovascular medicine

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Abstract

PBMV has become a safe and effective therapeutic option in a wide range of patients with mitral stenosis, and thus appears to be an attractive therapeutic alternative to surgery in patients who are good candidate for commissurotomy. PBMV can be done safely in cardiac catheterization laboratories percutaneously without general anesthesia, with relatively low risk and patients can leave the hospital 24 hours after the procedure.

Both The short and long term results of percutaneous mitral valvuloplasty were similar to or even better than results of surgically closed mitral commissurotomy. However, some complications had been reported with PBMV but those complications are low especially with increased operator experience.

The aim of this study was to see the effect of PBMV in mitral valve area immediate improvement, regression during one year after initial improvement and the factors affecting both improvement and regression. Also the study evaluated NYHA improvement post PBMV. The study aimed to see the mortality and complications of the procedure and need for revalvotomy and surgery throughout one year of follow-up.

Key Words:

Clinical Background of Mitral Stenosis, Percutaneous Balloon Mitral Valvuloplasty

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ABBREVIATIONS

ACC: American college of cardiology.
AHA: American heart association.
AF : Atrial fibrillation.
ANOVA: analysis of variance.
ASD: Atrial septal defect.
ASOT: Antistreptolysin O titre.
CBC: Complete blood count.
COP: Cardiac out put.
ESC: European society of cardiology.
ESR: Erythrocyte sedimentation rate.
INR: International normalization ratio.
JVP: Jugular venous pressure .
LA: Left arium .
LV: Left ventricle.
MR: Mitral regurgitation.
MS: mitral stenosis.
MVA: Mitral valve area.
NHLBI: National Heart Lung Blood Institute.
NYHA: New York heart association.
OS: Opening snap.
P2: Pulmonary component of the second heart sound.
PASP: Pulmonary artery systolic pressure.
PASSAX: Parasternal short axis view.
PBMV: percutaneous balloon mitral valvuloplasty.
PMC: Balloon mitral commissurotomy.
PLAX: Parasternal long axis view.
PR: pulmonary regurgitation .
RHD: Rheumatic heant disease .
RV: Right ventricle .
RA: Rheumatoid arthritis.
S1 : first heart sound .
S2 : second heart sound .
S3 :third heart sound .
S4 : fourth heart sound .
SLE: Systemic lupus erythromatosus
TEE: Trans esophageal echo.
TTE: Trans thoracic echo .
TR : Tricuspid regurgitation .

Percutaneous balloon Mitral valvuloplasty (PBMV) introduced in 1984 by Inoue et al.,(1) has ushered in a new dimension in the treatment of patients with mitral stenosis. Extensive clinical studies have established this minimally invasive, non surgical procedure to be safe and effective therapeutic modality in selected patients with mitral stenosis(2-8) and is equivalent to or even better than surgical commissurotomy(9-13). With successful balloon valve enlargement there is generally a two fold increase in the mitral valve area(2-8) and associated dramatic fall in transmitral valve gradient, left atrial pressure and pulmonary artery pressure. These hemodynamic benefits are mirrored in post procedural improvement in the patients' symptoms and exercise tolerance(14). The long term results of PBMV are excellent, especially when the acute results are optimal and in the presence of good valve morphology(14-19).

Beside the original Inoue technique using size-adjustable, self positioning balloon catheters, various other techniques using fixed sized balloon catheters have been developed for performing PBMV. These include the antegrade (transvenous) approaches with one or two balloon catheters through one or two inter-atrial septal punctures(20,21), or the retrograde (trans-arterial) approaches with or without trans-septal access(22). However, the Inoue balloon catheter system via the transvenous approach has remained the principal technique used today. Extensive experience in Inoue balloon Valvotomy demonstrated incremental operator experience and evolving refinements in balloon valvuloplasty techniques have resulted in a nearly 100% technical success rate and a significant diminution in complications despite the presence of a significant number of

technically demanding scenarios and high risk co-morbid conditions(4,14,23-25).

Closed mitral commissurotomy was first described by Harken and Bailey in the late 1940s(26). Subsequently, after the development of cardiopulmonary bypass, the open surgical commissurotomy replaced the closed technique in most countries in the late 1960s and early 1970s. In 1984, Kanji Inoue, a Japanese cardiac surgeon, firstly developed the idea that a degenerated mitral valve could be inflated using a balloon made of strong yet pliant natural rubber(1). At first, this unique technique was largely limited to the Far East Asia, where as in most of the other countries traditional cylindrically shaped balloons, which were initially developed for pulmonic balloon valvuloplasty, were utilized for mitral valvuloplasty(20). In India first reported the use of such a cylindrical balloon for mitral valvuloplasty. Subsequently, the idea of a double balloon technique was introduced from Saudi Arabia(21) as a potential alternative method for balloon commissurotomy. The double balloon technique requires that two guide wires be positioned in the left ventricular apex, through which two floating balloon catheters are then advanced across the mitral valve orifice. Although the double balloon technique is surely effective, it is more technically demanding and thus often requires a longer procedure time, which may lead to inadvertent complications. The guide wire positioned in the left ventricular apex sometimes induces perforation of the apex, leading to cardiac tamponade.

In fact, PBMV using a single Inoue balloon yields equivalent efficacy when compared with the double balloon technique and with lower procedural risks(27). Today, therefore, Inoue's single balloon technique has become the most popular method for performing PBMV in most parts of the world. The mechanism of PBMV is the same as the already abandoned closed mitral commissurotomy(28). Pathological studies have disclosed the main mechanism of successful PBMV is a fracture of the commissures. In comparison to surgical mitral commissurotomy, PBMV has shown equal or even better success rates(9, 11) and comparable restenosis rates(11). Randomized trials comparing PBMV to closed commissurotomy have shown that PBMV is superior to closed commissurotomy, providing a larger valve area and better long term durability(29). The decrease of the incidence of rheumatic heart disease in developed countries had already begun in 1910, and it is now below 1.0 per 100,000. On the other hand, the occurrence rate of rheumatic heart disease in developing countries remains substantial. Because the decline in the prevalence of rheumatic fever in industrialized nations started even before the era of penicillin and thus was related to improved living standards, the continued prevalence of rheumatic heart disease in undeveloped or developing countries is related not only to the limited availability of penicillin but to their socioeconomic status (ie, overpopulation, overcrowding, poverty, and poor access to medical care). According to the annual report by the World Heart Federation, an estimated 12 million people are currently affected by rheumatic fever and rheumatic heart disease worldwide, and high incidence rates are reported in the Southern Pacific Islands. Several studies were conducted on the prevalence of rheumatic heart disease, reporting 0.14/1000 in Japan(30), 1.86/1000 in

China(31), 0.5/1000 in Korea(32), 4.54/1000 in India,(33) and 1.3/1000 in Bangladesh. In Sudan as one of the developing countries, rheumatic fever still remains the main cause of cardiac valvular disease, including mitral valve disease. No previous studies had discussed the out come of PBMV on patients with mitral valve disease in Sudan. So, this study is the first one to enlighten this field in Sudan hoping to do further extended researches to cover all cardiac interventional and surgical activities in Sudan.

The aim of our study was:

- To study the effect of the balloon mitral valvuloplasty in improving the mitral valve area immediately, and after one year in Sudan International cardiac centre, Federal ministry of health, Khartoum, Sudan.
- To assess the degree of regression in the mitral valve area after one year from the immediate improvement.
- To study the factors affecting the change in the mitral valve area (initial mitral valve area, wilkins score, age and gender).
- To study the impact of mitral valve area change on patient symptomatic status.
- To study complications and mortality after balloon valvotomy, in addition to the patient need for revalvotomy or operation among patients underwent PBMV.

Anatomy of the mitral apparatus :

The mitral valve is a complex structure that consists of six major anatomic components: posterior left atrial wall, annulus, leaflets, chordae tendinae, papillary muscles and left ventricle free wall. Alteration of one, more than one or all of these components can cause mitral valve dysfunction (34). Those components are:

1- Mitral valve annulus.

2- Mitral valve leaflets : which are:

Anterior leaflet: The anterior leaflet has also been called the aortic, septal, greater or anteromedial leaflet. The anterior mitral leaflet has a much longer base to margin of closure width (2.3 cm) but small circumference (3 cm). The ventricular surface of the anterior leaflet form an important postero-superior boundary of the left ventricular out flow tract(35).

Posterior leaflet: The posterior leaflet is also called the ventricular leaflet, mural leaflets, smaller leaflet or the posterolateral leaflet. It has a true bundle of fibrous tissue (annulus) separating the myocardium of left ventricle. Both leaflets are connected to each other at junctions, commissures, which represent spaces between cusps, the commissures of the AV valves are junctions of continuous leaflet tissue(35).

3- Chordae tendineae:

The chordae tendinae are fibrous strings that originate from tiny nipples on the apical portion of the two papillary muscles and insert into their overlying commissures and into both adjacent leaflets. The chordae tendinae consists of primary, secondary and tertiary chordae that subdivide as they extend from papillary muscles to leaflets(34). Some chordae tendinae from each papillary muscle attached to both anterior and posterior

mitral leaflet or insert into the interleaflet or commissural areas. Thus chordae tendineae could be classified into:

1. Commissural chordate which arises as a main stem that branches rapidly like the struts of a fan to insert into the free margin of the commissural regions.
2. Leaflet chordae which insert into anterior and posterior leaflets.

On the average, 24 chordae are attached to papillary muscles and 120 chordae are attached to the leaflets. However, there is considerable variation in the number of chordae attached to either papillary muscles or to either mitral leaflet(36).

4- Left atrium (LA):

The left atrium contributes to the compliance of the mitral valve by contraction and atrial dilatation. Although it has been confirmed that atrial contraction and relaxation influence mitral valve closure in man, loss of effective contraction (for example atrial fibrillation) doesn't necessarily cause mitral regurgitation(37). The mechanism by which atrial contraction influence mitral valve closure may be due to propagation of pressure wave of left atrial systole into the left ventricle, which make the left ventricular pressure abruptly be greater than the pressure within the relaxing atrium. This rapid reversal of atrio-ventricular pressure difference closes the mitral valve(38).

5- Papillary muscles and left ventricular wall:

The Papillary muscles and left ventricular wall represent the muscular component of the mitral apparatus. They are located below the commissures of the valve. The two left ventricular papillary muscles are termed anterolateral and posteromedial(36). The anterolateral papillary muscle is usually larger than the posteromedial. The anterio lateral is generally the most uniform and usually consists of a single trunk that protrude more into the cavity of the left ventricle, while the posteromedial muscle often consists of 2 or 3 smaller pillars and usually have several connections to the left ventricular wall(39).

Figure 1: Components of Mitral Valve Apparatus

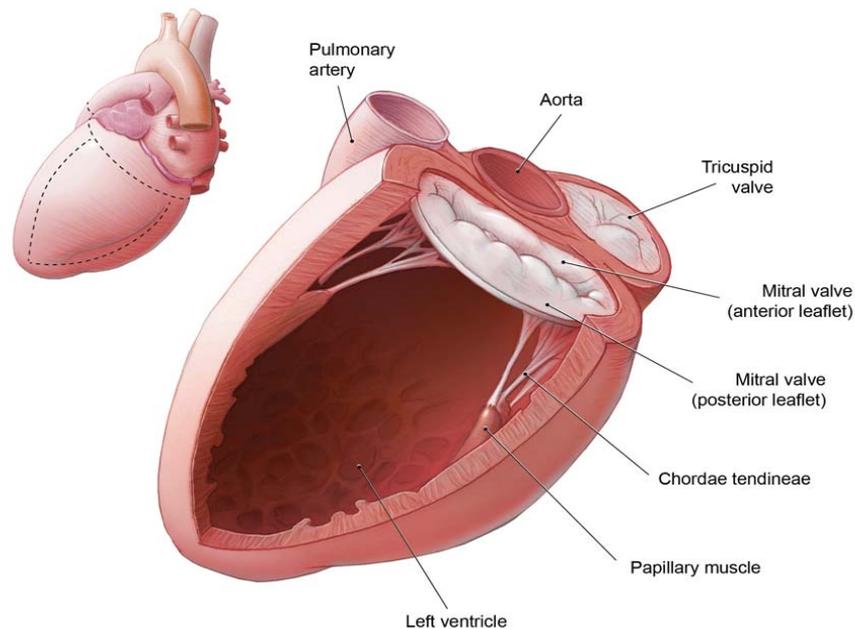


Figure 1: Components of mitral valve apparatus(34).