CHANGE IN LEFT ATRIAL VOLUME AND STRETCH RELATED PARAMETERS IMMEDIATELY AFTER AND ON FOLLOW UP AFTER SUCCESSFUL BALLOON MITRAL VALVULOPLASTY

A dissertation submitted to
THE TAMIL NADU DR. M.G.R. MEDICAL UNIVERSITY, CHENNAI
In partial fulfillment of
DM - Branch II CARDIOLOGY
Examination to be held in August 2014

C E R T I F I C A T E

This is to certify that the dissertation entitled

"Change In Left Atrial Volume and Stretch Related Parameters Immediately After and On Follow Up After Successful Balloon Mitral Valvuloplasty"

is a bonafide work done by

Dr. ARUP DEB

Christian Medical College, Vellore, Tamil Nadu

in partial fulfillment of the University rules and regulations for award of
DM - Branch II CARDIOLOGY

under my guidance and supervision
during the academic year 2011-14

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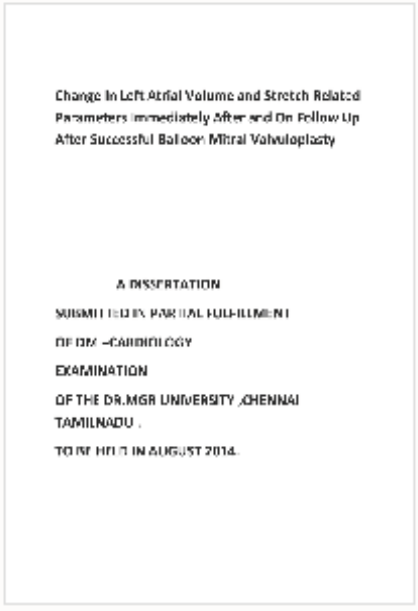

Change In Left Atrial Volume and Stretch Related Parameters Immediately After and On Follow Up After Successful Balloon Mitral Valvuloplasty

A DISSERTATION

SUBMITTED IN PARTIAL FULFILLMENT

OF DM –CARDIOLOGY

EXAMINATION

OF THE DR.MGR UNIVERSITY ,CHENNAI

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Immediately After and On Follow Up After Successful **Balloon Mitral Valvuloplasty(** 12

BMV) Background : Mitral stenosis(MS) is associated with adverse structural and functional remodelling

.Assessment of regional left atrial **function** can **provide insight** into **atrial electromechanical remodelling** 1

.There are limited studies published in the literature on immediate effect of BMV on left atrial structure and function . Aims and Objectives : This study intended to assess left atrial volumetric, functional parameters by various echocardiographic imaging methods before BMV and immediately following the procedure

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CONTENTS

ABSTRACT

Title : Change In Left Atrial Volume and Stretch Related Parameters Immediately After and On Follow Up After Successful Balloon Mitral Valvuloplasty(BMV)

Background : Mitral stenosis(MS) is associated with adverse structural and functional remodelling .Assessment of regional left atrial function can provide insight into atrial electromechanical remodelling .There are limited studies published in the literature on immediate effect of BMV on left atrial structure and function .

Aims and Objectives : This study intended to assess left atrial volumetric, functional parameters by various echocardiographic imaging methods before BMV and immediately following the procedure in patients with moderate to severe isolated MS. The study also assessed change in various hemodynamic parameters immediately following BMV along with follow up assessment of left atrial volume.

Material and Methods : Fourty Two (42) consecutive patients with moderate to severe isolated MS (Mitral valve area≤ 1.5cm²) were assessed by two dimensional, Doppler echocardiography and strain imaging before and immediately after BMV(≤48 hours) and on follow up(6-9 months).Hemodynamic parameters were assessed by mean Left atrial & pulmonary artery pressures and Left atrial to Left ventricular gradient .

Results : Left Atrial area showed significant decrease immediately following Balloon Mitral Valvotomy (24.33 ± 5.91 Vs 20.65 ± 4.42) p 0.001 while there was no significant difference between immediately post procedure to follow up (20.65 ± 4.42 Vs 20.20± 5.01) p 0.88

Similarly Left Atrial volume showed significant immediate post Balloon Mitral Valvotomy reduction (90.75 ± 36.82 Vs 65.53 ± 25.36) p 0.001 while there was no significant reduction between immediate post procedure to follow up period (65.53 ± 25.36 Vs 62.75 ± 30.83) p 0.88 .Mean strain at Inter Atrial septum and Lateral wall was reduced before BMV which improved significantly immediately post procedure with median value increasing from 4.08 to 11.38(p < .001) at the Inter Atrial septum and median value increasing from 1.38 to 6.74 (p 0.01) at lateral wall. There was no significant differences in Ventricular End diastolic strain parameters. There was significant reduction in pulmonary artery pressure immediately following BMV with median value decreasing from 22.5 pre procedure to 10.5 post procedure (p < 0.001) . Mean Left Atrial pressure also reduced significantly Along with reduction in Left Atrial to left Ventricular end diastolic gradient. Mean percentage reduction in pulmonary artery pressure in the group with Preprocedure mean pulmonary artery pressure >50 mmHg was higher than the group with pre procedure mean pulmonary artery pressure < 50 mmHg with trend towards significant reduction (p 0.05)

Conclusion : Left atrial reservoir function improves immediately along with hemodynamic parameters. Patients with higher pulmonary arterial pressures responds better. Left atrial maximum volume reduction occur immediately after BMV with no significant changes at follow up.

INTRODUCTION

Rheumatic heart disease still remains a major cause of morbidly and mortality in developing countries including India. Acute rheumatic fever is most common in school going age group of 5-15 years of age . Recent studies reveals that prevalence of rheumatic fever and rheumatic heart disease in the most vulnerable age groups is still unacceptably high. Rheumatic heart disease was encountered 1 to 5.4 per 1000 in school children while acute rheumatic fever in 0.3 to 0.5 per 1000 children.(1)

In rheumatic heart disease the mitral valve is affected the most. Upto 50% of rheumatic valvular heart disease involves only mitral valve while another 40% , there is combined involvement of mitral and aortic Valve. Mitral stenosis leads onto left atrial enlargement which in turn predisposes to atrial fibrillation. Atrial fibrillation by itself leads onto electro mechanical remodelling causing further left atrial enlargement and perpetuating the vicious cycle. Among valvular heart disease mitral stenosis is the leading cause for atrial fibrillation . Atrial fibrillation can occur upto 40% of mitral stenosis patients. Study data reveals that in rheumatic heart disease the emergence of atrial fibrillation depends on left atrial size and age of the patient. (2)

Atrial fibrillation is a marker of poor cardiovascular outcome. Enlargement of left atrium is a significant predictor of stroke and death. The relative risk for stroke increases by 2.4% in men and 1.4% in women for every 10 mm increase in left atrial size.(3) Left atrial volume is more predictive of adverse cardiovascular events than left atrial area or diameter.(4)Balloon mitral valvotomy provides excellent long term clinical and favourable echocardiography results in mitral stenosis. (5)

There are scanty studies regarding acute left atrial volume and size reductions following mitral balloon valvuloplasty. (6) Many methods have been used to assess left atrial function along with its volumetric assessment. Echocardiographic Strain and Strain rate imaging is one such method which non invasively assesses regional Left atrial function by determining local tissue deformation and rate of deformation.(7)

In this study we tried to assess left atrial volumetric changes by various echocardiographic parameters immediately following Balloon mitral valvuloplasty and during follow up along with changes in left atrial stretch related parameters both in normal sinus rhythm and in patients with atrial fibrillation.

AIMS AND OBJECTIVES

1. To assess change in the left atrial area and volume by various echocardiographic parameters immediately following (≤48 Hours) successful balloon mitral valvotomy (mitral valve area ≥ 1.5 cm^2) in patients with normal sinus rhythm and patients in atrial fibrillation.

2. To assess functional change in the left atrium following successful balloon mitral valvotomy by measuring left atrial strain and strain rate imaging

3. To assess hemodynamic response immediately after successful balloon mitral valvotomy (By measuring mean pulmonary artery pressure, mean left atrial pressures and left atrial – left ventricular end diastolic gradient)

4. To assess change in left atrial volumetric parameters on follow up (After 6 months)

REVIEW OF LITERATURE

Introduction :

Rheumatic fever and rheumatic heart disease are still a major health burden in India. Rheumatic fever and rheumatic heart disease are due to delayed non suppurative sequel of pharyngeal infection with group A Beta Hemolytic Streptococcus. After 2-3 weeks of latent period signs and symptoms of acute rheumatic fever appear. Although rheumatic heart disease follows a couple decades after initial acute rheumatic fever in Western world in India this period is much shorter. Rheumatic heart disease can appear within couple of years following initial infection with Group A Beta Hemolytic Streptococci in countries like India.

Epidemiology :

Incidence and prevalence of rheumatic fever and rheumatic heart Disease were assessed by Epidemiological(Community and School survey) and hospital based studies mainly from year 1920.In recent years the incidence of typical rheumatic fever has declined in India but definite decline in prevalence of rheumatic heart disease is debatable. Because of indiscriminate use of antibiotics and analgesics at all levels of health care the typical presentation

of acute rheumatic fever have been modified and majority of these patients have smoldering carditis which eventually progresses into valvular heart disease. Although School surveys show recently there is decline in rheumatic heart disease, it does not reflect the true scenario since, children 5-18 years not attending school and 18-40 years of age were not considered .(9) Although it is more than hundred years past since the recognition of the disease ,yet the magnitude of the problem is difficult to assess accurately in India. It is the leading cause of morbidity and mortality at the prime age of life in developing countries.

Pathogenesis :

Hyper immune response to Group A Beta Hemolytic Streptococci cause acute rheumatic fever. The agent, the host and the environmental factors are responsible for acute rheumatic fever.

Group A Beta Hemolytic Streptococci is the agent responsible for Acute Rheumatic Fever and its recurrence. (10) Lancefield Group A Beta Hemolytic Streptococci has an external capsule consisting mainly Hyaluronic acid ,the next inner cell wall consists of protein (type M,T and R) ,carbohydrate and rhamnose. The innermost layer consists of mucopeptides like L-lysine, L- alanine, D-glutamic acid, D-glucosamine and then comes the cytoplasmic

membrane . Not all streptococci are culprit to produce Acute Rheumatic Fever. Streptococci that produces Acute Rheumatic Fever is known as Rheumatogenic Strain. Rheumatogenic Strains have the following features

- Very rich in M protein (M serotypes 3,5,6,14,18,19,24)
- Highly resistant to phagocytosis
- Large Hyaluronic acid capsule which forms distinct mucoid colonies in Blood Agar Media

Acute rheumatic fever occurs secondary to hyperimmune immunological Response to Group A Beta Hemolytic Streptococci.(11) There is molecular mimicry between antigenic epitope of rheumatogenic streptococci and normal human tissue antigen .(12) These antigenic similiarity is responsible for hyperimmune response mediated by both cellular and humoral mechanism causing tissue damage..(13) N Acetyl glucosamine moiety cross reacts with antibodies to the heart valve tissue. Antibodies to the streptococcal peptidoglycan complexes have been implicated in rheumatic arthritis.(14) The Streptococcal M protein has homology with the cardiac contractile protein.

Only small proportion of patients infected with Group A BetaHemolytic Streptococci develop acute rheumatic fever. Hence, host susceptibility factor plays a major role in the genesis of acute rheumatic fever and rheumatic heart

disease. Previous attack of acute rheumatic fever increases susceptibility to recurrence. Likewise, an increased risk in the families with a history of rheumatic fever and higher concordance rate in homozygous twins compared with heterozygous twins suggests a role for familial susceptibility in addition to environmental factors . B cell Alloantigen D8/17 have been strongly associated with susceptibility to rheumatic fever.(15) Environmental factors like poor hygienic living condition and over crowding leads to increase risk of acute rheumatic fever and fheumatic heart disease.

Pathophysiology of Mitral stenosis :

4-6 cm^2 being the normal mitral valve area, mitral Stenosis is defined when mitral valve area is less than 2.5 cm^2. In Temperate climate onset of rheumatic stenosis from first attack of rheumatic carditis usually takes 1-2 decades. But in tropical countries the latent period is short and sometime can be as short as 2 years. Therefore, significant mitral stenosis may be seen in children and adolescent of less than 20 years of age which is known as Juvenile Mitral stenosis. Smouldering carditis is thought to be factor responsible for such rapid deterioration.(16) Juvenile Mitral stenosis is characterized by:

- Below 20 years of age with advanced NYHA functional class .
- Usually critical Mitral stenosis (mitral valve area < 1 cm^2).
- Presence of severe pulmonary arterial hypertension.
- Low incidence of atrial fibrillation .
- Usually no mitral valve calcification.

Severe mitral stenosis is defined as mitral valve area less than 1 cm^2. Mitral stenosis progresses slowly over years. Elevated left atrial pressure causes elevation of pulmonary venous pressure and symptoms of dyspnea. Elevated left atrial pressure leads onto structural remodelling of left atrium with deposition of collagen and fibrosis which give rise to atrial fibrillation.(17) Initially atrial fibrillation may be episodic but eventually atrial fibrillation becomes persistent. Once atrial fibrillation set in , it remains persistent even after successful balloon mitral valvotomy.(18) Atrial fibrillation leads onto left atrial stasis and predisposes to systemic thrombo embolism. Atrial fibrillation also contributes to the symptom of mitral stenosis by decreasing atrial contribution to the ventricular filling , thereby decreasing cardiac output. It is not the severity but the chronicity of mitral stenosis that predisposes to atrial fibrillation. Left atrial enlargement and structural changes leads to various complications associated with mitral stenosis

like atrial fibrillation and thromboembolic manifestation . Thus it is important to assess the function of left atrium in mitral stenosis.

Assessment of Left atrial Size, Volume and Function :

Left atrial volume is an independent prognosticator in various cardiac ailments. Measure of left atrial size and function, therefore it is important for any complete echocardiography evaluation more so in diseases which has direct impact on left atrial volume and function. Left atrial enlargementwas significant indicator of death in both Men and Women in Framingham Heart Study.(19) The mechanical functions of leftatrium has been described as Reservoir, conduit and contractile function. During ventricular systole and isovolumteric relaxation leftatrium functions as reservoir receiving blood from the pulmonary veins. The early phase of ventricular diastole left atrium acts as conduit between pulmonary vein and left ventricle. The last part of ventricular diastole the contractile function of left atrium propels blood from left atrium to left ventricle which assumes much more importance in disease conditions like left ventricular diastolic dysfunction. Left atrium is not Three dimensional symmetric structure. Left atrial enlargement may not occur in uniform manner across all the dimensions. Hence, antero posterior left atrial diameter measurement by M Mode echocardiography may underestimate assessment of left atrial size. In contrast left atrialvolume assessment by two

dimensional or three dimensional echocardiogram provides reliable assessment. Left atrial size is maximum at end systole. Hence, end systolic measurement is done to derive maximum left atrial volume. Regional left atrial mechanical function assessment by newer imaging methods like tissue Doppler strain and strain rate imaging is an important adjunct in overall assessment of left atrial function.(20)

Multimodality Imaging of Left atrium

Transthoracic Echocardiography :

The left atrial dimensions, area and volume are measured by two dimensional echocardiography. The left atrial anteroposterior diameter as measured with M mode is most frequently used parameter in clinical practice. However, it is inadequate to assess true left atrial size ,since it is one dimensional. Therefore, M mode measurement underestimates left atrial size.

Left atrial volume assessment is done by two dimensional or three dimensional echocardiography. However, the foreshortening of left atrium should be avoided . When measuring left atrium , the confluence of pulmonary veins into left atrium and left atrial appendage should be excluded for accurate assessment. Echocardiographic assessment of left atrial volume is done by Simpsons method, Prolate Ellipse method and Biplane Area Length

method.(21). Biplane area length method and Simpsons method compared closely while ellipsoid method under estimated left atrial volume.(22)

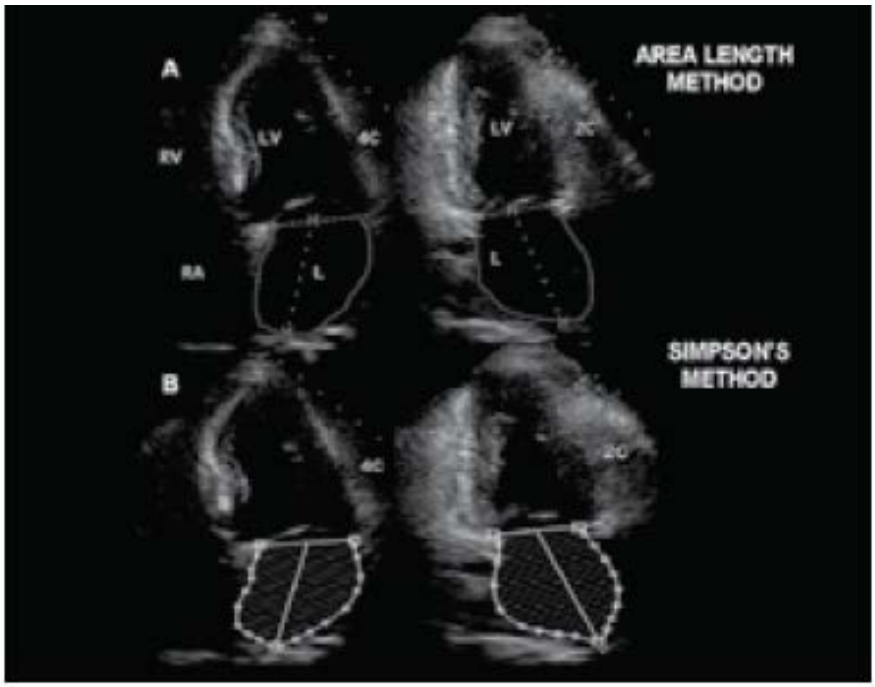
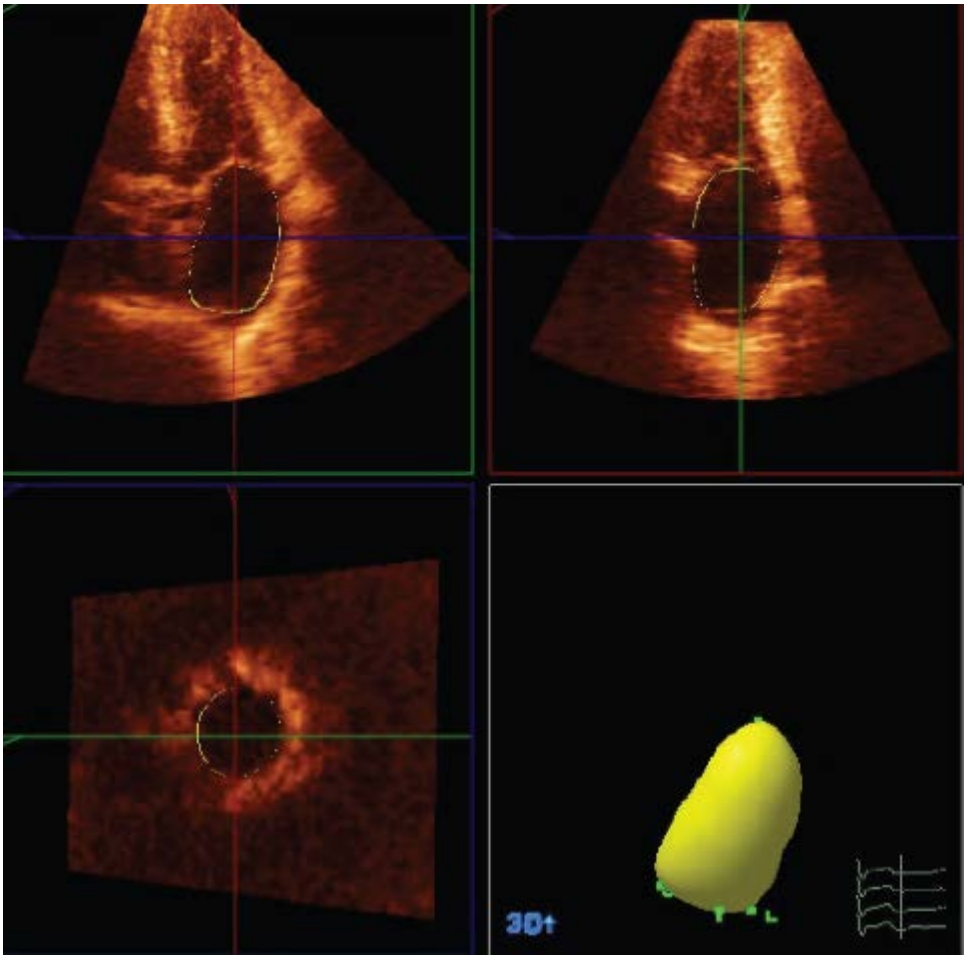


Fig. 1: Panel A: LA volume by Simpson's method. Panel B: LA volume by bi-plane area length method

Recently, three dimensional echocardiography has been introduced which was studied regarding the feasibility of assessment of left atrial volume. Three dimensional echocardiography has been validated against cardiac MRI.(23)

Left atrial volume assessment by two dimensional echocardiography is fraught with fallacies since, two dimensional echocardiogram relies on geometric assumptions for volume assessment which iscircumvented by three dimensional echocardiography. Three dimensional echocardiography can

assess the different left atrial function namely conduit, reservoir and active contraction . Three dimensional echocardiography is associated with lower inter and intra observer variability.



Assessment of Left Atrial Volume by 3 Dimensional Echo .Automatic border detection is obtained by making five reference points in the Apical Four and Two Chamber View .

Transoesophagial Echocardiography :

Measurement of left atrial size with transoesophagial echocardiography is not standardized. Trans oesophageal echocardiography is primarily used to rule out thrombus in left atrium and left atrial appendage. Moreover, transoesophagial echocardiography is used to measure left atrial appendagial velocity which is correlated with thrombus formation(velocity < 20 cm/sec) .

Multislice Computed Tomography :

Multislice computed tomography has excellent spatial and temporal resolution for accurate assessment of left atrial volume .However, because of significant radiation and contrast exposure it is not routinely recommended for the assessment of left atrial size .

Magnetic Resonance Imaging :

Magnetic Resonance Imaging(MRI) measures the left atrial volume most accurately. It does not require geometric assumptions and associated with high spatial and temporal resolution. MRI also is associated with less interobserver and intra observer variability and it is not associated with

radiation , contrast exposure. Detailed information regarding left atrial volume and size throughout cardiac cycles can be acquired by cardiac MRI.(24)

Assessment of Left atrial Function :

Regional left atrial functions are not routinely analysed .However, in diseased states along with left atrial anatomical changes there are significant functional derangements. Left atrial size has been shown to be important predictor of adverse outcome including atrial fibrillation ,stroke , heart failure and death. Recently, functional assessment of left atrium has been shown to be as robust a marker of adverse cardio vascular events. Hence, combined left atrial size and function assessment augments prognostication.(25)

Newer echocardiographic parameters like tissue doppler imaging and strain imaging allows segmental assessment of left atrial function.(26) Tissue doppler velocity assesses regional tissue velocity of myocardium while strain and strain rate imaging demonstrates local tissue deformation. Tissue doppler velocity assesses peak systolic and diastolic velocity of the myocardium and thereby , it can quantify regional electromechanical left atrial function.(27) Electromechanical activity of the atria is measured from the interval between the onset of P wave on the ECG and the end of the A wave on the Tissue doppler.(28) In atrial fibrillation even before left atrial enlargement, the inter atrial and intra

atrial electromechanical delay increases. Hence, it may be more predictive of atrial fibrillation than left atrial area and volume .(29) Angle dependency is the limitation of tissue doppler imaging.

Regional myocardial functional assessment is done by strain and strain rate imaging. Strain is a measure of myocardial deformation and the strain rate is the rate at which deformation occurs. Site and angle dependency are two characteristic feature of strain and strain rate imaging.(30) Strain and strain rate can be measure either by doppler derived method or by two dimensional speckle tracking .These two methods are increasingly being used for early detection of myocardial dysfunction . Strain imaging differentiates active from passive movements of myocardial segments which is a major drawback of tissue doppler imaging .(31) Speckle tracking differs from tissue doppler derived strain in that the former is angle independent.(32) Speckle tracking images the motion of speckles on ultrasound images. Region specific tissue movement is represented by shift of speckle. Strain and strain rates are calculated by tracking the speckles in one cardiac cycle.(33)

Pulse and colour coded tissue doppler imaging assesses left atrial function by pacing a small volume at an atrial segment of interest.(34) Usually a sample volume of about 2 mm for measuring velocity is used. While for the measurement of strain and strain rate upto 12 mmof length is preferred because of thin left

atrial wall. Pulse tissue doppler can measure only one segment at a time although it has higher resolution. On the contrary ,colour coded Tissue Doppler imaging can offer offline multi segment analysis. Thus different left atrial walls can be compared and assessed.

Left atrium in Health and Diseases

Left atrium is predictor of indivisual,s risk for the development of adverse cardiovascular events including atrial fibrillation, stroke, Myocardial infarction and congestive heart failure. The mechanical function of left atrium has been described in three phases : the reservoir, conduit and contractile function . During ventricular systole and isovolumetric relaxation , the left atrium functions as reservoir , receiving blood from the pulmonary vein. The early phase of ventricular diastole , the left atrium acts as a conduit between pulmonary vein and left ventricle. The last phase is atrial contraction where left ventricular stroke volume is augmented by 20%. Increased left atrial volume is predictor of cerebrovascular accidents and increased mortality. An index left atrial volume of $\geq 32ml/m^2$ is associated with increased risk of stroke independent of age and other risk factors .(35)(36) Left atrial volume is superior prognostic indicator of adverse cardiovascular events than left atrial diameter.(37) Index left atrial volume normal reference range is 22 ± 6 ml / $m^{2.}$(38)

Left atrium in Mitral Stenosis

Patients with Mitral stenosis were found to have increased left atrial size. Left atrial pump function also decreases with reduction in left atrial compliance.There is significant negative correlation betweenmitral valve area and left atrial pressures while positive correlation between mitral valve area and left atrial compliance. (39) Mitral stenosis is characterized by atrial remodelling characterized by left atrial enlargement , loss of myocardium and scarring. These factors predisposes the inducibility of atrial fibrillation.(40)

Atrial fibrillation is one of the commonest complications of mitral stenosis. In most series of mitral stenosis the incidence of atrial fibrillation is about 40%.However, the incidence of atrial fibrillation is closely related to the age of the patient than severity. (41)

Echocardiographic study by Henry et al showed a close correlation between left atrial size and atrial fibrillation. When left atrium was smaller than 40 mm only 3 of 117 patients had atrial fibrillation whereas when the left atrium was more than 40 mm 54% had atrial fibrillation .(42)

Age and Atrial Fibrillation in Mitral Stenosis

Age when first seen (yrs)	% in Atrial Fibrillation
11-20	0
21-30	17
31-40	40
41-50	60
More than 51	80

The most important impact of atrial fibrillation on patients with mitral stenosis is that it substantially increases the risk of systemic thromboembolism. Systemic embolism occur due to formation of thrombus in the left atrium or more commonly within the left atrial appendage. Systemic embolism appears to be unrelated to the severity of mitral stenosis. Cerebral emboli are particularly common accounting for 60-70% of episodes of systemic embolism. Two factors most closely associated with systemic embolism in patients with mitral stenosis are age and the presence of atrial fibrillation.(43)

Natural History of Mitral stenosis

The peculiarity of rheumatic fever in India is that it leads to established rheumatic heart disease much earlier than Western countries. The postulations behind early occurrence are

- Virulence factor of the Streptococci.
- Endemicity of streptococcal pharyngitis .
- Exuberant immune response .
- Prevalence of HLA type.

Symptomatic mitral stenosis is seen in significant proportion below 20 years of age in Indian context.

To reemphasize, 500 patients of Mitral Stenosis below 20 years of age were operated between 1958- 1972 by Stanley John .

Mitral stenosis is initially slowly progressive followed by progressive deterioration later.(44) The primary symptoms of mitral stenosis are caused by pulmonary venous hypertension. Approximately half of patients with mitral stensosis develop symptoms gradually while other half develop precipitation of

symptoms due to atrial fibrillation, thromboembolism and superadded respiratory infection . The chances of survival progressively decreases with

advancing years and increase in functional class.(45) The average age at the time of death with mitral stenosis is 48 years.(46)

10 Years Survival In Mitral Stenosis without Intervention

NYHA Class	Survival in Percentage
I	85
II	55
III	20
IV	None (at the end of 5 years)

Balloon Valvotomy

Asymptomatic patients of Mitral stenosis are followed by up by annual clinical evaluation, ECG and echocardiography and rate control with beta blockers or calcium channel blockers and if in atrial fibrillation along with antiocoagulant therapy and diuretics to prevent pulmonary venous congestion in conjunction with rheumatic fever prophylaxis.

Bailey et al was first to perform successful closed mitral commissurotomy. Percutaneous balloon mitral valvotomy was first performed by Inoue in the year 1984 while Lock et al performed Balloon valvotomy in 1985 .(47)(48)

Balloon mitral valvotomy is indicated in symptomatic mitral stenosis of atleast moderate severity (i.e Mitral valve area $\leq$ 1.5 cm^2).It is also indicated in asymptomatic but atleast moderate mitral stenosis with new onset atrial fibrillation and pulmonary arterial hypertension with resting pulmonary arterial pressure >50 mmHg and exercise induced pulmonary artery pressure > 60 mmHg. The last two criteria not being class I indications for balloon mitral valvotomy.

The success of balloon valvotomy depends on valve morphology. There are various scores for the evaluation of mitral valve regarding the feasibility of successful balloon mitral valvotomy .Among them Wilkins score is very frequently used in clinical practice. There are four parameters which are taken into account in Wilkins score ,these are valve thickening,valve mobility, amount of calcium present in the valve and degree of subvalvular involvement by the fibrotic process .(49) Echocardiographic score of 8 or less is associated with

better success rate with BalloonMitral Valvotomy .Thickening of the valve is the best predictor of outcome among all the parameters.(50)

Balloon mitral valvotomy increases mitral valve area by splitting of the commissures. Therefore , it is more successful in mitral stenosis secondary to fusion of commisures rather than mitral stenosis which is due predominantly subvalvular fusion. Similarly in bilateral commissural calcification where splitting of the commisures are suboptimal with balloon procedure ,this procedure is less successful.

More than moderate Mitral Regurgitation is considered contraindication for the balloon procedure. However, in Juvenile Mitral stenosis which is defined as mitral stenosis in less than 20 years of age , it may not be feasible to use adequate sized prosthetic valve since the child may outgrow the prosthesis, balloon mitral valvotomy needs to be attempted notwithstanding the presence of severe central mitral regurgitation.(51)

Good immediate final result is considered when valve area is more than 1.5 cm^2 in absolute value or atleast valve area increasing by more than 50% without mitral regurgitation greater than 2/4.(52)

Following successful Valvotomy there is immediate decrease in left atrial pressure along with improvement in cardiac index.(53) While pulmonary arterial pressures along with pulmonary vascular resistance are more gradually decreased.(54) Balloon valvotomy improves left atrial and left atrial appendigeal pump function which is significantly decreased in patients with Mitral Stenosis leading onto left atrial stasis of blood thereby, predisposing to systemic thromboembolism .(55)

Balloon mitral valvotomy results are less satisfactory in temperate countries since, these patients are older consequently,theirs valves have higher scores and are more deformed .(56)(57) On the contrary late results are more satisfactory in developing nations owing to early presentation of valvular heart disease. (58)

Restenosis after Balloon Mitral Valvotomy is defined as loss of more than 50% of the initial gain with absolute valve area less than 1.5cm². Studies indicate incidence of restenosis following successful Balloon Mitral Valvotomy is 2-40% .(59) Predictors of restenosis being Age, poor mitral valve anatomy with high echocardiographic score .

The outcome of patients with more than moderate Mitral Regurgitation following Balloon Valvotomy is generally poor .Majority of patient who develop more than moderate Mitral Regurgitation usually require Mitral Valve replacement in the long run.

Decreased incidence of thromboembolism following balloon valvotomy is secondary to improved left atrial and appendigial pump function leading onto less stasis of blood in the left atrium and in left atrial appendage .(60) However, Balloon Mitral Valvotomy does not decrease the incidence of Atrial Fibrillation .(61)

The predictors of Successful outcome of Balloon Mitral Valvotomy is multifactorial .(62)

Balloon Mitral Valvotomy has similar efficacy outcome compared tosurgical commissurotomy. Balloon Mitral Valvotomy is more convenient , lesser patient discomfort ,cosmetically more acceptable especially in females and involves lesser cost than surgical commissurotomy.

However, like any surgical procedure Balloon mitral valvotomy is not without procedural complications. The most ominous of these are cardiac perforation and embolic stroke. Development of severe Mitral Regurgitation remains another serious complication for which patient might require emergency Mitral valve repalcement. Procedural mortality ranges from 0-2.7%. The most common cause of procedure related death is left ventricular perforation due to left ventricular guidewire. Hemopericardium also can occur during transseptal puncture due to atrial perforation.Incidence of embolic stroke ranges from 1.1-5.4 %. S .Iatrogenic atrial septal defect due to atrial septal puncture usually is clinically inconsequential.(63)

Balloon mitral valvotomy and open mitral commisurotomy provides excellent early result and favourable long term results compared to closed mitral commissurotomy (64) Currently open mitral commisurotomy / mitral valve replacement is deemed the treatment of choice in patients with bicommissural calcification or heavy calcification, poor valve anatomy and patient undergoing some other concomitant cardiac surgery .

MATERIALS AND METHODS

Study Design :

This was a prospective study performed over 18 months from June 2012 to December 2013

Setting :

CMC Vellore is a 2000 bedded Tertiary Care teaching hospital . Consecutive Patients with atleast moderate Mitral Stenosis (Mitral Valve Area ≤1.5 cm^2) who were admitted from the out patient department were enrolled in the study

Subjects :

Inclusion Criteria

- Adults who are more than 18 years old.
- Moderate to Severe Mitral Stenosis (Mitral Valve Area ≤ 1.5 cm^2) in both normal sinus rhythm and in Atrial Fibrillation.

Exclusion Criteria

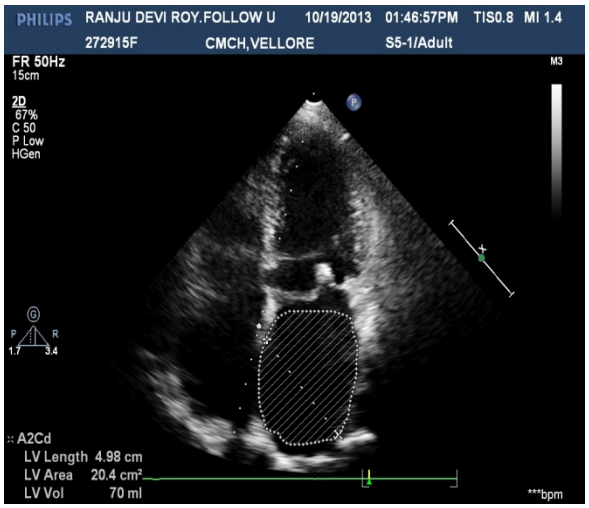
- Age less than 18 years .
- Unwilling to participate in the study .
- Presence of moderate to severe Mitral Regurgitation, Aortic Regurgitation or Aortic Stenosis.
- Development of more than mild Mitral Regurgitation post procedure.
- Emergency Balloon Mitral Valvotomy.
- Previous Mitral/ Aortic valve surgery or Balloon Valvotomy .
- Pregnancy .
- Systemic hypertension .

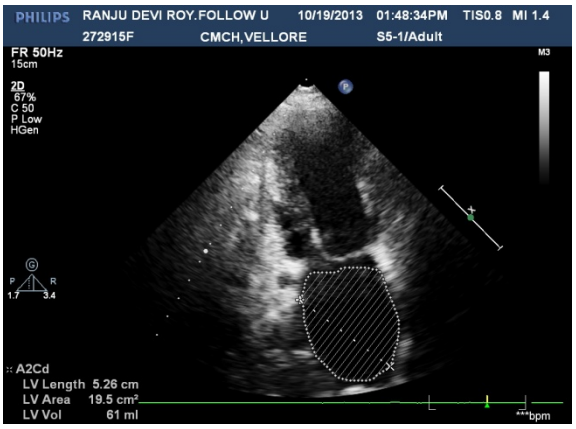
Clinical Assessment

All patients included in this study were subjected to detailed history ,thorough clinical examination, routine blood test, 12 lead ECG, detailed echocardiographic examination . Left Atrial regional functions were studied by Tissue Doppler Strain and Strain Rate imaging . The detailed 2 dimensional , M Mode and Doppler echocardiographic assessments were done before the procedure , after the procedure before hospital discharge(≤48 hours) and at the time of first follow up (6-9 months). Tissue Doppler derived strain and strain rate imaging were also done along with routine echocardiographic examinations.

Echocardiographic And Doppler Studies

All the patients included in the study underwent standard Thransthoracic echocardiogram and Tissue Doppler imaging in left lateral decubitus position in expiratory apnea by 5 Hz probe on i E 33 (Philips Medical System,Massachusetts, USA) . All the parameters were recorded in accordance with guidelines from the American Society of Echocardiography. Mitral Valve area was calculated by Planimetry and Pressure Half Time.(65) Colour Doppler was used to assess the presence of Mitral valvular regurgitation. M mode echocardiography was done to assess Left Atrial anteroposterior dimension as well to assess Left Ventricular Ejection Fraction. Left Atrial volume and area assessment was done at end systole by three principal echocardiography methods namely Prolate Ellipse method, Simpsons method .(66)(67) Left Atrial volume was assessed from Apical 4 Chamber,Apical 2 Chamber and Parasternal Long Axis windows. Maximum Left Atrial volume were assessed during ventricular systole when mitral valve was closed . Pulmonary veins and mitral apparatus were excluded from volume assessment.



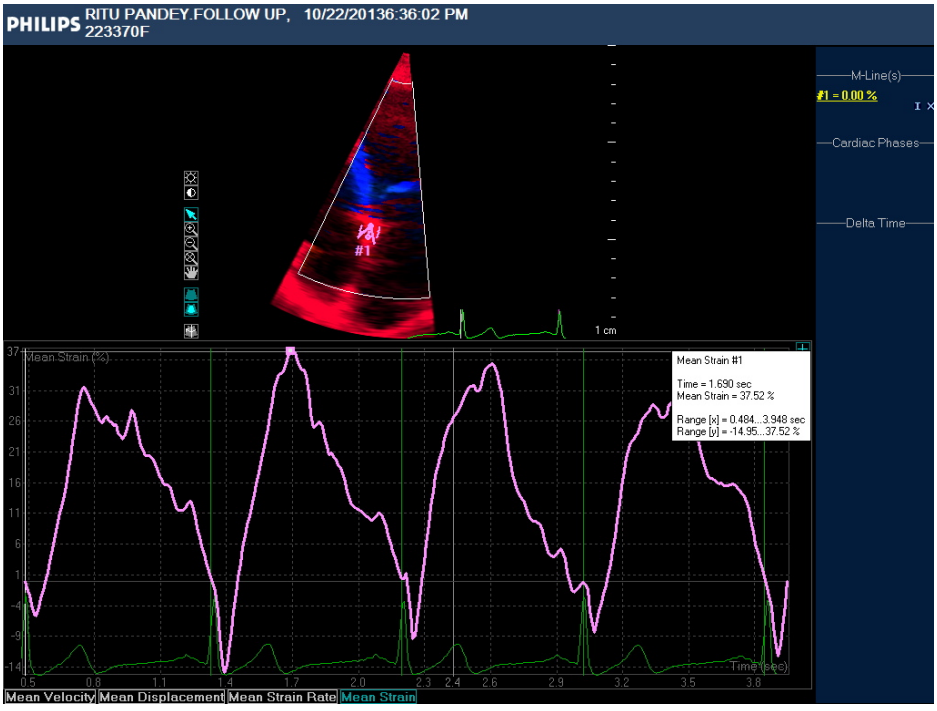


Left Atrial Volume Assessment by Simpsons Method in A4C and A2C view

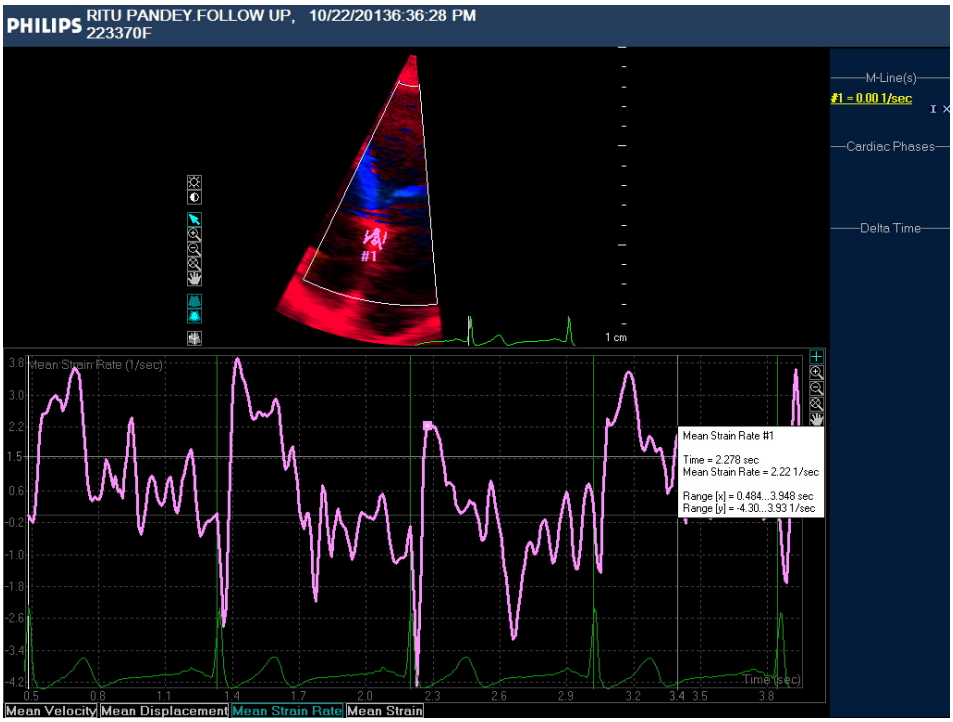
Atrial Strain and Strain Rate Imaging

Tissue Doppler derived strain imaging was performed in apical four chamber view by placing sample volume at mid point of Inter atrial septum and lateral Left Atrial wall. A high frame rate (> 110 frame/ sec) was used in the study

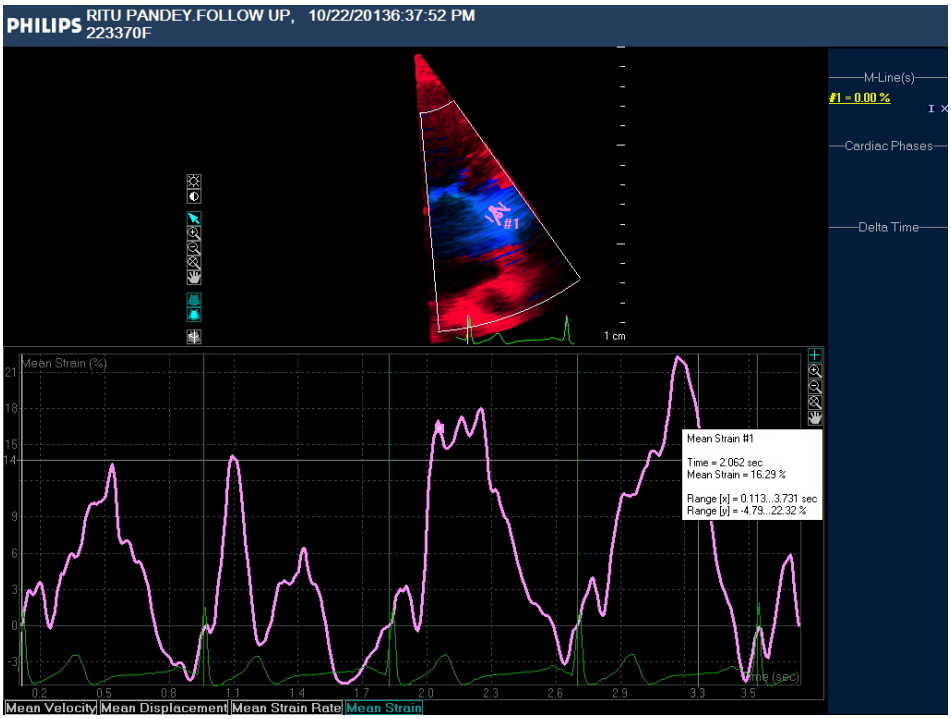
along with narrow sector width(≤30 degrees).Special effort was taken to align Doppler beam parallel to atrial walls. A small sample volume (10×2.5 mm) was preferred due to thin atrial walls. Images were acquired followed by offline analysis of strain and strain rate imaging using QLAB software. Sample volume was placed at mid Interatrial septum and mid Lateral wall in apical four chamber view. Strain and Strain rate imaging parameters were recorded at end diastole defined at peak of R wave in ECG and end systole defined as the end of T wave in ECG.



Strain Imaging with sample volume at mid point if interatrial septum



Strain Rate Imaging with sample volume at mid Interatrial septum



Strain Imaging with sample volume at lateral atrial wall

Follow up after Balloon Mitral Valvotomy

All patients underwent Trans septal puncture through femoral access through single Balloon technique. Successful Balloon Mitral Valvotomy is defined as increased in the mitral valve area of more than 50% with absolute Mitral Valve area $\geq$ 1.5 cm^2 and Mitral Regurgitation $\leq$2.(69) All the echocardiographic parameters described above were repeated following successful Balloon Mitral Valvotomy

Statistical Analysis

All statistical analysis were performed by SPSS software. Outcome variables were summarized as mean and standard deviation in the pre test and post test groups. A paired T test was used to study changes in the mean outcomes between the pre and post samples . For the skewed datas Wilcoxin sign rank test used and descriptive presented as median(min,max)

RESULTS

During the period of the study 42 patients were enrolled out of which 36 patients were in normal sinus rhythm and 6 patients were in Atrial Fibrillation. Both pre procedure and post procedure ECHO parameters were done for all the enrolled patients while follow up could be done for 19 patients.

Baseline Characteristics :

Variable	
Age mean(SD)	**37.36(11.06)**
Gender n(%)	**Male-15(35.71)** **Female-27(64.29)**
Symptom duration Median(minimum,max)	**24(2,204)**
NYHA Class	**I-2(4.76)** **II- 35(83.33)** **III-5(11.9)**
Rhythm	**AF-6(14.29)** **NSR-36(85.71)**

Most of the patients were in NYHA functional class II , 65% of them were females with mean age of 37 years .

Mitral Valve area were calculated by direct planimetry and Doppler derived pressure half time method . Left atrial area were calculated by direct manual tracing and Left Atrial volume was estimated by Simpsons and Prolate Ellipse method .

Mitral Valve area and Left Atrial volumetric parameters :

Variable	Pre BMV	Post BMV	p Value
Mitral Valve area cm^2(planimetry) n=42	0.89(0.50,1.48)	1.74(1.53,1.96)	<0.001
Mitral Valve area (Doppler) cm^2 n=41	0.80(0.45,1.40)	1.70(1.61,2.70)	<0.001
Left Atrial Area cm^2 (A4C) n=40	29.77(6.9)	24.87(5.4)	<0.001
Left Atrial Area (A2C) cm^2 # n=40	24.37(5.8)	20.47(4.5)	<0.001
Left Atrial Volume# (A4C) ml n=40	105(63,299)	91(34,169)	<0.001
Left Atrial Volume ml (A2C) n=40	82(44,209)	67.5(27,139)	<0.001
Left Atrial Volume ml (prolate ellipse) n=40	82.24(46.33,184)	59.89(26.9,117)	<0.001

Patients recruited in the present study underwent successful Balloon Mitral Valvotomy with median value increasing from 0.89 cm^2 to 1.74 cm^2.Left Atrial area decreased significantly from 29.77±6.9 cm^2 to 24.87±5.4 cm^2 .Left Atrial volume also reduced significantly post procedure

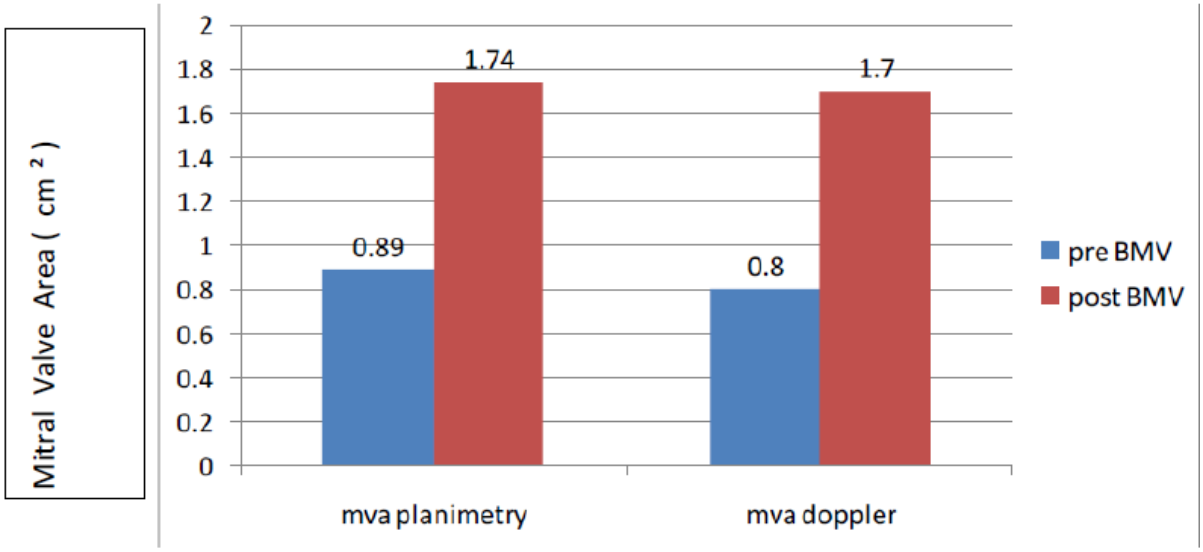


Fig – 1 : Mitral Valve Area (mva) pre and immediately post Balloon Mitral Valvotomy(BMV)

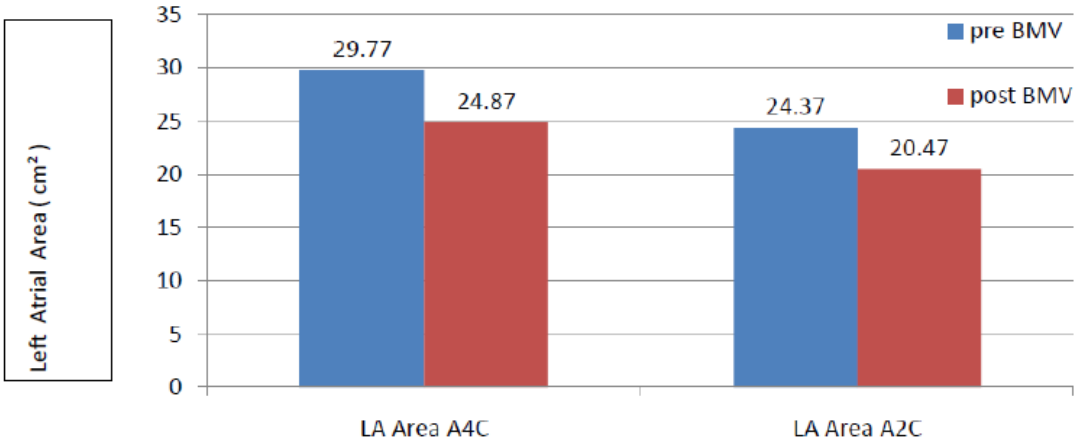


Fig -2 : Left Atrial Area(cm^2) in Apical Four and Apical Two chamber views (A4C & A2C) before Balloon Mitral Valvotomy and immediately after the procedure

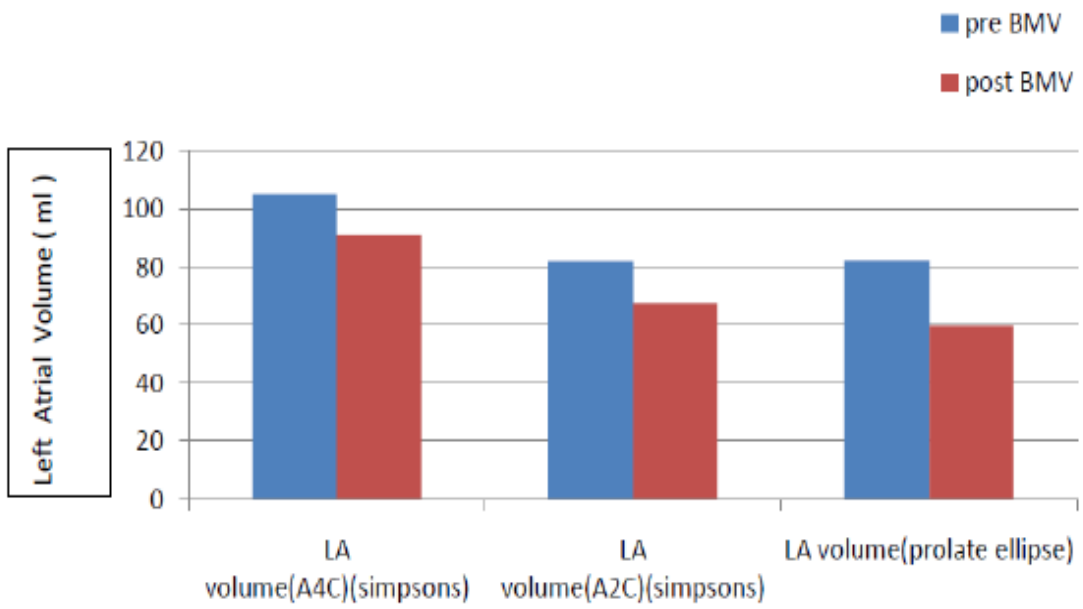


Fig -3 : Left Atrial Volume (ml) in Simpsons Apical Four chamber-A4C and Apical Two camber view- A2C and Prolate Ellipse Method before Balloon Mitral Valvotomy and immediately after the procedure

Strain Patameters

Variable	Pre BMV Median(min, max)	Post BMV Median(min,max)	p Value
IAS strain at Ventricular End Diastole (%)	-2.5(-9,-0.72)	-2.29(-11.33,-0.77)	0.06
IAS strain at ventricular End Systole (%)	4.08(0.92,10.16)	11.38(1.71,15.04)	<0.001
IAS strain rate at ventricular End Diastole (/sec)	-1.16(-6.9,-0.05)	-2.03(-9.5,-0.1)	0.196
IAS strain rate at ventricular End Systole	0.35(0.01,3.9)	1.1(0.02,4.01)	0.005
LA lateral wall strain at ventricular end diastole (%)	-2.35(-8.26,-0.9)	-2.3(-9,-1.2)	0.471
LA lateral wall strain at ventricular end systole (%)	1.38(1.1,12.25)	6.74(2.9,16.77)	0.01
LA lateral wall strain rate at ventricular end diastole(/ sec)	-0.9(-6.3,-0.1)	-1.2(-4.76,-0.9)	0.42
lateral wall strain rate at ventricular endsystole(/sec)	0.4(0.01,4.3)	1.1(0.01,4.2)	0.02

Mean strain at Inter Atrial septum and Lateral wall was reduced before Balloon Mitral Valvotomy which improved significantly immediately post procedure with median value increasing from 4.08 to 11.38(p < .001) at the Inter Atrial septum and median value increasing from 1.38 to 6.74 (p 0.01) at lateral wall.

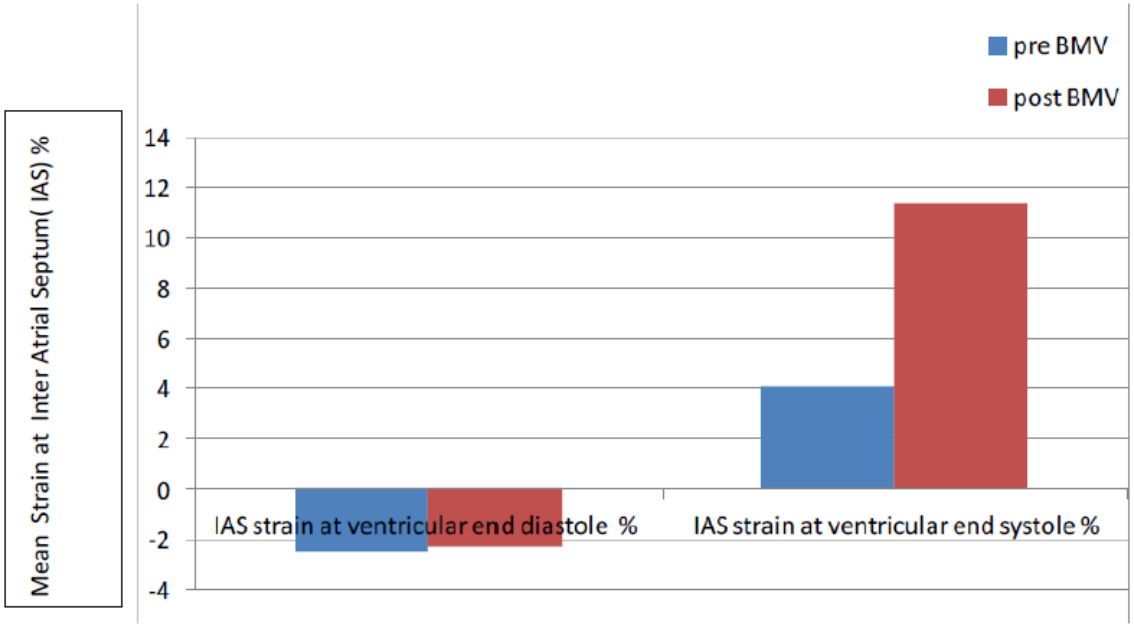


Fig -4 : Mean strain (%) at Inter Atrial Septum (IAS) before and immediately after Balloon Mitral Valvotomy

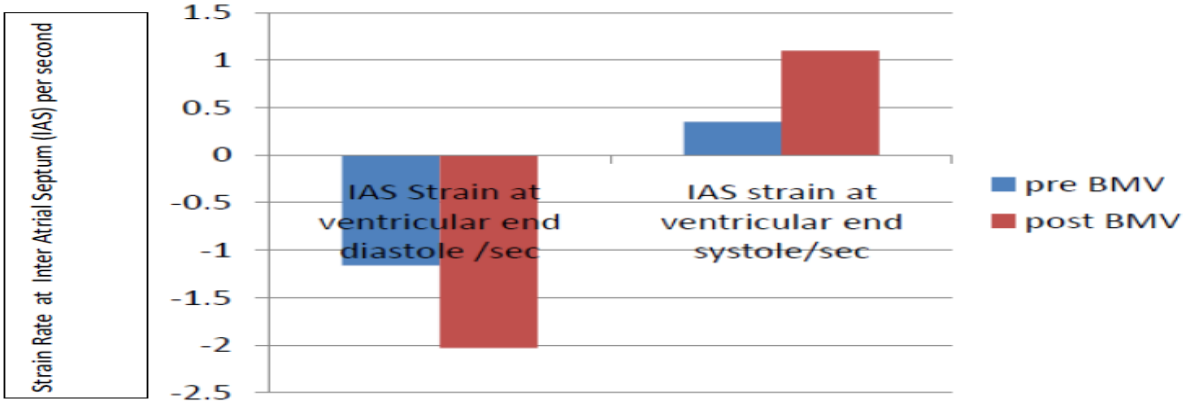


Fig -5 : Strain rate (/sec) at Inter Atrial Septum (IAS) before and immediately after Balloon Mitral Valvotomy

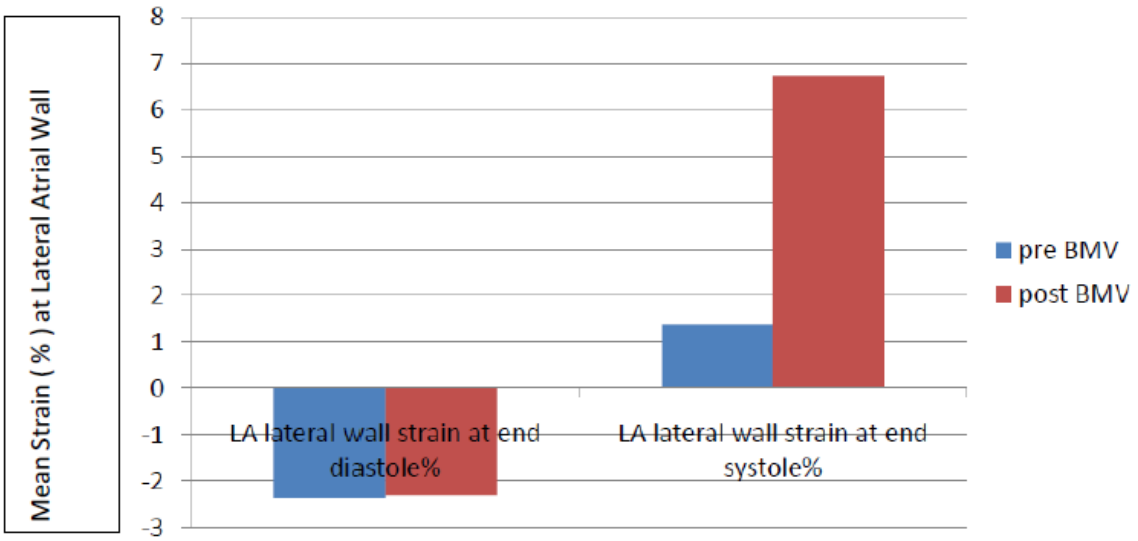


Fig – 6: Mean Strain (%) at lateral Atrial wall before and immediately after

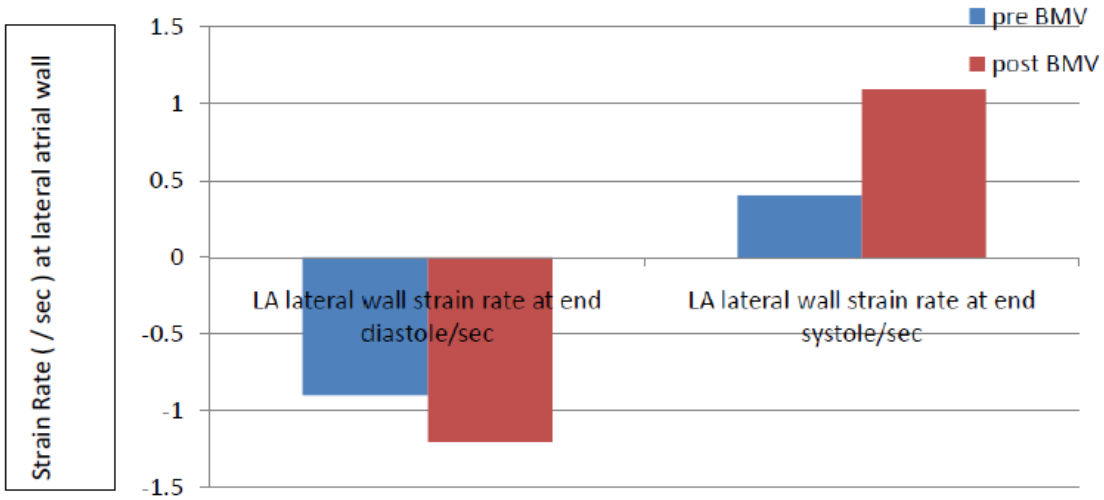


Fig – 7 : Strain rate (/ sec) at lateral atrial wall before and immediately after Balloon Mitral Valvotomy

Hemodynamic Parameters

Hemodynamic parameters before and after BMV were obtained at Cath Lab by measuring Pulmonary artery mean pressure , Left Atrial Mean pressure and Left atrial and Left ventricular gradient .

Variable	Pre BMV	Post BMV	p Value
Mean Pulmonary artery pressure (n=42)	22.5(4,39)	10.5(4,36)	<0.001
Mean Left Atrial Pressure (n=42)	32(16,87)	22.5(9,77)	<0.001
Left atrial –Left ventricular gradient (n=40)	15(0,32)	2(0,7)	<0.001

There was significant reduction in pulmonary artery pressure immediately following Balloon Mitral Valvotomy with median value decreasing from 22.5 pre procedure to 10.5 post procedure ($p < 0.001$) . Mean Left Atrial pressure also reduced significantly Along with reduction in Left Atrial to left Ventricular end diastolic gradient.

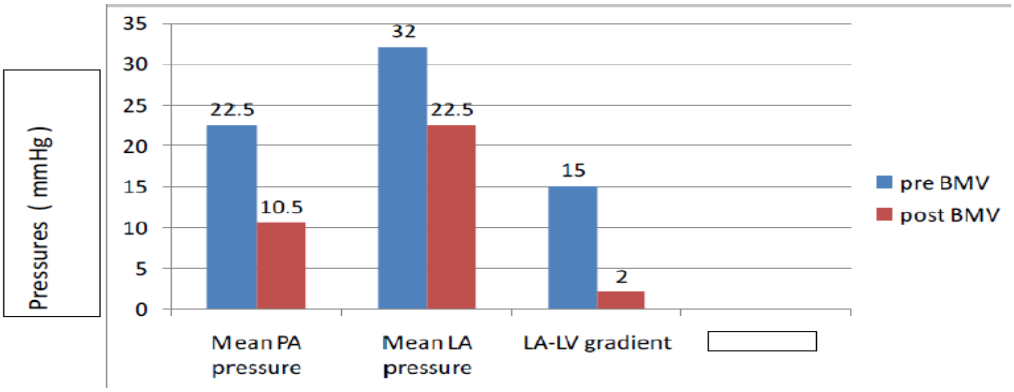


Fig -8 : Pre and Post Balloon Mitral Valvotomy Hemodynamic Responses

Variables	**Pre BMV <50 mmHg (Mean PA pressure)** Median(Min, Max) (n=35)	**Pre BMV>=50 mmHg (Mean PA pressure)** Median(Min, Max) (n=7)	**p-value**
Mean percentage change in post BMV Pulmonary Artery pressure	25.0(-41.7,63.4)	41.51(11.5,68.2)	0.05
	Pre BMV trans pulmonary gradient<12 mmHg Median(Min, Max) (n=25)	**Pre BMV trans pulmonary gradient>=12 mmHg** Median(Min, Max) (n=17)	
Mean percentage in change post BMV Pulmonary Artery pressure	21.7(-41.7,55)	41.5(30.0, 68.2)	**0.003**

Mean percentage reduction in pulmonary artery pressure in the group with Pre procedure mean pulmonary artery pressure >50 mmHg was higher than the group with pre procedure mean pulmonary artery pressure < 50 mmHg with trend towards significant reduction (p 0.05) . Likewise the group with high transpulmonary gradient (Transpulmonary Gradient ≥12 mmHg) had significantly more percentage decrease in mean pulmonary artery pressure following the procedure than the group with low transpulmonary gradient (median value 21.7 Vs 41.5) p value 0.003.

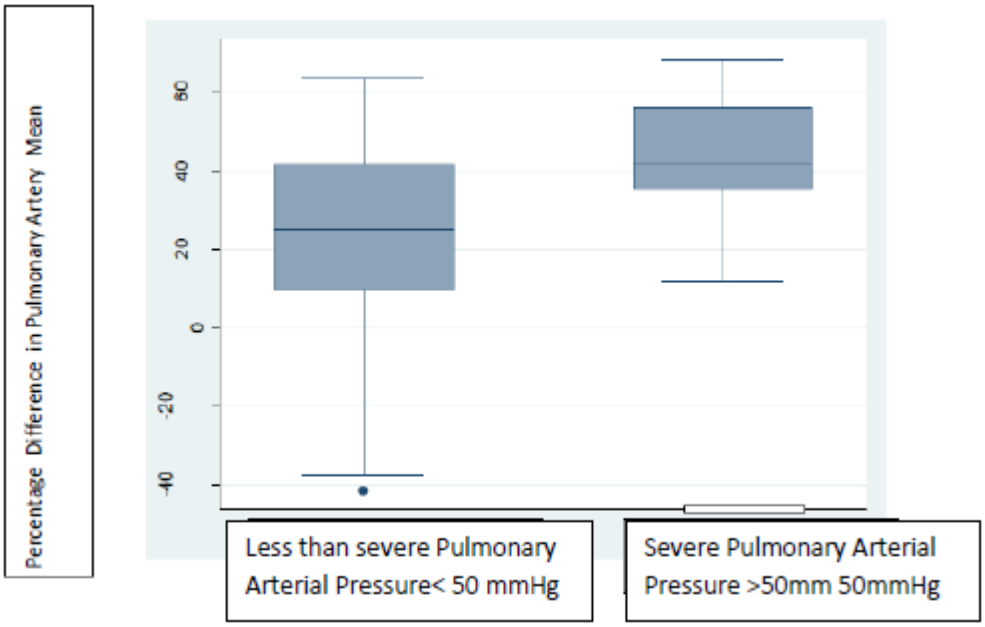


Fig – 9 : Diffrence in Percentage reduction in mean Pulmonary Artery pressure between severe Pulmonary arterial hypertension (mean > 50 mmHg)and non severe Pulmonary aterial hypertension (mean pulmonary artery pressure < 50 mmHg)

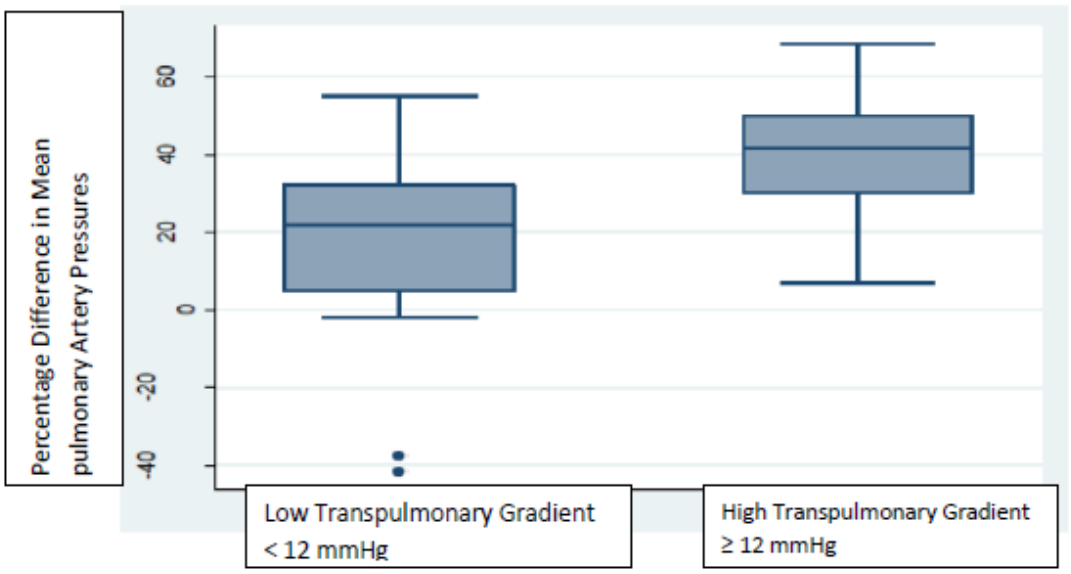


Fig - 10 : Difference in Percentage reductions in mean Pulmonary Artery pressure reduction post Balloon Mitral Valvotomy between High (Transpulmonary Gradient ≥ 12 mmHg) and Low Transpulmonary Gradient (Transpulmonary Gradient < 12 mmHg)

FOLLOW UP PARAMETERS

	Pre BMV (Mean)	Post BMV (Mean)	Follow up (mean)	Difference δ (p value)	Difference α (p value)
MVA (cm^2) 2D	0.921± 0.24	1.759± 0.31	1.801± 0.23	0.838±0.27 (0.001)	0.02 (0.781)
MVA Doppler	0.820±0.21	1.748±0.38	2.016±0.28	0.929±0.39 (0.001)	0.042 (0.02)
LA area a2c	24.33±5.91	20.65±4.42	20.20±5.01	3.68±3.54 (0.001)	0.12±3.71 (0.88)
LA area a4c	29.77±6.89	24.88±5.45	25.19±7.56	-4.89±4.21 (0.001)	0.42±1.04 (0.692)
LA volume a2C Simpson	90.75±36.82	65.53±25.36	62.75±30.83	-2.52±2.76 (0.001)	0.748±3.14 (0.88)
LA volume a4c Simpson	123.98±54.6	92.56±35.76	93.95±49.76	-31.42±35.88 (0.001)	2.13±40.13 (0.814)

BMV ballon mitral valvotomyMVA mitral valve area, LA left atriumδ ifference between the pre BMV(balloon mitral valvotomy) and post BMV α difference between the post BMV(balloon mitral valvotomy) and follow up Values in bracket is p value p value considered significant at <0.05

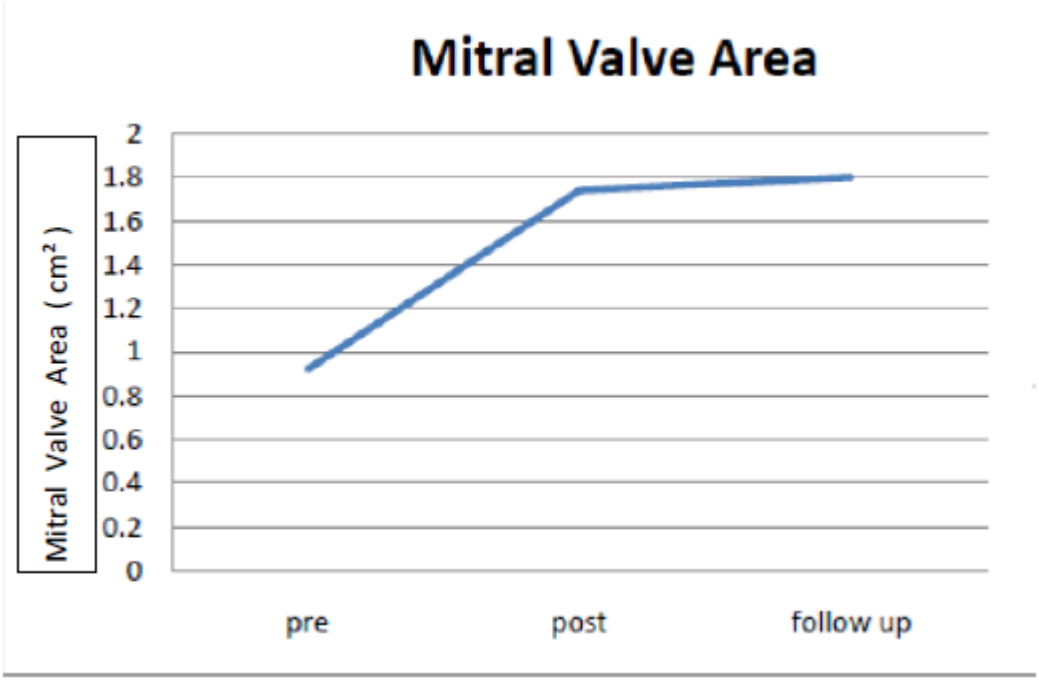


Fig -12 : Mitral Valve Area (cm²) Pre, Post Balloon Mitral Valvotomy and Follow up

Mitral valve area as measured by Planimetry showed significant increment from pre procedure to immediately after Balloon Mitral Valvotomy (0.921 ± 0.24 Vs 1.759 ± 0.31) p 0.001 while there was no significant difference between Post Balloon Mitral Valvotomy and follow up (1.759 ± 0.31 Vs 1.801 ± 0.23) p 0.781

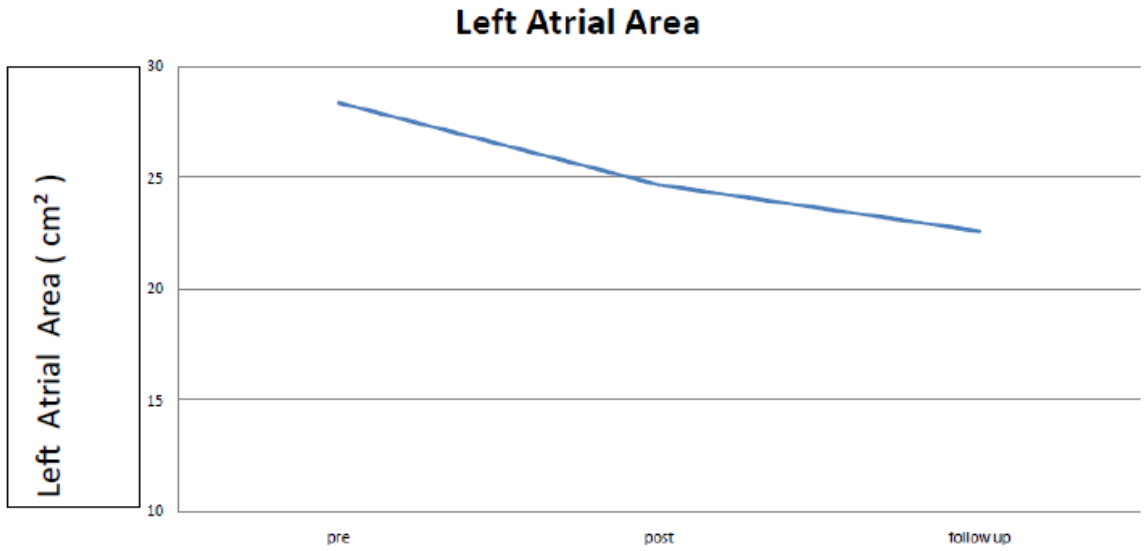


Fig - 13 : Left Atrial Area (cm^2) Pre , Post Balloon Mitral Valvotomy and Follow up

Left Atrial area also showed significant decrease immediately following Balloon Mitral Valvotomy (24.33 ± 5.91 Vs 20.65 ± 4.42) p 0.001 while there was no significant difference between immediately post procedure to follow up (20.65 ± 4.42 Vs 20.20 ± 5.01) p 0.88

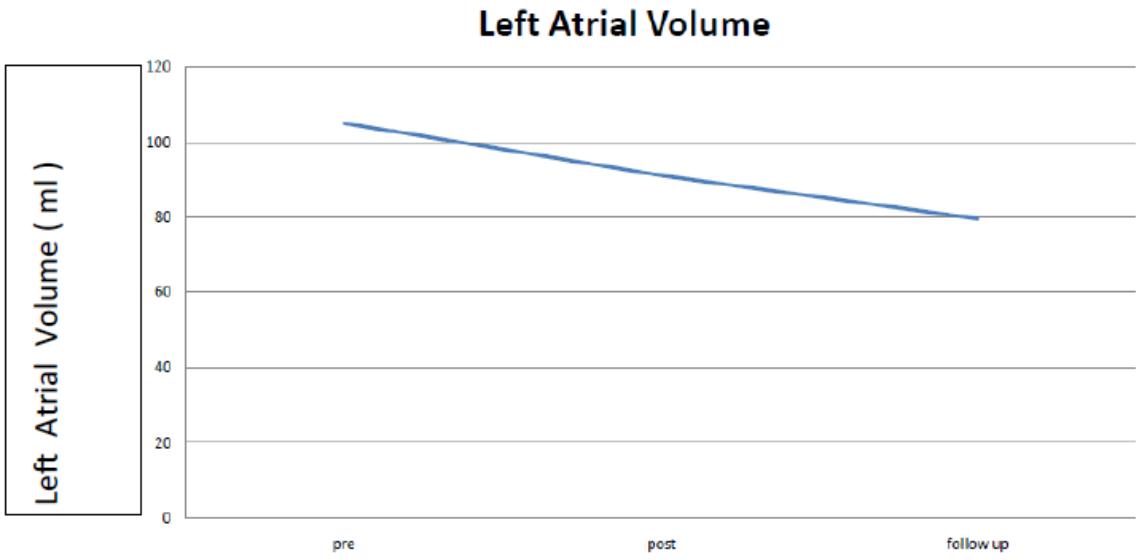


Fig - 14 : Left Atrial Volume (ml) Pre , Post Balloon Mitral Valvotomy and Follow up

Similarly Left Atrial volume showed significant immediate post Balloon Mitral Valvotomy reduction (90.75 ± 36.82 Vs 65.53 ± 25.36) p 0.001 while there was no significant reduction between immediate post procedure to follow up period (65.53 ± 25.36 Vs 62.75 ± 30.83) p 0.88

DISCUSSIONS

The present study is to our knowledge it is one of the few studies in India to assess the beneficial effect of balloon mitral valvotomy on left atrial volume and function immediately after and on follow up of balloon mitral valvotomy. The study assessed left atrial volumetric assessment by various two dimensional echocardiographic parameters along with mitral valve area assessment. The study also assessed the functional left atrial parameters by left atrial strain and strain rate measurements. The study assessed various hemodynamic parameters both pre and immediately post balloon mitral valvotomy .

Study done previously showed left atrial volume reduction following successful balloon mitral valvotomy (70) However, there was paucity of study regarding acute left atrial volumetric change following successful balloon mitral valvotomy . Our study revealed acute left atrial area and volume reduction which was statistically significant by the two dimensional echocardiographic parameters (53) Although Left Atrial volume reduction was significant immediately following balloon mitral valvotomy , the change in left atrial volumetric parameters from immediately post procedure to follow up was not statistically significant . Thus it can be surmised that beneficial effect of

balloon mitral valvotomy on left atrial volumetric parameters is an acute pheneomenon which causes significant reduction in left atrial volume immediately after the procedure and continues at a slower rate at long term left atrial enlargement is a marker of adverse cardiovascular outcome (19) Left atrial volume is more predictive of adverse cardiovascular outcome than left atrial area (4) Similarly the improvement in mitral valve area was maximum immediately after balloon mitral valvotomy (71) Mitral valve area assessment by planimetry did not show significant difference between immediately post balloon mitral valvotomy and follow up.

Rheumatic mitral stenosis is associated with atrial fibrillation in significant proportion of patients.(72) Prevalence of atrial fibrillation in our present study was approximately 15%. Advanced age and increase in left atrial area and volume are predictors of occurance of atrial fibrillation in rheumatic heart disease.(73) Our study also revealed overall left atrial volume is more in atrial fibrillation group compared to groups with normal sinus rhythm. The mean age in atrial fibrillation group was also significantly higher compared to normal sinus rhythm. However, because of small sample size in atrial fibrillation group we could not prove it to be statistically significant.

Mitral stenosis is associated with pulmonary arterial hypertension. Pulmonary arterial hypertension can be passive which is attributed to elevated left atrial mean pressure . There is reactive pulmonary arterial hypertension which can not be explained by elevated mean left atrial pressures. Reactive pulmonary arterial hypertension is diagnosed by elevated Trans pulmonary gradient .(74)(75) Balloon mitral valvotomy has beneficial effect on pulmonary arterial hypertension both acutely and on long term (76) Our study also revealed acute reduction of pulmonary arterial pressures following balloon mitral valvotomy. There were significant reductions in both passive and reactive pulmonary hypertension as well as severe pulmonary arterial hypertension which corroborates with the study done by Fawzy et al (77) However, the degree of response between severe and less severe degree of pulmonary hypertension varies although both results in reduction in pulmonary arterial pressures (78) In our study we observed that the group with higher Pulmonary Arterial pressure , the response was better compared to the group with lower pulmonary arterial pressure before Balloon Mitral valvotomy.

Mitral stenosis is associated with left atrial dilatation and remodelling . Thus proper assessment of left atrial function can give an insight into the prognosis in mitral stenosis.(79) Tissue doppler derived strain assessment is being used for atrial reservoir, conduit and contractile function.

Strain imaging can identify left atrial dysfunction in the absence of left atrial dilatations.(80) Left atrial reservoir function was assessed by strain at ventricular end systole measured at the end of T wave on ECG. Whereas conduit and atrial contractile function was measured at ventricular diastole at the peak of R wave on ECG .Abnormal strain imaging can predict onset of atrial fibrillation in mitral stenosis.(81) Strain rate analysis was done by Q LAB software off line analysis. Our study results revealed significant improvement of atrial reservoir function following balloon mitral valvotomy as demonstrated by improvement in ventricular end systolic mean strain both at inter atrial septum and lateral atrial wall. Before balloon mitral valvotomy mean atrial strain at ventricular end systole was significantly low. While strain rate change at these two segments were mostly non significant which supports the theory that mean strain is dependent on loading condition while strain rate is load independent and predominantly correlates with contractility .(82) Since, the immediate improvement of load dependent parameters like mean ventricular end systolic strain occurs ,it could be surmised that improvement of Left Atrial afterload contributed to it. There was no significant immediate improvement in load independent parameters like strain rate which could be due to structural remodelling of Left Atrium which usually takes longer time for improvement. This suggests immediate beneficial effect on Balloon Mitral valvotomy on functional property of Left Atrium. Di salvo et al demonstrated

patients having higher Left Atrial systolic strain has higher chance of being in Normal sinus rhythm after successful cardioversion. (83) Hence, improvement in Atrial Reservoir function following Balloon Mitral Valvotomy in the present study could indicate good long term prognosis of these patients and lesser chance of developing into Atrial Fibrillation. Strain parameters at ventricular end diastole did not change significantly after the procedure in our study which could be due to the fact that diastolic strain parameters are predominantly dependent on Left ventricular compliance characteristics .

STUDY LIMITATIONS

The major limitation of the present study is limited sample size. Larger studies with more sample size is required to confirm or refute the observations .

Although two dimensional echocardiographic assessment of left atrial area and volume are relatively accurate they are fraught with fallacies since they depend on geometric assumptions for volume assessment which is cirucumvented by using three dimensional echocardiography. Three dimensional echocardiography is validated against Cardiac MRI which is considered the most accurate for the assessment of left atrial volume . Both these techniques are associated with less inter and intra observer variability. Our study made use of two dimensional echocardiography for the assessment of left atrial volume which can be considered as study limitations .

The sample size in atrial fibrillation group was too small to compare with those patients with normal sinus rhythm .Hence, the outcome analysis between these two groups could not be compared.

We used tissue doppler derived strain assessment which are highly angle dependent . It was difficult to focus the region of interest of thin left atrial walls especially the thin left atrial lateral walls even after adequate beam alignment. Hence, in few patients we could not assess the strain parameters.

We could follow up only 19 patients for long term assessment which can be pointed out as one of the study limitations.

CONCLUSION

Patients with mitral stenosis achieved significant improvement in Mitral Valve area immediately after balloon mitral valvotomy . Along with improvement in mitral valve area they achieved significant reductions in left atrial volume Within 48 hours after balloon mitral valvotomy with no significant change at follow up .

Following balloon mitral valvotomy our patients had immediate significant reduction in mean pulmonary arterial pressures which was consistent across all the degrees of pulmonary hypertension . The group with higher pulmonary arterial pressure before balloon mitral valvotomy responded better. They also achieved significant improvement in other hemodynamic parameters like mean left atrial pressure and improvement in left atrial –left ventricular end diastolic gradient .

Left atrial function as assessed by Tissue doppler derived strain was abnormal in Mitral stenosis. There was significant improvement of left atrial reservoir function immediately post balloon mitral valvotomy.

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PROFORMA

Name :

Hospital number :

Age/Sex :

Mobile number :

Procedure Date :

Duration of symptoms :

NYHA class :

Rhythm :

Other valve disease :

Measurements	Preprocedure			Postprocedure			Follow up		
MVA planimetry									
MVA doppler									
LA Area A4C									
LA length(D2/L)									
LA Orthogonal shortaxisdimension(D1) A4C									
LA Area A2C									
LA Length A2C									
LA A-P Dimension in PLAX D3									
LA volume Simpsons									

A4C							
LA Volume Simpsons A2C							
LA Volume by Area Length							
LA volume by prolate ellipse							
TR Gradient							
Post Procedure MR							
	IAS			**Lateral Wall**			
Strain at ventricular end systole	pre	post	Follow up	pre	post	Follow up	
Strain at ventricular end diastole	pre	post	Follow up	pre	post	f/u	
Strain rate at ventricular end systole							

Strain rate at ventricular end diastole							

Hemodynamic Parameters

	Pre BMV	Post BMV
Mean Left Atrial pressure		
Mean pulmonary artery pressure		
Left atrial- Left ventricular gradient		

Informed Consent

Christian Medical College, Vellore

Department of Cardiology

Study to look at change in volume of the left upper chamber of the heart and stretch related parameters before Balloon surgery ,immediately after and at the time of follow up after successful balloon surgery of the mitral valve .

You are requested to participate in a study which looks into change in left upper chamber volume immediately after successful balloon valve surgery and on follow up visit along with change in stretch related parameters .

Mitral Stenosis resulting from Rheumatic Heart Disease is associated with reduction in Mitral Valve area.Reduction of valve area leads to enlargement of left upper chamber of the heart.Enlargement of the left upper chamber of the heart leads to irregular beating of the heart.Irregular heart beat (known as atrial fibrillation)is a risk factor for the development of adverse cardiovascular events including stroke ,heart failure and heart attack. The present study is to assess the change in left upper chamber volume immediately after balloon valve surgery and on follow up and to assess how much stretch related parameters contribute to this reduction which may have therapeutic significance in future .

What are you expected to do if you are taking part in it

If you are willing to take part in the study ,you will have to undergo detailed ECHO methods for left upper chamber volume assessment and stretch related paremeters assessment. After balloon valve surgery ,the echocardiographic examinations and blood samples are repeated within 48 hours. Current best standard of care you will get irrespective of your participation .There is no need to stay longer in the hospital or need to undergo extra test other than routine blood test.You will be asked to follow up on an OPD basis as part of standard care 3-6months time and same tests will be repeated.

Can you withdraw from the study after it starts

Your entry into the study is purely voluntary.If you do not want to be the part of the study ,you can withdraw even after the study starts. Withdrawal from the study will not affect your care and treatment will not be compromised.

Will you have to pay for the treatment ?

No,you do not have to pay extra other the usual procedure charges and hospital charges.

What happens after the study is over?

You will continue to see your cardiologist as a part of long term follow up of basic ailment.

Will your personal details be kept confidential ?

Confidentiality of your identity will be maintained ,your identity will never be divulged without your permission at anytime .However,the outcome of the study will be published in medical journal .Your medical notes will be reviewed by people associated with the study without your additional permission ,should you decide to participate in this study .

Study No :

Name : Signature:
Date:

Signature of relative Relation to patient Date

`

CONSENT FORM

Study Title :

Study Number:

Participants name :

Date of birth/Age in years

I _____

Son /daughter of _____

1.Declare that i have read the information sheet provided to me regarding this study and have clarified doubts that I had .

2. I also understand that my participation in this study is entirely voluntary and that I am free to withdraw permission to continue to participate at any time without affecting my usual treatment or my legal rights.

3.I understand that the study staff and institutional ethics committee members will not need my permission to look at my health records even if I withdraw from the trial.I agree to this access.

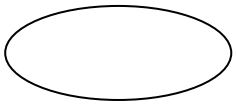
4. I understand that my identity will not be revealed in any information released to third parties or published.

5. I voluntarily agree to take part in this study

Name:

Signature:

Date :

Left Thumb Impression : 

Name of Witness :

Relation to participant :

Date :

ABBREVIATIONS

MVA : Mitral valve area

LA : Left Atrium

LAV : Left Atrial volume

LA A : Left Atrial area

PLAX : Parasternal long axis view

PE : Prolate ellipse

SIMP : Simpsons method

A4C : Apical four chamber view

A2C : Apical two chamber view

NSR : Normal sinus rhythm

AF : Atrial fibrillation

ED : End diastolic

ES : End systolic

LA M : Left atrial mean pressure

PA M : Pulmonary artery mean pressure

TPG : Trans pulmonary gradient

LA L : Left atrial length

LAV AL : Left atrial volume area length

D1 : Minor axis dimension

D2 : Major axis dimension

D3 : Dimension in PLAX view

2 D : Two dimensional

D : Doppler

LA-LV G : Left atrial left ventricular gradient

POST BMV

NAME	AGE	SEX	HOSP NO	SYMPTOM	NYHA	rhythm	mva 2d	mva d	LAA(A4C)	LAV(A4C)S	LAV(A2C) S	LA A(A2C)	LAL(A4C/ D1)	A4C/D2
regina	46	f	386312d	12	II	NSR	1.99	2.4	27	127	107	24.2	5.79	5.28
minati B	25	f	261936f	36	II	NSR	1.82	1.4	17	53	41	14.7	4.6	4.15
kalarani	36	f	191274f	12	II	NSR	2.32	2.34	22.9	60	52	18	4.23	5.77
jyothi	35	f	599902d	6	II	NSR	1.55	2.1	20.9	63	29	12.8	4.38	5.4
kavita M	29	f	274621f	48	II	NSR	2.2	1.9	20.5	80	46	20.7	5.5	4.36
reena P	56	f	250292f	24	II	**AF**	1.7	1.8	21.7	73	33	18.4	4.5	4.58
promod B	31	m	166005f	12	II	NSR	1.84	1.11	28.8	135	75	22.7	5.58	5.73
ranju roy	35	f	272915f	9	III	NSR	2.04	1.7	18	96.3	54	21	4.4	6.3
avdesh C	24	m	196148f	6	II	NSR	196	1.7	23.7	94	71	16.7	5.94	4.59
sivagami	30	f	260279f	6	III	NSR	1.4	1.5	26.5	74	83	22.1	5.39	5.5
meghnath	33	m	532119d	12	II	NSR	1.8	1.4	21	62	39	14.6	5.25	4.9
sushila D	38	f	290568f	8	II	NSR	1.65	1.55	24.7	91	71	23.1	6.02	4.98
namita B	43	f	152966f	12	II	NSR	1.8	1.98	26.5	96	74	18.7	6.29	4.4
sujatha K	36	f	394926b	24	II	NSR	1.8	1.7	23.8	75	55	19.9	6.5	5.08
sanjay S	30	m	191328f	36	II	NSR	1.67	1.8	26.6	54	34	17.3	4.64	5.4
phulaso K	32	f	997606d	24	II	NSR	2.2	2.44	17.1	56	26	14	5.38	4.36
ELUMALAI	64	m	426164F	2	II	NSR	1.26	1.35	30.2	134	78	22.7	5.55	6.42
AMINA BIBI	25	f	399272F	24	II	NSR	1.46	1.55	14.4	37	35	13.6	4.12	3.86
SOMA GIRI	31	f	405536F	12	II	NSR	1.68	1.59	20.5	81	76	19.4	4.07	6.07
CHANDRA	32	f	223566F	36	III	NSR	1.81	2.3	14.2	34	29	11.9	3.89	3.98
RUPLAL SAH	22	m	411400F	24	II	NSR	1.78	1.86	26.3	84	80	24.1	4.69	6.05
PARANJIT KA	32	f	156992D	48	II	NSR	1.69	1.9	27.6	90	67	21	5.91	4.97
MASUDA BE	46	f	363574F	60	II	**AF**	2.2	2.1	36.7	169	89	27.6	6.28	7.14
SAROJA DEV	55	f	450464F	204	I	**AF**	1.3	1.16	21.4	47	27	13.1	5.73	3.58
LALITHA	37	f	422546F	36	II	NSR	1.42	1.67	24.2	95	50	18.3	5.87	4.93
BHUDER MA	46	m	440719F	12	II	NSR	2.74	2.7	28.5	94	92	24.5	5.49	5.5
MEENA DEVI	45	f	436645	24	II	**AF**	1.78	1.52	33.6	137	94	27.8	6.87	5.82
SUBHASH DH	52	m	444457F	24	II	**AF**	1.9	1.2	29.9	103	93	26.3	7.01	4.31
ANANTH KV	38	m	398575F	6	II	NSR	1.5	1.03	28	98			5.9	6.03
fulzhari khat	17	f	471727f	36	III	NSR	1.03	1.44	13.4	39	49	15.4	4.24	4.05

POST BMV

sumathi	44	f	240904f	12	II	NSR	1.63	2.44	20.9	66	41	15.6	4.34	5.72
sakunthala d	35	f	464672F	12	II	NSR	1.68	1.51	31.8	159	139	30.9	6.1	5.81
nirmala	52	f	457116f	24	II	NSR	1.7	2.1	27.4	114	59	19.9	5.5	5.18
gulzar B	45	f	705048c	36	II	NSR	2.2	2	22.5	59	61	18.9	5.24	4.64
soundarajan	49	m	448441f	48	II	NSR	1.8	2	24.6	84	76	22.1	4.9	5.7
mahendra	48	m	360082c	12	II	NSR	1.6	1.7	28.2	130	99	25.6	4.9	5.9
sandeep	23	m	454003f	96	III	NSR	1.65	1.6	32.7	117	75	23.3	6.5	5.1
ritu P	28	f	223370f	12	II	NSR	1.6	1.3	34.7	155	66	22.9	6.3	6.1
hiraman P	20	m	115764f	12	II	NSR	1.9	1.5	24.3	77	57	21.7	4.4	6.2
jagdish P	50	m	336341f	144	I	**AF**	1.7	1.9	27.5	128	83	26.3	4.8	6.1
sarifuddin	26	m	528339d	24	II	NSR	1.45	1.8	21.7	93	68	19	4.6	5.3
padmavathy	49	f	11570f	18	II	NSR	1.9	2.1	33	162	74	22	5.6	7.1

POST BMV

											POST BMV IAS				POST BMV LATERAL WALL			
											STRAIN		STRAIN RATE		STRAIN		STRAIN RATE	
NAME	HOSP NO	LAL(A2C)	PLAX/D3	LAVAL	VPE	ANP	LAMP	PAMP	TPG	LA-LV G	ES(%)	ED(%)	ES(/sec)	ED(/sec)	ES(%)	ED(%)	ES(/sec)	ED(/sec)
regina	386312d	6.36	5.7	95.85	91.14		18	31	13	3	-11.73	21.49	-0.8	0.16	-12.17	2.36	-1.04	0.18
minati B	261936f	5.14	3.54	46	35.54		9	21	12	1	3.88	12.58	-2.03	0.29	-5.32	2.24	-4.76	0.08
kalarani	191274f	5.69	3.42	60.65	43.66		17	24	7	0	-1.59	2.11	-0.6	1.33	-4.1	0.32	-0.72	0.85
jyothi	599902d	4.73	2.85	47.99	35.25		8	19	11	1	1.57	10.72	-1.05	1.52	4.46	7.8	-0.4	1.04
kavita M	274621f	5.7	4.01	65	50.29		5	13	8	0								
reena P	250292f	4.51	3.53	75	38.05		10	16	6	2								
promod B	166005f	5.69	4.54	97.5	75.92		20	27	7	2								
ranju roy	272915f	5.5	3.7	58.36	53.64		9	42	33	7								
avdesh C	196148f	5.04	4.2	66.06	59.89		9	15	6	4	-7.9	2.38	-3.26	0.7	-2.1	1.48	-1.08	0.69
sivagami	260279f	5.83	4.8	92	74.42		12	26	14	3	-4.6	1.36	-2.3	1.96	-2.5	6.67	-2.45	0.37
meghnath	532119d	4.69	3.29	56.5	44.26		5	20	15	0								
sushila D	290568f	5.88	4.1	82.31	64.29		6	20	14	3	2.88	12.67	-9.5	3.9	-25	2.13	-4.2	1.2
namita B	152966f	5.6	3.6	75.17	52.11		9	20	11	2	1.36	7.22	-4.07	0.28	8.03	30.3	-2.2	2.5
sujatha K	394926b	6.58	3.28	61	56.64		5	77	73	1	3.23	8.69	-1.41	0.16	-1.17	0.49	-0.89	0.86
sanjay S	191328f	4.64	4.4	85	57.66		14	30	16	2	-6.01	8.42	-1.4	3	1.72	23.32	0.02	1.6
phulaso K	997606d	5.65	2.54				6	16	10	0	5.57	15	4.02	0.95	-1.52	2.23	-0.56	1.15
ELUMALAI	426164F	6.11	5.19	95.36	95.03		18	41	23	4	7.98	17.12	-1.9	1.09	-1.98	6.66	-2.1	0.12
AMINA BIB	399272F	4.07	3.85		32.02		8	9	1	0	2.9	0.7	-3.2	1.08	18	27	-1.9	2.9
SOMA GIRI	405536F	5.46	3.8	61.91	49.09		9	18	9	0	8.78	21.87	-1.8	1.09	8.3	25.16	-2.1	0.38
CHANDRA	223566F	4.11	4	36.08	32.38		9	15	6	2	1.7	9.8	-2.07	1.7	7.97	27	1.9	1.4
RUPLAL SA	411400F		4.4	89.05	65.29		9	16	7	3	-2.8	15.53	-2.02	1.44	13.9	27.24	-3.3	0.4
PARANJIT I	156992D	5.39	4.5	99.12	69.12		21	34	13	1	12.17	22.35	-1.67	2.56	-4.43	2.33	-0.4	0.7
MASUDA B	363574F	6.46	5	133.27	117		15	22	7	0	4.1	7.7	-1.5	0.02	0.55	3.5	-1.1	0.7
SAROJA DE	450464F	4.33	4	66.56	42		6	9	3	1	10.65	35	-0.9	0.7	6,41	30.46	-1.2	-0.03
LALITHA	422546F	5.24	4.3	76.35	65.08		36	39	3	NIL	17.9	37.26	-1.3	4.01	-1.01	20.41	-0.4	4.2
BHUDER M	440719F	6	5.1	107.91	80.5		8	26	18	1	3.3	12.04	-1.2	1.1	0.18	25.14	-1.5	1.15
MEENA DE	436645	6.3	5	136.42	104.55		12	23	11	1	-2.27	14.64	-2.7	0.3	-7.5	5.07	-1.1	1.2
SUBHASH I	444457F	4.5	3.4	155.08	53.72		19	16	-3	4	-5.2	9.05	-0.1	2.3	-6.5	2.86	-1.2	2.1
ANANTH K'	398575F		4.8		89.31		16	36	20	3	-32.33	0.62	NA	NA	NA	NA	-1.03	1.25
fulzhari kh	471727f	4.17	3	43.31	26.94		4	25	21	NIL	9.4	38.04	-2.3	2.1	21.25	45.77	-3.4	2.3
sumathi	240904f	5.5	4.4	5.03	57.12		16	33	17	4	-5.39	1.2	-2.3	1.25	-4.34	0.4	-0.7	1.1
sakunthala	464672F	5.93	4.8	143.75	88.97		6	16	10	0	5.56	28.64	-3.7	0.3	-4.1	4.29	-1.9	1.3
nirmala	457116f	4.75	4.3	97.57	64.07		24	47	23	4	NA	NA	NA	NA	NA	NA	NA	NA
gulzar B	705048c	4.36	4.2	82.9	52.94		14	28	14	2	-0.92	6.35	-0.5	0.32	5.98	15.31	-0.8	0.7
soundaraja	448441f	5.78	4.7	81.07	68.65		15	24	9	2	7.68	18.08	-1.1	1.05	-13.6	16.26	-1.7	1.59
mahendra	360082c	5.7	3.9	107.65	58.96		14	40	26	2	-3.15	7.12	-3.24	1.09	-6.42	13.6	-1.12	0.8
sandeep	454003f	5.9	4.8		83.21		9	17	8	2								
ritu P	223370f	6.2	5.07	110.72	101.9		5	15	10	1	NA	NA	NA	NA	NA	NA	NA	NA
hiraman P	115764f	6.1	5.1	73.47	72.76		15	28	13	3	-6.3	3.76	-4.9	2.11	NA	NA	NA	NA
jagdish P	336341f	7.1	5.1	100.78	78.09		11	18	7	2	NA	NA	NA	NA	NA	NA	NA	NA
sarifuddin	528339d	4.9	4.6	71.52	58.65		11	20	9	4	NA	NA	NA	NA	NA	NA	NA	NA
padmavath	11570f	6.3	5.1	97.95	106.05		14	31	17	2	14.01	9.5	-2.05	0.33	-3.19	6.8	-1.03	0.3

PRE BMV

NAME	AGE	SEX	HOSP NO	SYMPTOM	NYHA	rhythm	mva 2d	mva d	LA area A4C	LAV(A4C) S	LAV(A2C) S	LA A(A2C)	LAL(A4C/ D1)	A4C/D2	LAL(A2C)	PLAX/D3	LAVAL	VPE	ANP	LAMP	PAMP	TPG
regina	46	f	386312d	12	II	NSR	1.26	1.4	32.1	139	117	26.8	6.57	5.21	6.51	6.24	112	111		39	53	14
minati B	25	f	261936f	36	II	NSR	0.6	0.75	22.8	79	59	16.8	4.16	5.72	5.82	4.44	56	55.25		18	30	12
kalarani	36	f	191274f	12	II	NSR	1.1	0.72	24.8	90	74	22	4.38	5.99	6.01	4.8	77	65.86		19	41	22
jyothi	35	f	599902d	6	II	NSR	0.8	0.82	24.4	96	64	16.3	5.6	5.55	5.33	3.58	63	58.19		13.8	20	6.2
kavita M	29	f	274621f	48	II	NSR	1.2	1.14	27.7	98	62	23.2	6.52	4.8	5.54	4.23	98	69		12	18	6
reena P	56	f	250292f	24	II	**AF**	1.3	1.26	24.5	78	46	18.4	4.41	6.42	5.83	3.74	65.69	55.38		18	20	2
promod B	31	m	166005f	12	II	NSR	0.9	0.6	36.5	174	127	25.1	6.46	6.67	6.02	5.3	129	119		29	27	-2
ranju roy	35	f	272915f	9	III	NSR	0.7	0.6	37.3	172	77	24.3	5.6	6.8	6.3	5.5	122	109.54		34	72	38
avdesh C	24	m	196148f	6	II	NSR	0.9	1	27.1	85	85	22.1	6.86	4.75	5.35	4.5	95	76.69		12	20	8
sivagami	30	f	260279f	6	III	NSR	0.8	0.7	36.2	150	114	26.2	6.15	6.46	6.52	5	124	103		34	59	25
meghnath	33	m	532119d	12	II	NSR	0.8	0.7	28.8	115	66	20.9	5.99	5.68	5.58	4.65	91	82.74		29	63	34
sushila D	38	f	290568f	8	II	NSR	0.8	0.75	30.2	139	74	24.3	6.77	5.27	6.48	4.33	96	80.8		28	25	-3
namita B	43	f	152966f	12	II	NSR	0.6	0.8	26.5	107	87	24.7	6.72	6	6.21	3.6	89.53	75.91		12	26	14
sujatha K	36	f	394926b	24	II	NSR	0.7	0.65	28.4	105	75	19.9	6.32	5.71	6.73	4.52	75.94	85.31		4	87	83
sanjay S	30	m	191328f	36	II	NSR	0.8	0.96	27.7	94	69	21	5.09	6.95	5.45	4.45	90.64	82.33		39	37	-2
phulaso K	32	f	997606d	24	II	NSR	0.8	0.78	29.8	101	81	22.1	5.69	7.7	5.6	4.07	99.8	93.26		14	30	16
ELUMALAI	64	m	426164F	2	II	NSR	0.54	0.94	32.3	148	100	28.9	5.36	6.5	6.54	5.32	122	96.93		27	44	17
AMINA BIB	25	f	399272F	24	II	NSR	0.83	0.6	21	85	46	XVI	4.62	5.14	5.13	4.8		59.61		30	20	-10
SOMA GIRI	31	f	405536F	12	II	NSR	0.94	0.96	26.5	125	83	19.6	4.93	6.51	6.04	4.9	73.09	82.24		29	36	7
CHANDRA	32	f	223566F	36	III	NSR	0.5	0.48	21	86	49	18	4.26	5.24	5.49	4	61.31	46.69		26	41	15
RUPLAL SA	22	m	411400F	24	II	NSR	1.25	0.82	30.8	130	135	32.9	5.28	6.94	6.38	5.7	135.003	109.23		22	26	4
PARANJIT I	31	f	156992D	48	II	NSR	1.09	0.84	28.3	77	64	21.2	4.52	6.32	5.63	2.84		72.6		22	24	2
MASUDA B	46	f	363574F	60	II	**AF**	1.08	0.6	51.3	293	209	42.9	7.54	8.23	7.09	5.7	263.84	184		34	35	1
SAROJA DE	55	f	450464F	204	I	**AF**	0.88	0.83	27.2	90	44	15.9	6.23	4.72	4.64	5.3	79.22	81		13	17	4
LALITHA	37	f	422546F	36	II	NSR	0.9	0.52	23.6	74	63	20.1	5.65	4.92	5.02	4.3	81.96	62.51		32	41	9
BHUDER M	46	m	440719F	12	II	NSR	1.48	0.7	30.2	147	90	27.2	4.99	7.11	6.97	5.6	100.17	103		35	48	13
MEENA DE	45	f	436645F	24	II	**AF**	1.2	0.88	49	299	141	31.6	7.62	7.57	6.86	5.7	191.85	162		19	27	8
SUBHASH I	52	m	444457F	24	II	**AF**	1.37	0.94	33.6	109	93	26.3	8.3	4.96	5.81	5.5	151.43	118.41		18	16	-2
ANANTH K'	38	m	398575F	6	II	NSR	0.83	0.59	27.4	98	131	31.3	5.4	6.46	6.29	5.28	115.89	96.33		31	60	29
fulzhari kh	17	f	471727f	36	III	NSR	0.6	0.45	19.9	63	60	17.5	5.01	4.21	4.82	4.2	70.31	46.33		19	50	31
sumathi	44	f	240904f	12	II	NSR	0.99	0.9	23.7	71	68	19.8	4.14	5.95	5.96	IV.IV		67.03	56.68	27	24	-3
sakunthala	35	f	464672f	12	II	NSR	1.1	0.96	34.3	161	139	30.6	6.01	5.94	6.34	4.8	150.19	89.61		20	32	12
nirmala	52	f	457116F	24	II	NSR	1.06	0.93	32.3	94	79	21.8	6.25	4.67	4.8	4.7	108.17	71.74		38	46	8
gulzar B	45	f	705048c	36	II	NSR	1.09	1.06	22.2	73	57	18.4	5.89	4.18	4.27	4.2	83.06	54.08		21	31	10
soundaraja	49	m	448441f	48	II	NSR	0.8	0.7	27.4	114	87	23.6	5.31	5.26	5.74	5.6	104.29	81.8		29	35	6
mahendra	48	m	360082c	12	II	NSR	0.7	0.8	31.9	141	131	32	5.78	5.64	6.5	4.5	153.84	76.72		21	62	41
sandeep	23	m	454003f	96	III	NSR	0.99	0.7	na	na	99	27.2	na	na	6.2	5.1	na			20	25	5
ritu P	28	f	223370f	12	II	NSR	0.8	0.7	40	225	171	30.8	6.6	6.8	6.2	5.4	168.9	126.75		19	22	3
hiraman P	20	m	115764f	12	II	NSR	0.9	0.95	30.4	95	155	35.9	4.8	6.9	6.9	5.2	134.44	90.07		30	36	6
jagdish P	50	m	336341f	144	I	**AF**	0.8	0.9	29.1	142	91	27.4	5.2	6.5	6.6	4.7	104.26	83.08		22	23	1
sarifuddin	26	m	528339d	24	II	NSR	0.7	0.8	23.1	93	78	19.2	4.4	5.6	5.3	4	71.13	51.54		26	32	6
padmavath	49	f	111570f	18	II	NSR	1.2	1.2	39.4	205	102	28	6.3	7.4	7.1	5.6	130.66	136.54		23	38	15

PRE BMV

LA-LV	G	ES(%)	ED(%)	ES(/sec)	ED(/sec)	ES(%)	ED(%)	ES(/sec)	ED(/sec)
	17	-2.5	2.8	-2.3	0.2	NA	0.5	-1.72	0.16
	17	4.72	9.89	-1.3	0.09	-0.23	3.5	-1.05	0.22
	15	-1.23	0.7	-3.39	0.28	-2.44	2.6	-2.8	0.2
	12	-2.35	0.49	-3.1	0.14	-8.8	0.22	-0.5	1.7
	7	NA	NA	NA	NA	NA	NA	NA	NA
	10	NA	NA	NA	NA	NA	NA	NA	NA
	19	NA	NA	NA	NA	NA	NA	NA	NA
	32	-1.84	0.8	-0.11	1.55	-1.94	0.1	3.62	7.8
	7	-9.6	0.6	-2.5	0.27	-9.7	1.9	-2.2	0.49
	22	-4.5	0.21	-0.32	5.9	-3.27	0.9	-11.3	0.12
	19	NA	NA	NA	NA	NA	NA	NA	NA
	16	NA	4.54	-1.02	1.27	-20.3	1.9	-4.7	2.5
	6	-0.82	2.2	-2.57	0.19	-12.5	1.01	-1.95	1.5
	8	-5.4	0.54	-2.01	0.28	-6.21	2.68	-2.49	0.02
	27	-0.48	4.16	-4.2	3.4	-7.2	6.96	-1.3	0.82
	8	-2.96	0.26	-2.3	1	-2	1.63	-0.65	0.5
	19	3.49	10.81	-1.2	0.7	3.33	8.8	-1.3	0.33
	23	-2.5	2.3	-0.5	0.9	2.2	1.3	0.1	0.8
	19	4.01	15.16	0.04	2.5	0.4	1.36	-0.5	0.1
	19	1.9	6.9	-0.05	1.4	-16.6	1.4	-0.7	1.7
	14	-6.74	5.68	-2.46	0.21	-0.76	1.04	-1.1	0.04
	8	2.9	16.26	-0.03	0.2	-2.71	0.4	-0.04	0.43
	20	2.37	11.4	-0.6	0.01	-10.7	1.05	-0.8	0.1
	8	3.13	5.9	-0.9	0.8	7.2	12.31	-0.6	0.05
	0	-0.03	1.47	-0.7	1.19	13.2	25.58	-0.5	4.3
	27	-18	5.4	-2.7	1.8	4.5	13.3	-0.9	0.5
	9	-2.5	4.43	-1.47	0.19	-6.8	10.8	-0.6	0.9
	10	-2.8	0.12	-0.5	1.1	-10.7	0.11	-0.1	0.9
	24	-14.88	0.5	-1.7	0.3	-2.4	0.45	-2.6	1.45
	15	-0.55	5.31	-0.2	1.48	-0.9	6.92	-0.75	0.6
	19	-1.2	0.14	-0.9	0.22	-4.2	0.5	-0.5	0.3
	15	-12.1	5.4	-2.8	0.3	-2.3	3.7	-1.02	0.01
	18	NA	NA	NA	NA	NA	NA	NA	NA
	9	-2.07	25.94	-4.8	1.28	8.9	18.45	-2.9	1.3
	19	1.4	11.37	-1.7	1.37	13.3	29.25	-1.5	1.1
	11	-1.66	5.87	-0.4	0.8	-3.62	1.86	-2.1	0.2
	15								
	13	NA	NA	NA	NA	NA	NA	NA	NA
	12	-4.4	3.73	-6.9	0.4	NA	1.3	-3.2	0.3
	14	NA	NA	NA	NA	NA	NA	NA	NA
	18	NA	NA	NA	NA	NA	NA	NA	NA
	11	-9.4	0.3	-1.02	0.3	4.8	0.85	-0.9	0.02

FOLLOW UP

NAME	AGE	SEX	HOSP NO	SYMP	NYHA	rhythm	mva 2d	mva d	LAA(A4C)	LAV(A4C)S	LAV(A2C) S	LA A(A2C)	LAL(A4C/ D1)	A4C/D2	LAL(A2C)	PLAX/D3	LAVAL	VPE
regina	46	f	386312d	12	II	NSR												
minati B	25	f	261936f	36	II	NSR												
kalarani	36	f	191274f	12	II	NSR												
jyothi	35	f	599902d	6	II	NSR												
kavita M	29	f	274621f	48	II	NSR												
reena P	56	f	250292f	24	II	**AF**	1.8	2.45	17.6	44	43	17.2	4.2	4.4	4.7	4	58.48	74
promod B	31	m	166005f	12	II	NSR	1.6	1.55	22.3	77	60	17.5	5.1	4.6	4.8	4.7	72.11	110
ranju roy	35	f	272915f	9	III	NSR	1.55	1.8	19.9	70	61	19	4.39	5.32	5.08	4.5	63.26	105
avdesh C	24	m	196148f	6	II	NSR												
sivagami	30	f	260279f	6	III	NSR	1.79	2.44	25.4	96	77	21	5.3	4.85	5.2	3.3		
meghnath	33	m	532119d	12	II	NSR	2.06	1.96	20.9	82	45	14.8	5.06	4.92	4.46	3.8	58.95	95
sushila D	38	f	290568f	8	II	NSR												
namita B	43	f	152966f	12	II	NSR	1.6	2.1	21.6	75	64	21.7	4.4	6	6	4.1	66.4	108
sujatha K	36	f	394926b	24	II	NSR												
sanjay S	30	m	191328f	36	II	NSR												
phulaso K	32	f	997606d	24	II	NSR												
ELUMALAI	64	m	426164F	2	II	NSR												
AMINA BIBI	25	f	399272F	24	II	NSR	1.71	1.62	19.7	53	44	16	4.51	3.84	4.61	3.5	69.77	61
SOMA GIRI	31	f	405536F	12	II	NSR	1.8	2.2	17.8	56	61	19.2	4.1	4.7	4.7	3.4	61.8	66
CHANDRA	32	f	223566F	36	III	NSR		1.62	17.8	56	61	19.2	4.1	4.79	4.71	3.4	61.67	67
RUPLAL SAH	22	m	411400F	24	II	NSR	1.76	1.86	28.5	119	84	22.9	5.36	5.61	5.13	3.8	108.1	114
PARANJIT KA	31	f	156992D	48	II	NSR												
MASUDA BE	46	f	363574F	60	II	**AF**	2.1	2.06	44.8	239	173	35.9	7.2	7.1	6.6	5.4	207.1	276
SAROJA DEV	55	f	450464F	204	I	**AF**	1.47	1.62	26.2	88	61	17.4	5.59	4.46	5.02	4.4	86.88	110
LALITHA	37	f	422546F	36	II	NSR	1.9	2.01	21.4	62	60	18.9	4.98	5.06	5.49	4.5	67.94	113
BHUDER MA	46	m	440719F	12	II	NSR	2	2.17	29.8	149	74	22.4	4.8	6.24	5.66	4.5	100.2	135
MEENA DEV	45	f	436645F	24	II	**AF**	1.26	2.27	43.8	196	6.96	29	7.07	6.96	6.81	5.9		290
SUBHASH DH	52	m	444457F	24	II	**AF**												
ANANTH KV	38	m	398575F	6	II	NSR												
fulzhari khat	17	f	471727f	36	III	NSR												
sumathi	44	f	240904f	12	II	NSR	1.82	2.27	22.5	70	53	17.9	5.2	4.71	4.48	3.9		
sakunthala d	35	f	464672f	12	II	NSR												
nirmala	52	f	457116F	24	II	NSR	2.2	2.4	23.3	56	38	13.8	4.7	5.4	4.5	4		102
gulzar begun	45	f	705048c	36	II	NSR	1.8	2.1	22.8	83	56	17.1	5.5	4.7	4.5	4.2		109
	49	m	448441f	48	II	NSR												
	48	m	360082c	12	II	NSR												
	23	m	454003f	96	III	NSR												
Ritu pandey	28	f	223370f	12	II	NSR	1.9	1.72	27.7	96	58	19.9	5.8	4.8	5.3	3.9		
	20	m	115764f	12	II	NSR												
jagdish p	50	m	336341f	144	I	**AF**	2.1	2.1	29.9	112	75	23.1	4.8	5.9	5.9	4.3		122
	26	m	528339d	24	II	NSR												
	49	f	111570f	18	II	NSR												