



EFFECTS OF ISOLATED LA MAZE PROCEDURE ON CARDIAC DIMENSIONS, RHYTHM AND VENTRICULAR FUNCTION AMONG SURGICAL PATIENTS OF MITRAL VALVULAR HEART DISEASE WITH PERSISTENT ATRIAL FIBRILLATION

Cardiovascular

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ABSTRACT

Background: Atrial Fibrillation (AF) being one of the commonest arrhythmia is strongly associated with debilitated quality of life with increased morbidity and mortality. The maze procedure is a useful surgical modality for sinus rhythm restoration in patients with AF undergoing cardiac valve surgery. Isolated Ablation of the left atrium (LA) found to be superior in terms of higher efficacy in reversal to normal sinus rhythm. The present study was conducted planned to assess the effects of isolated LA maze procedure by diathermy on the cardiac dimensions, ventricular function and return to sinus rhythm post operatively among patients of mitral valvular heart disease with persistent atrial fibrillation. **Materials & methods:** An institution based descriptive study with prospective design was conducted over one and half year duration at the Department of CTVS, NRS Medical College & Hospital, Kolkata. In this study, 70 diagnosed cases of Mitral valve disease (MVD) with persistent AF undergoing mitral valve surgery with concomitant isolated LA Maze procedure by diathermy admitted at the institute and followed up at 1st and 3rd months post-operatively. Data were analysed using the SPSS version 20 software and checked for normal distribution; parametric or non-parametric test was performed accordingly. The difference between proportions was analysed using Chi square test; p value of less than 0.05 was considered statistically significant. **Results:** The mean age of the study population was 45 ± 6.45 years. The mean Left ventricular internal diameter (LVID) decreased significantly after the procedure (p value < 0.001). Age (p value < 0.006), NYHA Class (p value < 0.006) and LVEF (p value < 0.001) were significantly associated with the outcome of LA maze procedure at 3rd months of follow up. **Conclusion:** Improved LV function and maintenance of sinus rhythm were encouraging results after LA maze procedure using diathermy along with Mitral valve surgery.

KEYWORDS

Atrial Fibrillation, Isolated Maze procedure, Cardiac rhythm, left ventricular diameter

INTRODUCTION

Atrial Fibrillation (AF) is the most common symptomatic arrhythmia affecting by a global prevalence of 0.5–5.5%^{1,3}. Studies conducted in India have shown a wide variation (0.1% to 1.6%) in AF prevalence^{4,5}. Most of the patients are initially asymptomatic; in due course they will land up with lot of complications, limiting their day to day activities. Because of the abnormality in atrial activity there is abnormal atrial systolic event leading to ventricular dysfunction with reduced output, formation of thrombus in atrium leading to cerebrovascular accident and thromboembolic events. AF is associated with fivefold increase in risk for developing Stroke⁶. Structural changes that alter the atrial architecture potentially lead to development of AF⁷.

Since Cox Maze procedure was introduced by James L. Cox in 1987, surgical ablation of AF has been one of the most effective means of curing this arrhythmia. This procedure was designed to block the multiple macro-reentrant circuits which were the supposed cause of AF^{8,9}. The procedure was proved to be highly efficacious with 97% freedom from symptomatic AF and became the gold standard for the surgical therapy of AF for more than a decade^{10,11}. So, treating AF during mitral valve replacement or repair with the goal to attain a sinus rhythm helps in early postoperative recovery along with a potential to allow the patient to have better quality of life without the risk of thromboembolism. Isolated Ablation of the left atrium found to be superior in terms of higher efficacy in reversal to normal sinus rhythm, less invasiveness, lesser duration of procedure and lesser complications. The use of diathermy as a potent energy source in LA Maze procedure is satisfactory. This technique has got some advantages e.g., less time consuming, easy availability, simple to use, and affordable. But limited data are available studying the efficacy of diathermy in maze procedure for treatment of AF in mitral valve surgery. In this context, the current study was planned to assess the effects of isolated Left Atrial (LA) maze procedure by diathermy on the cardiac dimensions, ventricular function and return to sinus rhythm post operatively among patients of mitral valvular heart disease with persistent atrial fibrillation.

MATERIALS AND METHODS:

The present institution based descriptive study with prospective design

was conducted over one and half year duration at the Department of CTVS, NRS Medical College & Hospital, Kolkata, West Bengal. The study population was all the adult patients diagnosed of Mitral valve disease (MVD) with persistent Atrial Fibrillation undergoing mitral valve surgery along with Cox maze procedure (isolated LA Maze procedure) using diathermy admitted at the institute during the study duration. Patients who were critically ill, with any history suggestive of coronary disease or 2D echocardiography suggestive of any Regional Wall Motion Abnormality (RWMA) or positive Treadmill Test (TMT) or previously diagnosed Coronary Artery Disease (CAD) abnormalities and refusal to undergo the intervention or participation in the study were excluded from the study. During the study period, all of the eligible study populations were approached and after applying the inclusion and exclusion criteria, 70 patients were selected using complete enumeration technique. Prior approval was obtained from the Institutional Ethics Committee (IEC) of NRS Medical College and Hospital, Kolkata. Informed consent from the parents and legal guardian of the subjects was taken after they understand participant information sheet (PIS) explaining the nature of study and procedures, which was provided to them printed in their own language. Relevant data were collected using pre-defined and pre-tested schedule by interviewing the subjects and followed by relevant physical and biochemical measurements before, during and after the surgical procedure at 1st and 3rd months of follow up.

After conventional bicaval cannulation cardiopulmonary bypass was achieved; aorta cross clamped, and mitral valve was replaced through the LA approach along with other valve replacement when required. LA clot was removed when present, and LA appendage was closed by purse string when indicated followed by LA Maze procedure using diathermy¹². We have used Valleylab Force FX Electrosurgical GeneratorTM for diathermy. Diathermy was set at 40 in coagulation spray mode with contact time of 1 to 2 s to create atrial lesion. Lesions were created by slow progression of the cautery pencil such that the tissue blanched when the cautery arc was moved against the tissue. Standard right-sided left atriotomy was made parallel to the inter-atrial groove. All ablation lines were made endocardially in cavum of left atrium. The first ablation line was made encircling both left pulmonary veins. The second was from mid-point of the posterior mitral annulus

to the first encircling line. The third line created was encircling the base of the LA appendage (closed by purse string). The fourth line joined the first and third encircled lines. The fifth line was created encircling both right pulmonary veins. The final line joined the left and right pulmonary vein isolation encircling lines. LA size reduction (tailoring procedure) was done where LA size was > 6 cm. Post-operatively, all patients were given Digoxin (0.25mg) and no other anti-arrhythmic drugs were given. Anti-coagulation maintained with Acenocoumarol or Nicoumalone (AcitromTM) post-operatively and the dose was titrated according to the International normalized ratio (INR). Data were analysed using the SPSS version 20 software. Descriptive analysis was done in the form of proportion for categorical variables, mean or median for continuous variables. Data were checked for normal distribution using tests for normality and parametric or non-parametric test was performed accordingly. The difference between proportions was analysed using Chi square test; p value of less than 0.05 was considered statistically significant.

RESULTS:

In this present study, 70 patients diagnosed of Mitral valve disease (MVD) with persistent Atrial Fibrillation undergoing mitral valve surgery with Isolated Left Atrial Cox Maze Procedure by diathermy were studied. The mean age of the study population was 45 ± 6.45 years. In the present study, most of the subjects were in the age group of 41-60 years (53%). Most of the patients were females (60%). There were 54% of the patients belonged to NYHA Class 2 and palpitation, followed by shortness of breath and fatigue were common symptoms (Table 1).

Table 1: Distribution of study subjects according to background characteristics (n=70)

Background characteristics	Frequency	Percentage
Age (years)		
21-40	26	37
41-60	37	53
>60	07	10
Sex		
Female	42	60
Male	28	40
NYHA Class		
NYHA 2	38	54
NYHA 3	26	37
NYHA 4	06	09
Presenting complaints*		
Palpitation	50	72
Shortness of breath	46	66
Fatigue	20	28
Syncope	05	6.7
Limb weakness	07	10

NYHA-New York Heart Association class *Multiple responses,

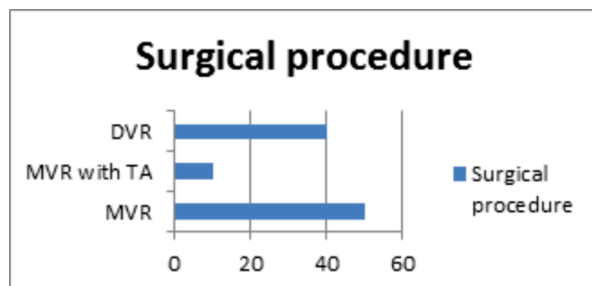


Figure 1: Distribution of study subjects according to surgical procedure (n=70)

In the present study, 50% of the patients underwent Mitral valve replacement (MVR) with LA maze procedure, 40% Double Valve Replacement (DVR-MVR with AVR) with LA maze procedure and among 10% MVR with Tricuspid Annuloplasty (MVR with TA) Ring Placement with LA maze procedure was done (Figure 1).

On baseline echocardiography, left ventricular dysfunction was severe among 7% of the patients, 15% with moderate and 38% with mild; 27% with severe right ventricular dysfunction pre-operatively. Severe

mitral stenosis (MS) was present among 40% and 33% with moderate MS (Table 2). Normal sinus rhythm was obtained among 85% of the patients at first month of follow up, and at 3 months, 80% were reverted back to Normal sinus rhythm (Table 3). The mean Left ventricular internal diameter (LVID) at both diastole and systole decreased after the procedure, which were statistically significant [Wilcoxon Signed Rank test, p value < 0.001] (Figure 2).

We found that age (p value-0.006), NYHA Class (p value-0.006) and LVEF (p value <0.001) were significantly associated with the outcome of LA maze procedure at 3rd months of follow up (Table 4).

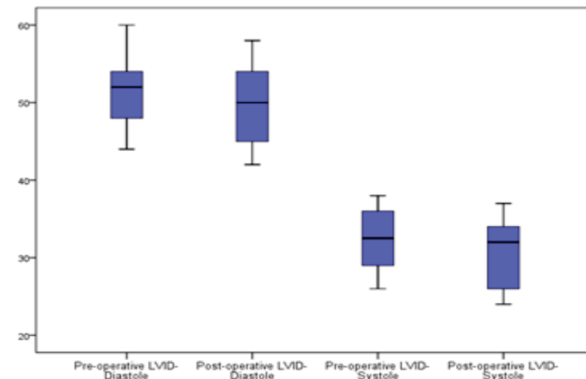


Figure 2: Box Whisker plot showing the distribution of Left ventricular internal diameter (LVID) on echocardiography before and after the procedure (at 3 months of follow up) among the study subjects

Table 2: Distribution of study subjects according to baseline Echocardiography findings (n=70)

Echocardiography findings	Frequency	Percentage
LVEF (%)		
Normal (51-70)	28	40
Mild dysfunction (41-50)	27	38
Moderate dysfunction (31-40)	10	15
Severe dysfunction (≤ 30)	05	07
Right ventricular dysfunction		
Normal	51	73
Severe	19	27
Left atrium size (mean $\pm$ SD) (mm)	51.56 $\pm$ 6.89	
Left ventricular internal diameter		
At Diastole (mean $\pm$ SD) (mm)	51.09 $\pm$ 4.55	
At Systole (mean $\pm$ SD) (mm)	32.17 $\pm$ 3.62	
Severity of MS		
Mild	19	27
Moderate	23	33
Severe	28	40

LVEF-Left Ventricular Ejection Fraction, MS-Mitral stenosis

Table 3: Distribution of study subjects according to post-operative findings (n=70)

Post-operative findings	Frequency	Percentage
Mortality		
No	63	90
Yes	07	10
Surgical re-exploration*		
No	58	92.6
Yes	04	7.4
SSI*		
No	59	93.3
Yes	04	6.7
LA clot on surgery		
No	58	83.3
Yes	12	16.7
Hospital stay (days)		
Duration (mean $\pm$ SD)	16.8	6.38
ECG findings at 1st follow up month*		
Normal sinus rhythm	53	85

Atrial fibrillation	10	15
ECG findings at 3rd follow up month*		
Normal sinus rhythm	50	80
Atrial fibrillation	13	20
Left ventricular internal diameter		
At Diastole (mean $\pm$ SD) (mm)	49.54 $\pm$ 4.45	
At Systole (mean $\pm$ SD) (mm)	30.86 $\pm$ 3.91	

*n=63

Table 4: Distribution of variables associated with outcome of LA maze procedure at 3rd months of follow up (n=63)

Variables	LA maze procedure n (row %)		Chi square value, p value
	Successful	Failed	
Age (years)			9.98, 0.006
21-40	22 (91.7)	02 (8.3)	
41-60	26 (78.8)	07 (21.2)	
>60	02 (33.3)	04 (66.7)	
Sex			0.16, 0.688
Female	30 (81)	07 (19)	
Male	20 (77)	06 (23)	
NYHA Class			10.19, 0.006
NYHA 2	23 (92)	02 (8)	
NYHA 3	16 (66.7)	08 (33.3)	
NYHA 4	01 (25)	03 (75)	
LVEF			27.26, 0.000
Normal	25 (92)	01 (8)	
Mild dysfunction	22 (88)	03 (12)	
Moderate dysfunction	02 (25)	06 (75)	
Severe dysfunction	01 (25)	03 (75)	
Severity of MS			2.47, 0.290
Mild	14 (93.3)	01 (6.7)	
Moderate	16 (72.7)	06 (27.3)	
Severe	20 (77)	06 (23)	

DISCUSSION

Atrial fibrillation (AF) being the most common persistent arrhythmia seen in clinical practice, which is responsible for approximately one-third of all the hospitalizations for cardiac rhythm anomalies¹³. Systemic embolization is the most dreaded complication in patients with AF. Therefore, restoration of sinus rhythm in patients with persistent AF is very important to reduce the risk of cerebral embolism, preservation of cardiac output and exercise capacity, and lessening the symptoms. The Cox-Maze III procedure is recognized as the gold standard for the surgical treatment of medically refractory AF. Isolation limited to Ablation to the left atrium has got significant advantages in minimizing the technical complexity and invasiveness, decreases the cardio-pulmonary bypass times, and reduce the risk of surgical complications while maintaining procedural efficacy^{14,15}. The Maze IV procedure uses various energy sources e.g., radiofrequency, high-frequency ultrasound, laser, and microwave¹⁵. The present study was conducted to assess the effects of isolated (Left Atrial) LA maze procedure using diathermy on the cardiac dimensions, ventricular function and return to sinus rhythm post operatively at 1st and 3rd month of follow up. The findings of the study are hereby being discussed with other relevant studies.

The study by Jeonget al.¹⁶ observed that the mean age of the patients with long duration AF was 55 $\pm$ 13 years and majority of the subjects were females. Sayed SA et al¹⁷ in their study found the mean age was 35.3 $\pm$ 9.12 with female pre-dominance. Pandey SM et al¹⁸ reported 39.75 $\pm$ 13.84 years of mean age. The findings of our study correspond with the findings of these studies. Jeong et al. in their study reported 59% of the patients were NYHA class III-V, Sayed SA et al found that 26% of the patients belonged to NYHA Class 2. In the present study, we observed 54% of the patients belonged to NYHA Class 2 which may be influenced by different study settings or different sample composition.

Left ventricular filling and stroke volume can be augmented by regaining of LA activity after the maze procedure. This will eventually play a significant role in prevention of stroke or thromboembolism by increasing the blood flow velocity in the LA¹⁹. The current study found that the mean Left ventricular internal diameter (LVID) at both diastole and systole decreased significantly after the procedure.

The present study observed that surgical re-exploration needed in 7.4 % patients, surgical site infection (SSI) occurred among 6.7%, LA clot on surgery was found in 16.7%. Mean hospital stay was 16.8 $\pm$ 6.38 days. We found that normal sinus rhythm was obtained among 85% of the patients at first month of follow up, and at 3 months, 80% were reverted back to Normal sinus rhythm. Patwardhan et al.²⁰ in their study showed that the radio frequency (RF)-modified Maze was highly effective in early and late restorations of sinus rhythm in patients with rheumatic heart disease (RHD). They found that in the Maze group, sinus rhythm was restored in 85.71% patients immediately and sustained in 78.57% patients over the follow-up as against an immediate conversion rate of 5.3% patients, in the non-maze group. Sueda et al.²¹ approached only the left atrium for persistent AF and successfully achieved 100% of regular rhythm after surgery and 78% at 6 months. Pandey SM et al showed that in which only the left atrium was addressed, with 95% of AF reversion after surgery and 90% at 3 months. Wu et al²² reviewed 199 patients and documented the success of radiofrequency maze procedure for persistent atrial fibrillation with concomitant mitral surgery and found that sinus restoration was achieved among 154 patients according to the rhythm at discharge after 2 weeks of postoperative continuous monitoring. We found that age, higher NYHA Class and severe left ventricular dysfunction were significantly associated with the outcome of LA maze procedure at 3rd months of follow up. It was observed that higher age (>60 years), higher class of NYHA, more severe left ventricular dysfunction were associated significantly with unsatisfactory outcome of isolated LA maze procedure. Similarly, Jeong et al. reported that old age, NYHA functional class, long AF duration, diabetes, and enlarged left atrium were associated with late AF recurrence. The present study being a single centre study with small sample size may limit the study finding to some extent for generalization of results. Therefore, we recommend a multi-centric study with larger sample size with more follow up period would be more appropriate.

CONCLUSION:

From the salient findings from the study, we can conclude that concomitant isolated Left Atrial maze procedure using diathermy with Mitral valve surgery was significantly effective in conversion of persistent AF to normal sinus rhythm, decreasing the left ventricular internal diameter and reducing the severity of left ventricular dysfunction post-operatively. It was also observed that higher age, higher class of NYHA, and more severe left ventricular dysfunction were significant factors associated with unsatisfactory outcome of isolated LA maze procedure.

Conflict of Interest: None to declare

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