Original Article

Journal of Cardiovascular Medicine and Surgery
Volume 5 Number 3, July - September 2019
DOI: http://dx.doi.org/10.21088/jcms.2454.7123.5319.4

Early Results of Left Atrial Reduction Plasty in Patients Undergoing Mitral Valve Replacement

Sunil Dhar[1], Anubhav Gupta[2], Sartaj Ahmed Guru[3], Ajit Kumar Padhy[4]

Authors Affiliation: [1]Mch Final Year, [2]HOD, [3]Mch First Year, [4]Assistant Professor, Dept. of CTVS, Vardhman Mahavir Medical College and Safdarjung Hospital, Ansari Nagar, New Delhi, Delhi 110029, India.

Abstract

Objective: To study the early outcomes of left atrial reduction plasty in patient undergoing mitral valve surgery with giant left atrium. *Methods:* We surgically excised the redundant left atrial wall in order to reduce the size of giant LA and replaced the mitral valve. Concomitant tricuspid valve repair was also done in patients having significant tricuspid disease. *Results:* Twelve patients underwent left atrial reduction plasty with mitral and tricuspid valve surgery. There was 48.15% reduction in left atrial size. Postoperatively, 75% regained sinus rhythm from atrial fibrillation. NYHA function was better. One patient was relieved from bronchial compression. There was no complication and no mortality. *Conclusion:* Left atrial reduction plasty is an effective modality for treating AF in patients of GLA undergoing mitral valve surgery. The restoration and maintenance of sinus rhythm in short term follow up is satisfactory.

Keywords: Giant left atrium; Left atrial reduction plasty; Mitral valve replacement; NYHA; Left ventricular ejection fraction; AF

How to cite this article:
Sunil Dhar, Anubhav Gupta, Sartaj Ahmed Guru *et al.* Early Results of Left Atrial Reduction Plasty in Patients Undergoing Mitral Valve Replacement. J Cardiovasc Med Surg. 2019;5(3):131-136.

Introduction

Rheumatic mitral valve lesions with long history usually have giant left atrium (GLA) and found in about 19% of patients who require replacement surgery.[1] Left atrial size is significant predictor of associated morbidity in form of chronic atrial fibrillation, respiratory dysfunction due to bronchial compression, hemodynamic disturbance arises due to LV compression, risk of atrial thromboembolism and increased risk of stroke, sudden death.[2-6]

The first description of GLA was given in 1849 by Hewett by reporting autopsy finding of aneurysmal dilatation of left atrium (LA) with thickening and contraction of left atrioventricular opening in the context of mitral valve disease.[7] As per recent studies, GLA defined by (a) diameter of left atrium on M-mode ECHO > 65 mm, (b) left ventricle posterobasal wall bent inwards > 30 mm after onset of diastole.[8-11]

Mitral valve replacement alone in patients of GLA seldom restores the sinus rhythm in patients of atrial fibrillation. Convincing results of restoration of sinus rhythm are published in the literature when

Corresponding Author: Ajit Kumar Padhy, Assistant Professor, Dept. of CTVS, Vardhman Mahavir Medical College and Safdarjung Hospital, Ansari Nagar, New Delhi, Delhi 110029, India.

E-mail: drajitpadhy@gmail.com

Received on 10.06.2019 **Accepted on** 26.06.2019

added with LA reduction plasty and modified Maze procedure.[12,13] Few advocates additional LA reduction plasty to the mitral valve replacement suffices a symptomatic relief by reversing the atrial fibrillation attributed to the pulmonary veins isolation by the suture line.[14–16]

We did left atrial reduction plasty, in patients of mitral valve disease with GLA, in addition to prosthetic valve replacement with endocardial suture exclusion of left atrial appendage (LAA) with running 4–0 prolene in 2 layers ensuring tight approximation of walls. In this study, we aim to investigate the early results of LA reduction plasty mainly in achieving and maintenance of sinus rhythm inpatients of chronic atrial fibrillation and its impact on left ventricular ejection fraction.

Materials and Methods

In our study, we operated total 12 patients of GLA with concomitant mitral and tricuspid valve disease from May 2018 to Jan 2019. All operations were performed by the same surgical team. Study included all the patients with mitral valve disease qualified for surgery according to 2014 AHA/ACC guidelines for the management of patients with valvular heart disease. Other additional criteria included chronic atrial fibrillation with enlarged left atrial size (>65 mm) and associated tricuspid valve disease requiring tricuspid valve surgery.

The patients requiring mitral leaflet repair or annuloplasty, patients with left atrial thrombus image on echocardiography, patients having fascicular or atrioventricular nodal conduction disturbances in preoperative period, undergoing redo surgery, emergency surgery, patients with a clear indication for any combined procedure including aortic valve disease, ascending aorta aneurysm, and coronary artery stenosis were excluded from this study.

Operative technique

Median sternotomy approach with aortic and bicaval cannulation was used. The transverse sinus looped separately to facilitate the exposure of superior wall of LA up to the base of left atrial appendage. The left atrium was circumferentially dissected from pulmonary venous vestibule on the right side to the fossa ovalis along the Sondergaard's groove. Superiorly, inferiorly and laterally the redundant left atrium freed from any attachments. LA exposed at Sondergaard's groove. A circumferential left atrial reduction was performed internally by excising a triangular area of redundant tissue between inferior pulmonary veins and mitral annulus inferiorly. The base of triangle is between Right inferior pulmonary vein (RIPV) and behind the inferior vena cava (IVC), and its apex towards the left inferior pulmonary vein (LIPV) and posterior mitral annulus extending up to base of LAA and another triangular area of redundant tissue between superior pulmonary veins and Fossa ovalis superiorly. The base of triangle between RSPV and a point behind the retracted superior vena cava (SVC) enough to excise the redundant LA wall superiorly whilst its apex is between base of LAA adjacent to LIPV. (Fig. 1) Exposure can be made better with retracting

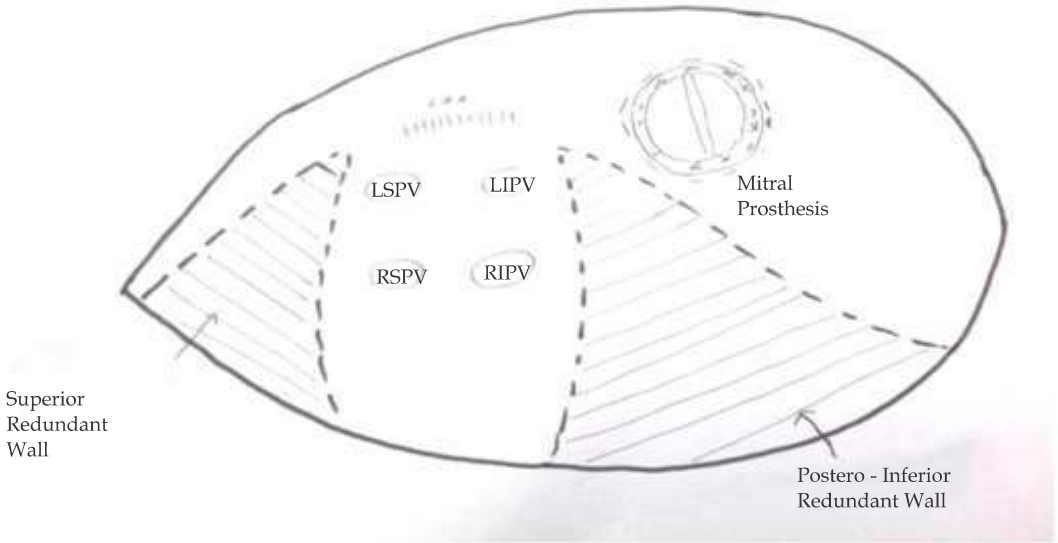

Fig. 1: The triangular shaded area with in the dotted line (- - - - -) shows the line of incision to excise superior and postero-inferior redundant wall, also (+++++) shows the suture closure of left atrial appendage.

Table 1:

Sl. No	Age/ Sex	Weight / Height	Pre op NYHA	Post op NYHA	Pre-op valvular Pathology	Pre op EF	Post op EF	Operation	Chordal preservation	Cross clamp time (Min)	Pump time (Min)	Pre op LA diameter in mm.	Post op LA diameter in mm.	Pre op Rhythm	Post-operative rhythm (In 1st 3 month)	Complication
1	44/F	163/63	III	I	SEV MS MOD MR	50	55	MVR, LA RP	TOTAL	209	240	75	46	AF/FVR	AF/CVR	No
2	25/F	153/40	II	I	SEV MS, SEV MR	45	50	MVR,, LARP	TOTAL	204	244	88	43	AF/FVR	NSR	No
3	16/F	155/36	II	I	SEV MS, SEV TR	60	60	MVR, LARP, TVR	TOTAL	154	185	79	42	AF	NSR	No
4	28/F	151/38	III	I	SEV MR, MOD TR,	60	55	MVR, LARP	TOTAL	147	218	77	38	AF	NSR	No
5	36/F	155/81	III	I	SEV MS, MOD MR, MOD TR,	55	58	MVR LARP	TOTAL	181	210	81	44	AF	NSR	No
6	35/F	143/29	II	I	SEV MR	60	55	MVR LARP	TOTAL	134	195	69	38	AF/CVR	AF/CVR	No
7	31/F	155/40	II	I	SEV MR, MOD MS SEV TR,	55	55	MVR LARP TVR	TOTAL	162	255	78	46	AF	NSR	No
8	28/F	160/55	IV	I	SEV MR	60	50	MVR LARP	TOTAL	71	124	78	42	AF	NSR	No
9	19/M	153/43	III+ LBO	I	SEV MR, MILD TR	55	45	MVR LARP	TOTAL	152	180	79	35	AF/FVR	AF/CVR	No
10	28/F	151/42	II	I	SEV MR, MOD TR,	60	50	MVR LARP TVR	TOTAL	138	180	79	39	AF/FVR	NSR	No
11	28/F	162/48.8	II	I	SEV MS, SEV MR, MOD TR	55	60	MVR, LARP, TVR	TOTAL	99	120	82	45	AF/FVR	NSR	No
12	37/M	167/47	III	I	SEV MS, SEV MR	60	60	MVR LARP	TOTAL	93	117	80	32	AF/CVR	NSR	No

M=Male, F=Female, SEV=severe, MOD=Moderate, MS=Mitral stenosis, MR=Mitral regurgitation, LA=Left atrium, LARP=Left atrial reduction plasty, MVR=Mitral valve replacement, TVR=Tricuspid valve repair. NSR=Normal sinus rhythm, AF=Atrial fibrillation.

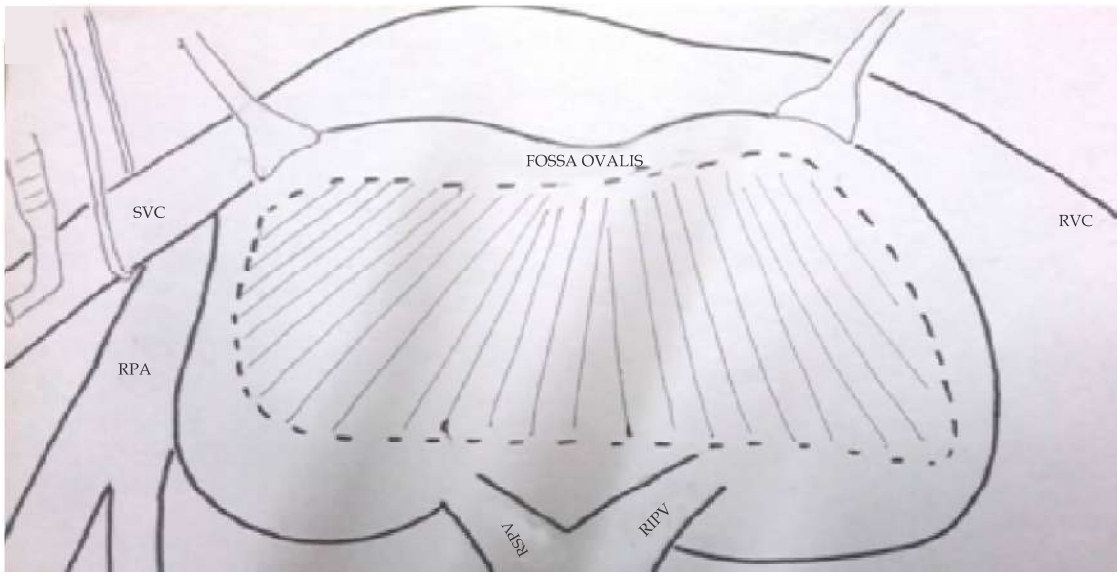

Fig. 2: The shaded area within the dotted line (- - - -) shows resection of the redundant tissue between right pulmonary veins and fossa ovalis, extending down below the IVC.

transverse sinus. The left atrial resection on right side completed by resecting the redundant tissue between right pulmonary veins and fossa ovalis, extending down below the IVC. The base of LAA excluded by running 4–0 prolene sutures. (Fig. 2) The gaping triangular resection was reapproximated internally with running 4–0 polypropylene after replacing the mitral valve with mechanical valvular prosthesis. For patients requiring tricuspid valve surgery, right atriotomy approach was chosen separately.

Study showed 100% outpatient follow up with no mortality. The data was obtained from them during their routine follow up at 3 months after surgery (Table 1).

Statistical study: As the sample size was small we used mean and mean deviation in our study.

Results

We operated on total 12 patients where number of female patients (n=10, 83.3%) more than the male (n=2, 16.67%). 4 out of 12 patients underwent additional tricuspid valve repair procedure. Mean CPB time was 192.16 min and cross clamp time was 145.33 min. preoperative LA size was 78.75 mm (± 2.79) and postoperative LA size was 40.83 mm (± 3.69) which showed size reduction by 48.15%. At 3 month in the follow up 4 of 12 (33%) patients showed improvement in LV function and 12 of 12 (100%) patients showed improvement in NYHA function (Table 2).

Table 2: Patient demographics

Characteristics	
Male	n=02 (16.67%)
Female	n=10 (83.33%)
MS	n=0
MS+MR	n=3 (25%)
MS+TR	n=1 (8.3%)
MR	n=2 (16.7%)
MR+TR	n=3 (25%)
MS+MR+TR	n=3 (25%)
Mean CPB time (min)	192.16
MVR with LARP	191 ± 38
MVR, TVR with LARP	185 ± 35
Mean cross clamp time (min)	145.33
MVR with LARP	148.87 ± 37.62
MVR, TVR with LARP	138.25 ± 19.75
Mean LA diameter(mm)	
Preoperative size	78.75 ± 2.79
Postoperative size	40.83 ± 3.69
Reduction in size (%)	48.15%
LVEF	
Improvement	n=4 (33.3%)
Reduction	n=5 (41.67%)
No change	n=3 (25%)
NYHA function	
IV	n=1 (8.33%)
III	n=5 (41.67%)
II	n=6 (50%)
Improvement in NYHA function:	n=12 (100%)

Discussion

Many surgical methods have been described in the literature to reduce the size of LA. We noticed that in GLA, the posterior LA wall is very thin and grossly redundant. With the increase in size it folds under itself and progresses downwardly, which may result inpostero-lateral LV wall compression. Fugita *et al.*[17] claimed that in some of the cases of severe mitral valvular disease and GLA, compression and bending of the basal portion of the posterior wall of the left ventricle occurs and is accompanied by paradoxical movement.

Fujita *et al.* observed that the strut of the mitral prosthetic mitral valve leans against the ventricular septum and the inflow stream of blood gets directed towards the left ventricular outflow tract in GLA following mitral valve replacement. Such observations led them devise the para-annular plication technique where plication of the posterior wall done between pulmonary vestibule and mitral annulus. It reduces the bleeding complications but cause no loss to the critical tissue mass generating AF. Isolation of pulmonary isthemus remains incomplete with this technique. The para annular semilunar postero-inferior wall plication is a blind process and may injure mediastinal structures in situations where the mediastinal structures are adherent with posterior LA wall. The superior wall plication cause decompression of the compromised bronchial airways.

Amongst all excision techniques[14–20], our approach is a little deviation from the technique described by Sinatra *et al.*[18] The circumferential LA wall excision technique by Adam *et al.*[14] included the LA appendage, we feel that it will expose the circumflex artery to the risk of injury unnecessarily. Therefore, we preferred internal endothelial closure of LAA instead of complete excision and in an order to achieve complete isolation of the pulmonary veins we directed our incision line to the base of LAA. Our technique reduced the LA size by 48.15% in 12 patients in comparison to 50% reduction as opined by Adam *et al.* We have been able to achieve bronchial decompression in one patient. The excision and new technique is though surgically challenging due to prolonged ischemic time, complication of bleeding from the suture line of papery thin LA wall, it theoretically isolates the pulmonary veins completely. It acts as a barrier to chaotic wavelets and macro-re-entry circuit. Ovidio *et al.*[16] advocated surgical reduction plasty, where they had experienced 100% restoration of sinus rhythm at the end of 36 months with surgical excision. In our study 9 of 12 patients (75%) achieved sinus rhythm at the end of 3 months. The recurrence of AF may be related to the size of LA as revealed in the studies by Wang *et al.*[12,13] Sugiki *et al.* introduced Spiral resection of left atrial wall by superior transseptal approach, but there is always a possibility of conduction abnormalities.[19] Lessana *et al.* conducted partial autotransplant technique The advantages included excellent exposure of mitral valve and significant reduction of left atrium size, but the disadvantages are: (i) involvement of non diseased SVC, transaction and reapproximation of which can produce brain edema (ii) prolongation of the ischemia time.[20]

The technique we performed is relatively simple, avoids extensive suture line. The retraction of SVC and transverse sinus simultaneously increased the exposure of superior surface of LA and facilitated our reach to the base of left atrial appendage. We did not require any right atrial incision for reductionplasty. Due to good visualisation of posterior mediastinal structures the risk of injury is avoided and abatement of symptoms is imminent.

Conclusion

LA reduction plasty is an effective modality for treating AF in patients of GLA undergoing mitral valve surgery. The restoration and maintenance of sinus rhythm in short term follow up is satisfactory, however the effectiveness, the risk benefit ratio of this technique requires further prospective randomised studies with a long-term follow up.

References

1. Di Eusanio G, Gregorini R, Mazzola A, *et al.* Giant left atrium and mitral valve replacement: risk factor analysis. Eur J Cardiothorac Surg. 1988;2:151–9.
2. Scherer M, Dzemali O, Aybec T, *et al.* Impact of left atrial size on chronic atrial fibrillation in mitral valve surgery. J Heart Valve Dis. 2003;12:469–74.
3. Scherer M, Therapidis P, Miscovic A, *et al.* Left atrial size reduction improves the sinus rhythm conversion rate after radiofrequency ablation for continuous atrial fibrillation in patients undergoing concomitant cardiac surgery. Thorac Cardiovasc Surg. 2006;54:34–8.
4. Read D, Abbott R, Smucker M. Prediction of outcome after mitral valve replacement in patients with symptomatic mitral regurgitation. The importance of left atrial size. Circulation. 1991;84:23–34.

5. Somerville J, Chambers R. Systemic embolism in mitral stenosis: relation to the size of the left atrial appendix. Br Med J. 1964;2:1167–9.
6. Benjamin E, D'Agostino R, Belanger A, *et al.* LA size and the risk of stroke and death: the Framingham Heart Study. Circulation. 1995;92:835–41.
7. Plaschkes J, Borman J, Merin G, *et al.* Giant left atrium in rheumatic heart disease: a report of 18 cases treated by mitral valve replacement. Ann Surg. 1971;174:194–201.
8. Kawazoe K, Beppu S, Takahara Y, *et al.* Surgical treatment of giant left atrium combined with mitral valvular disease. Plication procedure for reduction of compression to the left ventricle, bronchus, and pulmonary parenchyma. J Thorac Cardiovasc Surg. 1983 Jun;85(6):885-92.
9. Isomura T, Hisatomi K, Hirano A, *et al.* Left atrial plication and mitral valve replacement for giant left atrium accompanying mitral lesion. J Card Surg. 1993;8:365–70.
10. Kothari A, Kothari K. A giant left atrium. J Postgrad Med. 2005;51:49–50.
11. Ates M, Sensoz Y, Abay G, *et al.* Giant left atrium with rheumatic atrial stenosis. Tex Heart Inst J. 2006;33:389–91.
12. Wang W, Buehler D, Martland AM, *et al.* Left atrial wall tension directly affects the restoration of sinus rhythm after Maze procedure. Eur J Cardiothorac Surg. 2011;40:77–82.
13. Wang W, Guo LR, Martland AM, *et al.* Biatrial reduction plasty with reef imbricate technique as an adjunct to maze procedure for permanent atrial fibrillation associated with giant left atria. Interact Cardio Vasc Thorac Surg. 2010;10:577–581.
14. Adams C, Busato GM, Chu MW. Left atrial reduction plasty: A novel technique. Ann Thorac Surg. 2012;93:e77–9.
15. Sankar NM, Farnsworth AE. Left atrial reduction for chronicatrial fibrillation associated with mitral valve disease. Ann Thorac Surg. 1998;66:254–6.
16. Ovidio A. García-Villarreal, Amadeu B. *et al.* Left atrial Reduction. A new concept in surgery for chronic atrial fibrillation. Rev Esp Cardiol. 2002;55(5):499–504.
17. Fujita T, Kawazoe K, Beppu S, *et al.* Surgical treatment on mitral valvular disease with giant left atrium—the effect of para-annular plication on left atrium (abstract). Jpn Circ J. 1982;46:420–6.
18. Sinatra R, Pulitani I, Antonazzo A, *et al.* A novel technique for giant left atrium reduction. Eur J Cardiothorac Surg. 2001;20:412–4.
19. Sugiki H, Murashita T, Yasuda K, *et al.* Novel technique for volume reduction of giant left atrium: simple and effective 'spiral resection' method. Ann Thorac Surg. 2006;81:378–80.
20. Lessana A, Scorsin M, Scheuble C, *et al.* Effective reduction of a giant left atrium by partial autotransplantation. Ann Thorac Surg. 1999;67:1164–5.