

Dor's Surgery for Left Ventricular Aneurysm: Clinical Study

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Abstract

Aims: To find the early outcome following dor's procedure for post infarct LV aneurysm. *Settings and Design:* This is a retrospective study of left ventricle aneurysm repair done at the Sri Jayadeva Institute of Cardiovascular Sciences and Research, Bangalore, since June 2013 to September 2017. *Methods and Material:* Between June 2013 and September 2017, 23 patients underwent left ventricular aneurysm repair using Dor's repair. The location of the left ventricular aneurysm was anterior (73.9%), apical (8.7%), posterior (17.4%). The indication for operation was congestive heart failure in all patients. *Statistical Analysis Used:* Anova and Bonferroni correction Test was used to analyse the data obtained. *Results:* Intra-aortic balloon pumping was used postoperatively in 2 cases and 7 patients needed inotropic support for more than 24h. Mean time on the ventilator was 11.7 ± 3.6 hours and mean stay in the intensive care unit was 49.26 ± 13.7 hours. Overall mortality was 4.3% (one patient). Mean preoperative ejection fraction (EF) after surgery in was 37.9%. EF showed improvement after surgery to 49.23%. Decrease in end-diastolic volume (EDV) was from 111 ml/m² to 69.19 ml/m². Decrease in end-systolic volume was from 76.57 ml/m² to 45.76 ml/m². All of these values showed statistically significant improvement. At the end of one month postoperatively, 83% of them were in NYHA class I and 17% were in class II. *Conclusions:* Dor's repair is a reproducible surgical option for treatment of post infarction left ventricular aneurysm to restore its volume and geometry. Early results are good in terms of survival and functional improvement.

Keywords: LV Aneurysm; Dor's Repair.

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Introduction

Heart failure is a major health problem with increasing prevalence of patients surviving acute myocardial infarction. Patients with moderate or severe heart failure have a poor 3 year prognosis despite major advances in medical treatment alone. Cardiac transplantation and ventricular assist technologies are definite or temporary surgical therapies with improved results [1]. These are limited by donor organ shortage and financial restraints. Traditional cardiac surgical methods may have limited benefits in this patient group [2].

It has been reported that CABG alone in patients with ischemic heart disease and low left ventricular ejection fraction relieved angina symptoms, but long

term prognosis was dismal with 76% of patients dead within 10yrs, most of them from heart failure [3]. As a consequence there has been a growing interest in alternative surgical methods to treat the diseased ventricle [4].

Post infarction left ventricular remodelling is characterised by left ventricular dilatation and abnormal geometry leading to systolic and diastolic dysfunction. Development of left ventricular aneurysm is a serious long term complication of acute myocardial infarction, often leading to heart failure, ventricular tachycardia and thromboembolic events. Ventricular tachycardia after acute myocardial infarction is associated with high risk of sudden cardiac death [5]. The most common cause of left ventricular aneurysm is acute occlusion of left anterior descending artery with aneurysm formation

in the anterior wall and septum. Historically about 10 to 30% of patients surviving a major myocardial infarction will develop left ventricular aneurysm. However at present the incidence of left ventricular aneurysm appears to have decreased due to improved revascularization treatment of patients with acute myocardial infarction, likely reducing the incidence of permanently occluded left anterior descending artery. Improved management of hypertension and avoidance of corticosteroids which are known risk factors for left ventricular aneurysm contribute to its lower incidence [6].

In 1954 Charles Bailey first performed surgical repair of left ventricular aneurysm. Denton Cooley, in 1958, reported first resection under cardiopulmonary bypass. In 1985, Wincent Dor describe an original surgical technique, the Endoventricular Surgical Patch plasty [7] built on prior contributions by Cooley and Jatene [8,9].

Subsequently, Dor and associated have reported excellent clinical and haemodynamic results of this procedure in several hundreds of these patients [10]. The Dor procedure excludes the akinetic or dyskinetic portion of the anterior wall, septum, reshapes the left ventricle with a stich that encircle the transitional zone between contractile myocardium and aneurysm tissue, and uses a patch to re-establish ventricular wall continuity [7,11].

By this technique, the operation improves size and geometry of the left ventricle, reduces wall tension and paradox movement and enhances overall systolic function. In addition, the procedure may treat the ventricular arrhythmia problem and also allows for removal of intra cavitory thrombi. Myocardial revascularization is almost always performed and mitral valve procedures are feasible thought the ventriculotomy or by a standard atrial approach.

Left ventricular reconstruction by the Dor procedure has been subsequently applied to patients with large akinetic ventricles [12,13].

Surgical Procedure

Under general anaesthesia, with invasive monitoring of arterial pressure and central venous pressure in place. The patient is painted and draped. The skin, subcutaneous tissue cut, median sternotomy done and pericardium opened in midline. After systemic heparinization with unfractionated heparin (4mg/kg) aortic and two stage single right atrial venous cannula placed.

On cardiopulmonary bypass at normothermia with beating heart the left ventricle is opened in the aneurysm segment. The clots evacuated. The morphological difference between the normal myocardium and the infarcted segment is identified. If the mitral valve has to be replaced or repaired it is done after arresting the heart with cold blood cardioplegia antegrade or else, a Fontan stich is taken in the infarcted to reduce the orifice to the aneurysm segment with a 3-0 polypropylene suture. A Gortex patch is sized to the orifice and is fixed with 2-0 polyester *pledgeted* interrupted sutures in the infarcted segment. Once three forth of the patch is fixed the heart is arrested in diastole using cold blood antegrade cardioplegia. The patch placement is completed and the left ventricle is sutured with felt pledget using continuous 3-0 polypropylene suture. If graft have to be placed the grafting is done to the required vessel.

One the heart is deaired, cross clamp is released and we come off cardiopulmonary bypass with inotropic support. Protamine is given (1mg : 1mg of heparin) and haemostasis achieved. Chest is closed in layers over mediastinal chest tubes and a right ventricular pacing wire.

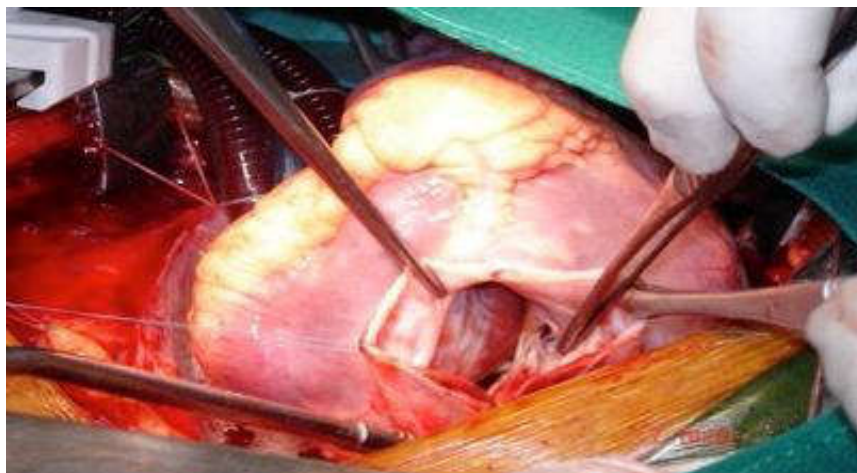


Fig. 1: On CPB Left Ventricular Aneurysm Opened

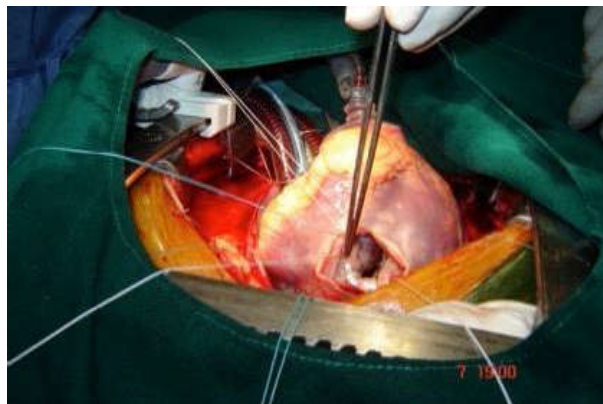


Fig. 2: Fontan stitch taken and interrupted sutures for gortex patch



Fig. 3: Infarcted and Aneurysm area been excluded

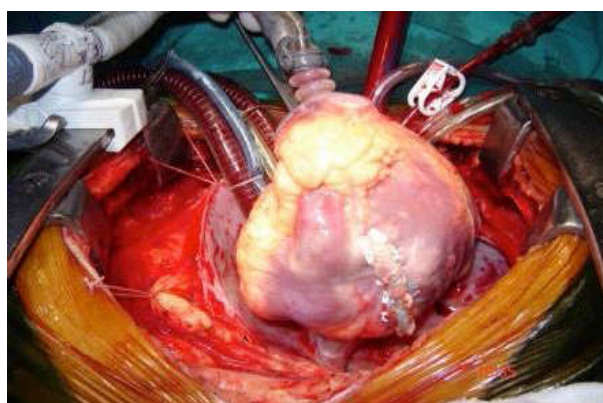


Fig. 4: Left Ventricle been closed

Materials and Methods

Study Population

From Sri Jayadeva Institute of Cardiovascular Sciences and Research, Bangalore surgical database registry, we identified all patients who had left ventricular restoration surgery with or without CABG in the presence of left ventricular aneurysm between 2013 and 2017.

The medical records of 23 patients (19 men and 4 women) who fulfilled the entry criteria for the study were reviewed, including preoperative clinical data, 2D Doppler echocardiographic results, coronary artery anatomy, and operative data.

The average age was 57.26 ± 7.67 (45 to 65 yrs) with male dominance [male 19 (82.6%) and females 4 (17.4%)]. These patients had the following comorbidities hypertension in all (23 i.e. 100%), diabetes in 10 (43.5%) and renal dysfunction in 4 (17.4%) of the patients.

Presentation: The patient presented with left ventricular failure, angina or ventricular tachycardia

or a combination of these. Majority of them were in NYHA class III or IV (16 patients) and in class II (7 patients).

Investigations: All of them had complete blood count, renal function test, liver function test, thyroid function test, carotid doppler, routine urine analysis, ECHO cardiogram, coronary angiogram and serology for HIV, HBSAg and HCV. The following data was procured from the case files -

- Mitral Regurgitation – trivial in 14 (60.9%), grade 1 in 8 (34.8%) and 1 had severe (4.3%) mitral regurgitation.
- Angiogram – single vessel disease in 6 (26.1%), double vessel disease in 5 (21.7%) and triple vessel disease in 12 (53.2%)
- LV Aneurysm – anterior in 17 (73.9%), posterior 4 (17.4%) and apical in 2 (8.7%).

Results

Operative Data

- SURGERY PERFORMED – DOR'S in 9 (39.1%), CABG + DOR'S in 13 (56.5%) and CABG + DOR'S + MVR in 1 (4.3%).
- CABG was performed in 14 patients of which – single vessel in 1 (7.1%), double vessel in 7 (50%) and triple vessel in 6 (42.9%).
- CPB TIME – 72.04 ± 47.03 MIN
- X CLAMP TIME – 27.53 ± 13.18 MIN
- BLEEDING – 160.43 ± 120 ML
- VENTILATION – 11.7 ± 3.6 HRS
- ICU STAY – 49.26 ± 13.7 HRS
- The average postoperative stay – 9.38 ± 1.28 DAYS

- Reversed great saphenous vein graft was used as conduit.
- The LVID (d), LVID(s), ESV, EDV AND Ejection fraction was compared before and after the surgery.

Early Findings: Early mortality was 2 of 23 (4.3%). Both of them died due to heart failure/ low cardiac output syndrome. Inotropic support was needed in all the patients. Intra - aortic balloon was used in 2 of the 23 patients.

Statistical Analysis

Anova and Bonferroni correction Test was used to analyse the data obtained.

LVID(d)		P Value
BEFORE	58.48+/- 3.723	0.000
AFTER	50.38+/-3.528	
1 MONTH	47.95+/-2.26	0.01
LVID(S)		P Value
Before	58.48+/- 3.723	0.000
After	50.38+/-3.528	
1 Month	47.95+/-2.26	0.01
EDV	I	P value
Before	111.62+/- 15.02	0.000
After	73.38+/- 8.78	
1 Month	69.19+/- 7.79	0.000
ESV		P VALUE
BEFORE	76.57+/- 9.89	0.000
AFTER	50.19+/- 5.82	
1 MONTH	45.76+/- 3.57	0.000
Ejection Fraction		P Value
BEFORE	37.9+/- 1.41	0.000
AFTER	43.9+/- 3.3	
1 MONTH	49.23+/- 2.44	0.000

Discussion

This study presents our experience and results in a consecutive series of patients undergoing the Dor procedure for left ventricular aneurysm.

We report our early results in term of survival in a group of patients with reduced left ventricular function.

The operative goal is to achieve complete coronary revascularization, reduce left ventricular volume and restore its shape. Findings of mitral regurgitation and ventricular tachycardia are addressed when necessary.

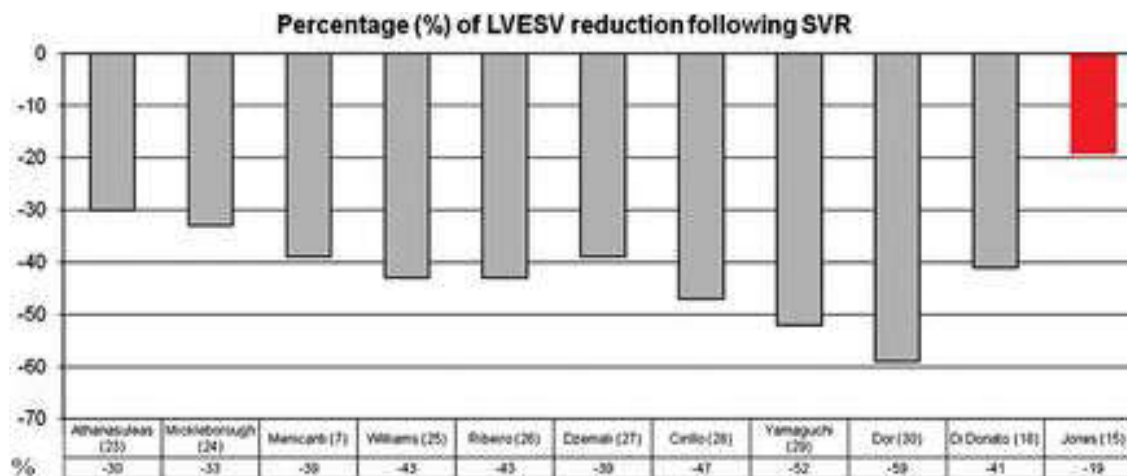
The hypothesis is that surgical ventricular restoration, by means of the Dor procedure, improves quality of life and survival in patients with left ventricular aneurysm suffering from angina, chronic

heart failure or ventricular tachycardia following myocardial infarction.

Excellent single-center long-term results of hemodynamic data and survival have been published by Dor [10] and Menicanti [11] and multi-center results published by the international Reconstructive Endoventricular Surgery returning Torsion Original Radius Elliptical shape to the left ventricle (RESTORE) team are equally satisfactory [13]. Our results presented in this study are comparable to those previously reported.

The aim of this study has not been to compare results in different subgroups of left ventricular morphology but instead report our overall surgical outcome.

We had an average reduction of 31ml/m² in end systolic volume as compared with other studies in the table below [13,21-26].



Outcome a result of revascularization patients receive added benefit from surgical ventricular restoration-Complete revascularization is mandatory for a good outcome. Specifically, the left anterior descending artery should receive a graft, due to the fact that although the distal part may be occluded, the proximal part supports the septal branches which are critical for the blood supply of the basal portions of the ventricle and septum.

However, recent reports [2,14] support the belief that revascularization alone is not sufficient in the dilated ventricle. More precisely, patients with ischemic cardiomyopathy and a substantial amount of viable myocardium and a high end-systolic volume due to left ventricular remodeling have a decreased likelihood of improvement of global function following myocardial revascularization [2]. In addition, patients with a large left ventricular end-systolic volume have a worse long-term prognosis as compared to patients with a smaller left ventricular end-systolic volume [14]. Published data [15] also suggest that geometric rebuilding by surgical ventricular restoration leads to restoration of a more synchronous contractile pattern which improves left ventricular performance.

Revascularization and Mitral Valve Repair

It is well known that patients with ischemic cardiomyopathy and mitral insufficiency have lower life expectancy and poorer quality of life. At present, it is generally accepted that patients with mitral regurgitation, even of a moderate degree, undergoing CABG benefit from a concomitant mitral valve procedure [16-18]. Mitral regurgitation is common in the dilated ventricle. We have therefore found it reasonable to adapt an aggressive approach in patients with left ventricular aneurysm and severely

depressed left ventricular function and performed mitral valve procedures in 4.3% (1/23) of the case in this series. Both procedures can be performed through the ventriculotomy [11,13].

Sizing of the New Ventricle

Dor and Menicanti [11] advocates the use of a sizing balloon or mannequin in order to get a more objective assessment of postoperative LV size. We have not used any kind of sizer and instead relied on eye-balling and experience. In our series, all of the operations have been performed by the same surgeon who has therefore gained proficiency in determining the correct size and placement of the patch. In most cases with thin-walled, fibrotic, dyskinetic left ventricular aneurysm, which includes almost all of the patients in our series, there is a clear transitional zone between dysfunctional tissue and viable contracting myocardium, which makes it easy to define the new ventricle.

On or Off Clamp

There have been, and still is, some debate regarding performing the ventricular reconstruction part of the operation with the heart beating or in cardioplegic arrest. Dor initially described the procedure on the arrested heart, but in the report from the RESTORE group [13], in about half of the cases the ventricular portion of the procedure was done on the beating heart. One recent retrospective study showed no additional advantage of the beating heart approach over the continuous aortic cross clamping method in a group of 53 patients undergoing the Dor procedure [19]. We followed partial surgery beating heart and cardioplegic heart for closure of patch and left ventricular wall.

Linear or Patch Repair

Traditionally a linear repair technique has been used on thin-walled left ventricular aneurysms. This technique does not allow for exclusion of the septal portion of the aneurysm. A recent retrospective study comparing simple linear repair and endoventricular patch plasty for left ventricular aneurysm has shown lower surgical risk and higher long-term survival after endoventricular patch plasty. The authors clarify that the differences in outcome should be interpreted with care due to study design [20]. Mickleborough have reported excellent results in a series of 285 patients, who had akinesia or dyskinesia and wall thinning, with a modified linear closure technique. Thus, different methods for aneurysm repair and septal exclusion have been described apart from simple excision and linear closure. We believe that the patch plasty described by Dor is the method of choice after left anterior descending artery occlusion and anterior infarction since, in these cases, the septum is always affected, and the patch technique is the best way to effectively exclude the septum and safely ensure diastolic capacity. Furthermore, the linear repair often makes grafting of the left anterior descending artery impossible as left anterior descending artery might be included in the left ventricular suture line.

Conclusion

We find that the Dor procedure is a reproducible procedure, but technical challenges such as determination of post-reconstruction left ventricular size and techniques and indications for concomitant mitral valve surgery remain an issue.

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Conflict of Interest

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