POST INFARCT LEFT VENTRICULAR ANEURYSMS: 5 YEAR SURGICAL EXPERIENCE IN A RURAL CARDIAC CENTRE
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ABSTRACT: OBJECTIVES: This is a long term follow up of 54 patients with post infarct left ventricular aneurysm, operated over a period of 5 years, from 2005 to 2010, in a rural cardiac centre. This study aims at assessing efficacy of simple linear closure technique and its long term results. Follow up was done over a period of 2 to 5 years by clinical examination and 2D echocardiography. MATERIALS AND METHODS: 54 patients underwent surgery for left ventricular aneurysm. Age ranged from 50 – 70 years. 50 patients were operated electively and 4 patients within 15 days of acute myocardial infarction. All were approached by median sternotomy incision. Aortic canulat ion was done after heparinisation (3mg/kg). Aorto-bicaval canulation was employed and membrane oxygenators were used in all patients. After cross clamping the aorta, blood cardioplegia was used in all patients. Aortic cross clamp time varied from 40-90 min and bypass time varied from 90-120 min. Aneurysm was resected and sutured with 2/0 prolene and Teflon felt reinforcement with CABG as concomitant procedure in some. Inotropic support with adrenaline, dopamine or dobutamine was used in all patients. IABP was employed in 48 patients. All patients were electively ventilated for 24-48 hours. 6 required re exploration due to bleeding. 10 patients had mild MR which was left alone. RESULTS: 54 patients were operated for left ventricular aneurysm over a period of 5 years. 4 patients died postoperatively due to low cardiac output and arrhythmias. Follow up was done clinically and with 2D Echocardiography. At the end of 2 years, 22 patients showed no further improvement in LVEF, 32 patients LVEF improved by 10-15%. All patients required decongestive management. 6 patients died at the end of 2 years. CONCLUSION: Timely and planned surgery with simple techniques, for left ventricular aneurysms can give acceptable mortality and morbidity, in a rural cardiac Centre. KEYWORDS: Post infarct left ventricular aneurysm, Low cardiac output.

INTRODUCTION: For a long time, left ventricular aneurysm resection has been the choice of treatment in patients with coronary artery disease, with heart failure, angina or thromboembolic complications. Modifications of the original resection and linear suturing of the ventricular wall was accepted as a treatment modality,1 which was later followed by Dor’s repair (ventricular remodeling),2 Jatene’s purse string technique3 and end aneurysmorrhaphy described by Cooley.4 Controversies existed regarding the best surgical option for patients with akinetic or dyskinetic LV aneurysms.5,6

In our series of 54 patients, with post infarct left ventricular aneurysms, operated over a period of 5 years, using a simple aneurysmal resection with linear ventricular wall closure and coronary artery bypass grafting (CABG), as and when indicated, yielded satisfactory long term
results. Pre-operative assessment of the patients was done with clinical examination, 2D echocardiography and coronary angiography. Follow up was done over a period of 5 years by clinical examination and 2D echocardiography.

MATERIALS AND METHODS:

**Patient Population:** In our study, 54 patients with post infarct left ventricular aneurysms were operated over a period of 5 years, in our institute, by the same surgeon, from 2005 to 2010. Patients with associated post infarct VSD or significant mitral regurgitation were excluded from the study. Among these patients, 40 (74%) were males and 14(26%) were females. Their age ranged from 50-70 years (mean: 59.6+6.3 years). 12(22%) of the 54 patients had single vessel disease, left anterior descending (LAD), 26 patients (48.1%) had double vessel disease, LAD and obtuse marginal (OM) or right coronary artery (RCA) and 8 patients (15%) had triple vessel disease (TVD). 12 patients (22%) were diabetics, 20 patients (37%) were smokers and 36 patients (66.7%) were hypertensive. In this study, patients with concomitant ventricular septal defects (VSD), were excluded. The presenting symptoms, in our study group were as follows. 50 patients (92.6%) had shortness of breath (NYHA FC III), 32 patients (59.2%) had angina (CCA FC II) and 8 patients (14.8%) had rhythm disturbances in the form of ventricular tachycardia and multiple ectopics. On 2D echocardiography, the left ventricular ejection fraction (LVEF) ranged from 25% to 50% (mean: 23.4+3.8%). 10 patients (18.5%) were detected to have mild mitral valve regurgitation (MR).

**Operative Technique:** 50 patients (92.6%) were operated electively and 4 patients (7.4%) were operated within 15 days of acute myocardial infarction. All were approached by median sternotomy incision. Aortic cannulation was done, after heparinization (3mg/kg). Aortic cannula (Sarns metal, USA) and Bicaval cannulation (Cal Med, Edwards-USA) was employed. Membrane oxygenators (Polystan, USA and/or Dideco, Italy) were used in all patients. After patients were supported on normothermic cardiopulmonary bypass, aorta was cross clamped. Normothermic blood cardioplegia (4:1) was then instituted into the aortic root, in all patients.

Once diastolic arrest was achieved, macroscopic inspection of the akinetic area was done, and the thinnest part of the sac was opened. Thrombus, if found was evacuated. The sac was resected carefully without injuring the papillary muscles. The LV cavity was cleaned with sterile saline using asepto syringe, to remove debris (Thrombus). Two 1cm wide Teflon felts were employed, on either side of the excised ventricular wall margin, as reinforcement, and the edges were sutured with 2-0 double armed polypropylene (Ethicon, Johnson & Johnson). The sutures were mattress sutures and over and over simple sutures (Fig. 1-3). In 8 patients (14.8%), the interventricular septal loss during resection was dealt with a Gortex (Gore, USA) patch. During the surgery, the associated procedures done were, evacuation of thrombus (n=6, 11.1%) and CABG (n=40, 74%).
Fig. 1: LV aneurysm

Fig. 2: Linear repair of LV aneurysm in progress

Fig. 3: Post repair
This was followed by revascularization procedure by CABG, using LIMA for LAD and reversed great saphenous vein for the rest, in an arrested heart, which was done in 40 patients (66.7%). In 2 patients (3.7%), due to diffuse coronary artery disease, CABG was deferred. Out of the 40 patients who underwent CABG, 32 patients (80%) had RCA and left circumflex artery (OM) grafted and in the remaining 8 patients (20%), 6(15%) had RCA and 2(5%) had OM grafted. The aortic cross clamp time varied from 40 – 90min (Mean: 78.3±4.1 min) and bypass time varied from 90-120 min (Mean: 107.3±5.7 min). LAD was not grafted when it was involved in the aneurismatic area. The mild MR observed in 10 patients (18.5%) was left alone. All patients had ventricular pacing wires placed. All patients were weaned off the cardiopulmonary bypass, after thorough deairing via the aortic root vent, with inotropic support using adrenaline, dopamine or dobutamine. Intra-aortic balloon pump (IABP) support was employed in 48 patients (88.9%). For 4 patients (7.4%), who underwent surgery within 15 days of acute myocardial infarction, IABP was introduced 4-5 days prior to surgery. In the remaining 50 patients (92.5%), IABP was introduced during intra operative period.

Aortic cross clamp time varied from 40–90 min (Mean: 78.3±4.1min) and bypass time varied from 90–120min (Mean: 107.3±5.7min). The resected specimen was subjected to histopathological examination which revealed scarred tissue. All the patients were electively ventilated for 24-48 hours. 6 patients (11%) required re exploration due to bleeding. 4 patients (7.4%) died during immediate postoperative period due to low cardiac output and uncontrolled arrhythmias. These patients were those who were operated within 15 days of acute attack of myocardial infarction.

All patients underwent 2D echocardiography in the immediate post-operative period, which showed an improvement of LVEF by a mean of 10% in 50 patients (92.5%). In 4 patients (7.4%), who were operated within 15 days of acute myocardial infarction, LVEF could not be confidently reassessed due to marked rhythm disturbances. The surviving patients were discharged, at the end of 10-15 days, on decongestive diuretic therapy. Follow up was done, over a period of 5 years, by clinical examination and LVEF assessment by 2D echocardiography, at the end of 2 years.

**Statistical Analysis:** Comparisons between the preoperative and postoperative LVEF was compared with the use of non-parametric test for repeated sample with Wilcoxon signed rank test. Categorical values like NYHA functional class was analyzed using chi-square test. Unpaired t-test was used to find any statistical difference between other continuous numerical data. Data’s were analyzed using computer software, Statistical Package for Social Science (SPSS) 16th version. Statistical significance was considered as a value of p<0.001. The means of the continuous variables are presented as mean±standard deviation.

**RESULTS:** 54 patients were operated for post infarct left ventricular aneurysm over a period of 5 years. 4 patients (7.4%) died during the immediate postoperative period due to low cardiac output and arrhythmias. In the remaining patients, IABP support was weaned off within 24 to 36 hours. None of the patients required active pacing in the post-operative period. All patients underwent 2D echocardiography in the immediate post-operative period, which showed an improvement of LVEF by a mean of 10% in 50 patients (Fig. 4).
Follow up was done clinically and with 2D Echocardiography over 5 years. During the follow up period, symptomatic improvement was seen in all the patients (n=50) as follows. Shortness of breath improved from NYHA FC III to II in 34 patients (68%) and from NYHA FC III to I in 16 patients (32%) (Fig. 5). Out of 32 patients who had angina preoperatively, 28 patients (87.5%) improved from CCA FC II to I. 4 patients (12.5%) required anti angina medication.

![Comparison of Left ventricular ejection fraction (%) - preoperative and post-operative](image1)

![Comparison of NYHA Functional class - preoperative and post-operative](image2)

Of the 8 patients who had rhythm disturbances in pre-operative period, 4 patients (50%) required minimal treatment for the same. At the end of 2 years, 22 patients (44%) showed no
further improvement in LVEF, 28 patients (56%), LVEF improved by 10-15%. All patients required decongestive management. 6 patients died at the end of 2 years. 8 patients (14.8%) were lost for follow up after 2 years. Results have been summarized in Table 1. The improvement in LVEF in the series was found to be statistically significant with a p value of 5.087x10^-18.

| Patient status | LVEF % (mean) | NYHA FC (For dyspnoea) No. of patients | CCA FC (For angina) No. of patients |
|----------------|--------------|----------------------------------------|-----------------------------------|
| Pre-operative  (n=54) | 24.35         | I 0 II 4 III 50                        | I 0 II 32                         |
| Post-operative (n=50)  | 44.4          | I 16 II 34 III 0                      | I 28 II 4                         |

Table 1: Summary of the results of our study

**DISCUSSION**: This article presents the short and long term results achieved in a series of 54 patients with isolated post infarct left ventricular aneurysm. Patients with associated post infarct VSD or mild MR were excluded from the study. The operative technique was simple linear suturing of the resected ventricular wall and septoplasty in 8 patients. Operative mortality was high in earlier studies in patients with akinetic vs. dyskinetic aneurysms. Furthermore it has been observed that patients with clear cut aneurysms with symptoms will benefit in terms of increase in LVEF, improved grades of shortness of breath and angina and survival. Though we used IABP in most of the patients, neither IABP nor inotropic support produced any statistically significant improvement in survival.

Among the surviving patients, the improvement of LVEF by 10-15% was significant, which in itself would have relieved the symptoms. We agree with Suma and colleagues that in akinetic aneurysms, the limits of scarring are not always well demarcated. By resecting the non-functional and dilated wall and plicating the resected ends, we are making an attempt to reduce the chamber dimensions and restore the left ventricular wall tension. The linear suturing of the resected left ventricular wall will in itself maintain the near natural left ventricular geometry as compared to other techniques. Our in hospital mortality was less compared with recently reported series, which varied from 3-18%. Evacuation of the thrombus and thorough lavage may have contributed to no peri operative strokes. The mean increase in LVEF by linear suturing was comparable with similar studies published earlier. Ventricular septal reconstruction did not contribute to increase in LVEF.

**CONCLUSION**: Aneurismal sac excision with linear suturing of the left ventricular wall, with or without CABG, is a simple and effective treatment modality in the surgical management of post infarct left ventricular aneurysms. Timely surgery for these aneurysms can be done with acceptable mortality and morbidity.
REFERENCES:

1. Cooley DA, Collins HA, Morris GC, Chapman DW. Ventricular aneurysm after myocardial infarction: surgical excision with use of temporary cardiopulmonary bypass. JAMA 1958; 167:557-60.

2. Dor V, Saab M, Coste P, Kornaszewski M, Montiglio F. Left ventricular aneurysm: a new surgical approach. J Thorac Cardiovasc Surg 1989; 37:11-9.

3. Jatene AD. Left ventricular aneurysmectomy. J Thorac Cardiovasc Surg 1985; 89:221-31.

4. Cooley DA. Ventricular endoaneurysmorrhaphy: a simplified repair for extensive postinfarction aneurysm. J Card Surg 1989; 4:200-5.

5. Dor V, Sabatier M, Di Donato M, Montiglio F, Toso A, Maioli M. Efficacy of endoventricular patch plasty in large post infarction akinetic scar and severe left ventricular dysfunction: comparison with a series of large dyskinetic scars. J Thorac Cardiovasc Surg 1998; 116:50-9.

6. Mangschav A. Akinetic versus dyskinetic left ventricular aneurysms diagnosed by gated Scintigraphy: difference in surgical outcome. Ann Thorac Surg 1989; 47:746-51.

7. Mickeborough LL. Left ventricular aneurysm modified linear closure technique. In: JL Cox, Sundt TM III, editors. Operative techniques in cardiac and thoracic surgery: a comparative atlas. Vol 2. Philadelphia: WE Saunders; 1997.p 118-31.

8. Pasini S, Gagliardotto P, Punta G, et al. Early and late results after surgical therapy of post infarction left ventricular aneurysm. J Cardiovasc Surg 1998; 39:209-15.

9. Sinatra R, Macrina F, Braccio M, et al. Left ventricular aneurysmectomy; comparison between two techniques: early and late results. Eur J Cardiothorac Surg 1997; 12:291-7.

10. Cosgrove DM, Lytle BW, Taylor PC, et al. Ventricular aneurysm resection: trend in surgical risk. Circulation 1989; 79(Suppl): I-97-101.

11. Stephenson LW, Hargrove WC, Ratcliffe MB, Edmunds LH. Surgery for left ventricular aneurysm: early survival with and without endocardial resection. Circulation 1989; 79(Suppl): I-108-11.

12. Di Donato M, Sabatier M, Dor V, Toso A, Maioli M, Fantini F. Akinetic versus dyskinetic postinfarction scar: relation to surgical outcome in patients undergoing endoventricular circular patch plasty repair. J Am Coll Cardiol 1997: 29: 1569-75.

13. Cooper GS, Bunton RW, Birjiniuk V, et al. Relative risks of left ventricular aneurysmectomy in patients with akinetic scars versus true dyskinetic aneurysms. Circulation 1990; 82(Suppl): IV-248-56.

14. Elefteriades JA, Solomon LW, Salazar AM, Batsford WP, Baldwin JC, Kopf GS. Linear left ventricular aneurysmectomy: modern imaging studies reveal improved morphology and function. Ann Thorac Surg 1993; 56: 242-52.

15. Mills NL, Everson CT, Hockmuth DR. Technical advances in the treatment of left ventricular aneurysm. Ann Thorac Surg 1993; 55: 792-800.

16. Grossi EA, Chimitz LA, Galloway AC, et al. Endoventricular remodelling of left ventricular aneurysm: Functional, clinical and electrophysiological results. Circulation 1995; 92(Suppl): II-98-100.
17. Kwata T, Kitamura S, Kawachi K, et al. Systolic and diastolic function after patch reconstruction of left ventricular aneurysms. Ann Thorac Surg 1995; 59: 403-7.
18. Shapira OM, Davidoff R, Hilbert RJ, et al. Repair of left ventricular aneurysm: long term results of linear repair versus endovascularorrhaphy. Ann Thorac Surg 1997; 63: 701-5.
19. Mangovern GJ, Sakert T, Simpson K, et al. Surgical therapy for left ventricular aneurysms: a 10 year experience. Circulation 1989; 79(Suppl): I-102-7.
20. Yannikas J, MacIntyre W, Underwood D, et al. Prediction of improvement in left ventricular function after ventricular aneurysmectomy using Fourier phase and amplitude analysis of radionuclide cardiac blood pool scans. Am J Cardiol 1985; 55: 1308-12.

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