TECHNIQUES OF LEFT VENTRICULAR ANEURYSM REPAIR: CHALLENGES AND OUTCOME
Jignesh Kothari¹, Hemang Gandhi², Bhavin Brahmbhatt³, Kinnaresh Baria⁴, Sanjay Patel⁵, Himani Pandya⁶

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ABSTRACT: INTRODUCTION: Left ventricular aneurysm is commonly secondary to coronary artery disease. The resulting abnormal geometry after surgical treatment is most important. Many techniques have evolved over a period to restore near normal geometry of left ventricle (LV). It is mandatory to address atherosclerotic lesions which are root cause of ischemia and its sequel.

METHOD AND MATERIALS: Four patients with myocardial infarction presented to our institute were investigated with 2 Dimensional Echocardiography and contrast enhanced computerized tomography (CECT) of thorax. All patients underwent left ventricle aneurysm repair and two patients also underwent Coronary Artery Bypass Grafting (CABG). We followed all of them with CECT and clinical examination. RESULT: All patients had good post-operative recovery. Their Intensive Care Unit parameters were within acceptable limits. The functional class improved to New York Heart Association class II for these patients. Post-operative CECT showed significant reduction in LV dimension and no alteration in LV geometry. CONCLUSION: The technique of Left Ventricle aneurysm repair should be determined by pre-operative evaluation and CABG must be attempted if possible.

KEYWORDS: Left Ventricular aneurysm, Coronary artery bypass grafting.

INTRODUCTION: Serious and even fatal cardiac lesions may subsequently result from myocardial necrosis in patients surviving the initial acute episode of coronary occlusion. Among the more lethal complications are rupture of the ventricle, perforation of the ventricular septum, rupture of the papillary muscle, mural thrombosis with embolization, and ventricular aneurysm. The most common of these complications is aneurysm of the left ventricle (LV) which occurs in 10 to 35% of patients who have had transmural myocardial infarction.¹

Definition: LV aneurysm is defined as post infarction aneurysm of left ventricle that is a consequence of transmural scar with dyskinesis (Paradox) of LV motion.¹

Operation for LV aneurysm is indicated for congestive heart failure, systemic emboli from mural thrombus, persistent arrhythmia not responding to medical therapy, angina, impending rupture and mitral insufficiency.

All patients in our series presented with congestive heart failure.

We present our clinical and physiological data in four patients undergoing aneurysm repair and simultaneous Coronary Artery Bypass Grafting (CABG) surgery on cardiopulmonary bypass to demonstrate effectiveness of surgical treatment and its influence upon cardiac function and survival.
MATERIAL AND METHODS: All patients presented with congestive heart failure. They were evaluated with history, X ray Chest, Electrocardiogram (ECG), 2 Dimensional Echocardiography (2 D Echo), and Biochemical Investigations. Their 2 D Echo was suggestive of LV aneurysm so they underwent coronary angiography and contrast enhanced CT (CECT) Thorax for complete diagnosis of coronary artery disease and extent of aneurysm. Once stabilized, they were posted for surgery.

**Patient 1:** 2 D Echo was suggestive of pseudoaneurysm at apical and lateral side of LV with EF of 30%. CECT was suggestive of large LV apical aneurysm measuring 76 x 73 x 41 mm3. LAD was diffusely disease and calcified, rest of the arteries were normal. (Figure 1A)

**Patient 2:** 2D Echo was suggestive of LAD and RCA territory hypokinesia with LV posterior basal aneurysm EF of 25%. CT angiography and CECT suggestive of partial thrombus pseudoaneurysm from inferior basal aspect of left ventricle measuring 74 x 72 x 67 mm3. (Figure 2A) LAD had diffuse disease while proximal RCA had 60% disease.

**Patient 3:** 2D Echo was suggestive of Large LV aneurysm with EF of 20 – 25% and Coronary angiography showed 99%, Long Segment occlusion in proximal LAD while other coronary vessels were normal. Contrast enhanced CT (CECT) thorax suggestive of large apical aneurysm with dilated LV cavity. LV cavity measures 79.4 x 60.5 mm2 and at the apical level 45 x 41 mm2. (Figure 3A)

**Patient 4:** 2D Echo was suggestive of antero lateral aneurysm with EF 25%. Coronary angiography revealed long segment proximal LAD lesion with plaque in LMCA. Other coronary arteries were normal. CECT was suggestive of apical aneurysm measuring 84 x 74 x 67 mm3. (Figure 4A)

**Surgical Technique:** All Patients had invasive arterial blood pressure monitoring and pulmonary artery catheter monitoring. After Median sternotomy cardiopulmonary bypass (CPB) was established with aortic and bicaval cannulation. Antegrade Cardioplegia was given through aortic root. Technique was different in first two cases as compared to next two case.

**Patient 1 and 2:** After CPB and aortic cross clamp (ACC) antegrade cardioplegia was given. Patient 1 had diffuse LAD disease and apex was compromised so CABG was not performed. Patient 2 had undergone Saphenous Vein Graft (SVG) graft to LAD and Right Coronary Artery (RCA) was not grafted because of aneurysmal area. After dissecting adhesion aneurysm was opened vertically. In patient 2 aneurysm was firmly adhered to diaphragm. (Figure 1B, 1C, 2B) Fibrous margin were opposed with teflon felt and 4-0 polypropelene sutures. Necrosed muscle was opposed over it to prevent bleeding making it a linear repair. (Figure 2C).

**Patient 3 and 4:** After CPB and ACC Antegrade cardioplegia was given. Patient 3 had diffuse LAD disease with apical aneurysm so CABG was not done. Patient 4 had undergone SVG graft to
Proximal LAD. As the patient was on CPB the aneurysmal area retracted. We identified fibrous margin and it was plicated with teflon felt and 4-0 polypropelene continuous overrunning suture of felt. (Figure 4B and 4C).

All patients were followed with post-operative 2D Echo and CECT.

**RESULTS:** Patient 1 had diffuse oozing so chest was kept open with packing. Chest was closed next day. Rest of the patient had primary chest closure. The CPB time and ACC time were reasonable. Patients were electively ventilated for minimum period of 24 hours due to severe LV dysfunction pre-operatively. They were extubated once hemodynamic data was satisfactory. Post-operative drainage, inotropic requirement and ICU stay was within acceptable limit. (Table 1)

| Patients | Pre Operatively (CC x AP x TR) | Post operatively (CC x AP x TR) |
|----------|-------------------------------|----------------------------------|
| Patient 1| 76x73x41mm³                   | 70.2x69.35 mm³                   |
| Patient 2| 74x72x67mm³                   | 53x57x59 mm³                     |
| Patient 3| 79.4x60.5x41 mm³              | 54x45x40 mm³                     |
| Patient 4| 84x74x67 mm³                  | 50.7x45x39 mm³                   |

**Table 1:** Postoperative course details of all the four Patients

CPB- Cardio Pulmonary Bypass; ACC- Aortic Cross Clamp; ICU- Intensive Care Unit.

All patients were discharged within 10 -12 days. Post-operative 2D Echo showed EF of 30 -35%, with no valvular regurgitation. Functional class was improved to NYHA II. The post-operative CECT showed good LV function with near normal LV geometry and no aneurysmal area and effective reduction in LV dimension. (Figure 1D, 2D, 3B, 4D and Table 2).

**DISCUSSION:** Johnson and colleague defined aneurysm as a “large single area of infarction (Scar) that causes the LVEF to be profoundly depressed (to approximately 0.35 or lower).” The history of LV aneurysm begun in 1944. When Beck described fascia lata plication to treat a LV aneurysm. Then, in 1955, Likoff and Boiely successfully resected an aneurysm through thoracotomy, using a special clamp, without cardiopulmonary bypass.
Various technique of aneurysm repair have evolved over a period. Among them Linear repair (Cooley), Plication (Vauthey), endoventricular Repair (Jatene), and endoventricular circular plasty (Dor) are commonly used.\(^{(5-8)}\)

Each one has advantages and disadvantages. Linear repair is most commonly used but it has major disadvantage of decrease in the functional LV cavity size and distorting natural LV geometry. Plication is relatively easier technique but it misses mural thrombus and may cause injury to sub-valvular apparatus as this is relatively blind procedure. The Jatene technique involves large amount of prosthetic material which is exposed to pericardial cavity and predisposes to infection. The Dor has disadvantage that buttressed felt is left open and increase chances of bleeding. A circular suture is necessary to place around the margin of cut ventricle.

For first two cases as the aneurysm was very large so we prefer conventional linear repair without distorting normal LV geometry. It was evident on post-operative CECT. For next two cases we were sure with our pre-operative diagnosis that there is no thrombus in aneurysm and by plicating LV cavity will be maintained in near normal contour. In addition we find plication to be relatively faster, easier, and prevent blood loss. We took care of maintaining the LV geometry because the results of surgical repair are related to the magnitude of the geometric effects on the remaining LV.

The impairment of left ventricular function in patient with aneurysm is due to altered geometry of LV and decrease contractility of other part of LV which is affected by extensive coronary artery disease. The importance of complete revascularization should not be overlook.\(^{(9,10)}\) It is recommended that at least bypassing proximal third of LAD will supply major septal branches if septum is not scarred. We have done CABG in patient 2 and patient 4 to achieve complete revascularization. We believe repair of aneurysm and complete revascularization has helped patient with improvement in functional class.

Ventricular aneurysm is frequent late complication of extensive myocardial infarction. Symptoms results from impairment of cardiac function produced by non-contractile expansile aneurysm. The optimum time for surgical intervention following myocardial infarction is governed by pathological state of diseased myocardium. Surgical excision and ventricular repair is feasible and rational surgical treatment for ventricular aneurysm following myocardial infarction when lesion is of sufficient size to cause impairment of cardiac function.

It should be accompanied by complete revascularization of disease coronary in order to achieve near normal LV function because long term prognosis is dependent on adequacy of residual left ventricular function, because patient with severe LV dysfunction has higher mortality rate.\(^{(11)}\)

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Figure 1: A: Pre-operative CECT of Patient 1, B: Peri-operative picture of open aneurysm, C: Peri-operative picture of open aneurysm, D: Post-operative CECT Patient 1
Figure 2: A: Pre-operative CECT of Patient 2, B: Peri-operative picture of open aneurysm, C: Peri-operative Picture of Linear Repair, D: Post-operative CECT Patient 2

Figure 3: A: Pre-operative CECT of Patient 3, B: Post-operative CECT of Patient 3
Figure 4: A: Pre-operative CECT of Patient 4, B: Peri-operative picture of aneurysm, retracted segment of LV, C: Peri-operative Picture of Plication, D: Post-operative CECT Patient 4
AUTHORS:
1. Jignesh Kothari
2. Hemang Gandhi
3. Bhavin Brahmbhatt
4. Kinnareesh Baria
5. Sanjay Patel
6. Himani Pandya

PARTICULARS OF CONTRIBUTORS:
1. Associate Professor, Department of Cardio Vascular and Thoracic Surgery, U. N. Mehta Institute of Cardiology and Research Centre, Affiliated to B. J. Medical College, New Civil Hospital Campus, Asarwa, Ahmedabad.
2. Associate Professor, Department of Cardiac Anesthesia, U. N. Mehta Institute of Cardiology and Research Centre, Affiliated to B. J. Medical College, New Civil Hospital Campus, Asarwa, Ahmedabad.
3. Resident, Department of Cardio Vascular and Thoracic Surgery, U. N. Mehta Institute of Cardiology and Research Centre, Affiliated to B. J. Medical College, New Civil Hospital Campus, Asarwa, Ahmedabad.
4. Resident, Department of Cardio Vascular and Thoracic Surgery, U. N. Mehta Institute of Cardiology and Research Centre, Affiliated to B. J. Medical College, New Civil Hospital Campus, Asarwa, Ahmedabad.
5. Research Assistant, Department of Research, U. N. Mehta Institute of Cardiology and Research Centre, Affiliated to B. J. Medical College, New Civil Hospital Campus, Asarwa, Ahmedabad.
6. Research Associate, Department of Research, U. N. Mehta Institute of Cardiology and Research Centre, Affiliated to B. J. Medical College, New Civil Hospital Campus, Asarwa, Ahmedabad.

NAME ADDRESS EMAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Jignesh Kothari,
Associate Professor,
Department of Cardio Vascular and Thoracic Surgery, U. N. Mehta Institute of Cardiology and Research Centre,
Affiliated to B. J. Medical College,
New Civil Hospital Campus,
Asarwa, Ahmedabad.
E-mail: jvks20@yahoo.com

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