

## Sub mitral left ventricular aneurysm—Our experience

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### Abstract

**Objective** Submitral left ventricular aneurysm is a rare anomaly which occurs most commonly among the black population. We would like to share our experience of 3 cases that we treated successfully by surgery at our institute.

**Methods** From January 2001 to December 2010, 3 patients of submitral left ventricular aneurysm were treated at our institute. Age ranged from 25 to 30 years. There were 2 male subjects and 1 female subject. Two patients had moderate mitral regurgitation and one patient had severe mitral regurgitation. One patient had aneurysm with multiple necks. Diagnosis was made by echocardiography and was confirmed by angiography in all cases. In 2 cases aneurysm was excised and annulus was resuspended with interrupted sutures and in one case mitral valve was repaired with annuloplasty ring.

**Results** All patients were discharged in stable condition. There was no early or late mortality. Follow up was done at 3 months and 3 years. Early follow up showed severe mitral regurgitation in one case and residual aneurysm cavity in one case. One case in which annuloplasty ring was used had no mitral regurgitation or residual aneurysm cavity.

**Conclusion** Submitral left ventricular aneurysm is a rare cardiac lesion. Diagnosis can be done by echocardiography. Surgery is the treatment of choice and careful closure of all the necks of aneurysm and use of mitral annuloplasty ring is preferable. This can reduce recurrence of the post-

operative mitral regurgitation and avoids the residual aneurysm cavity.

**Keywords** Annuloplasty · Echocardiography · Aneurysm

### Introduction

Submitral Left Ventricular Aneurysm (SLVA) is an unusual, non-ischemic left ventricular aneurysm. It was first described by Abrahams in 1962 [1] and seems to be caused by a congenital weakness of the fibrous annulus at the level of the atrio-ventricular junction. The SLVA is most commonly found among the black population [1–3], and it does not cause uniform and consistent symptoms. We would like to share our clinical experience of this rare entity.

### Materials and methods

From January 2001 to December 2010, 3 patients of submitral left ventricular aneurysm were treated at our institute. Age ranged from 25 to 30 years. There were 2 male subjects and 1 female subject. The preoperative clinical and demographic profile is listed in Table 1. The diagnosis was made by transthoracic and transesophageal echocardiograms (Fig. 1) and was confirmed by left ventriculography (Fig. 2). All three patients underwent surgical correction through conventional median sternotomy. The cardiopulmonary bypass was achieved by aortic and bicaval cannulation. Under moderate hypothermia (28°C) the aorta was cross clamped and myocardial protection was provided with cold blood antegrade root plegia. In case-1, the approach was through the left atrium and

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**Table 1** Pre-operative and demographic profile

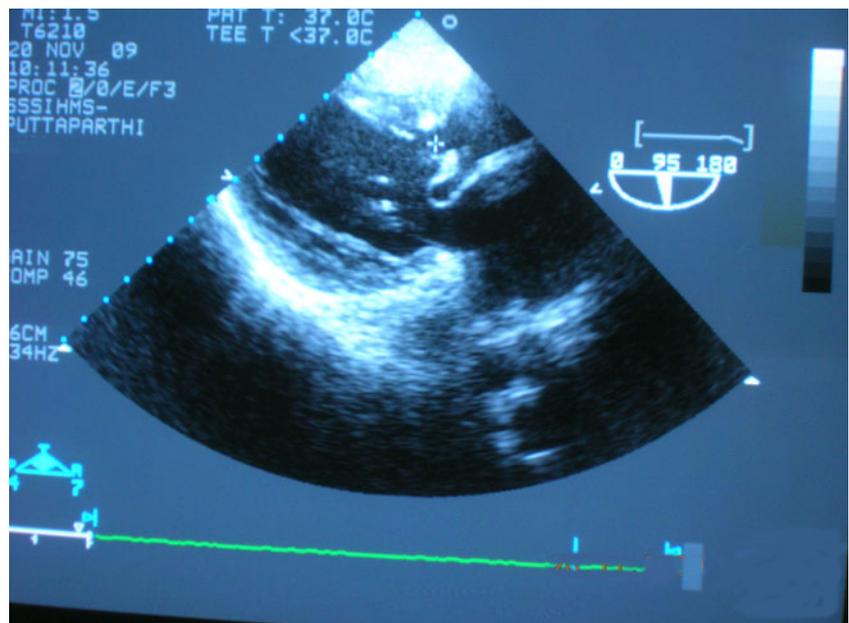
Cases	Age (Years)	Sex	Symptoms	Signs	Chest X-Ray	Electrocardiogram	Echocardiogram	Left ventricular angiogram
Patient-1	26	Male	DOE	Gr 3/6 PSM at Apex Radiating to L Axilla	CTR 65% Pulmonary Congestion	NSR	Infero- posterior and lateral wall dyskinetic PML Prolapse Moderate MR LVEF 45%	Large SMA bulging into LA Moderate MR Normal coronaries.
Patient-2	25	Female	DOE	Gr 3/6 PSM at Apex Radiating to L Axilla	CTR 60% Pulmonary Congestion	NSR	Avulsion of PML annulus from LV wall Aneurysm extending posterior to left atrium Moderate-Severe MR LVEF>60%	Large posterior SMA bulging into LA Severe MR Normal coronaries.
Patient-3	30	Male	DOE Chest Pain	Gr 3/6 PSM at Apex	CTR 55%	NSR, LAD	Aneurysm at junction of PML with LV Mouth of aneurysm 1.6 cm (Fig. 1) Moderate MR/TR LVEF>60%	Large SMA bulging into LA (Fig. 2) Mild MR Normal coronaries.

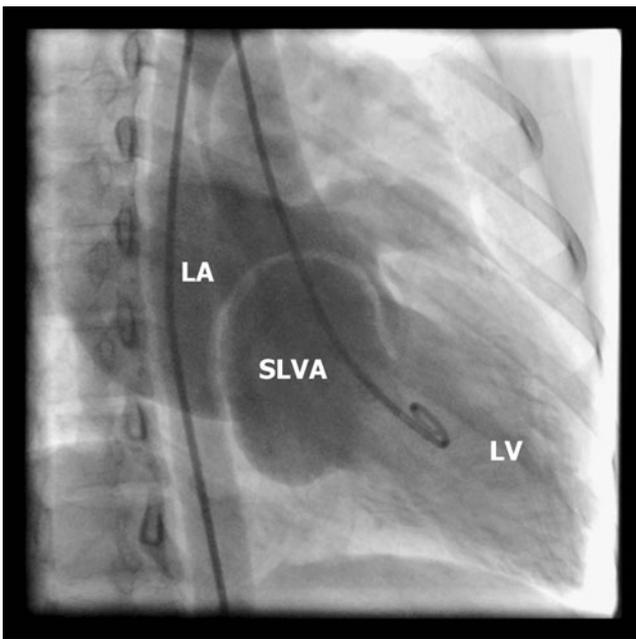
*DOE* Dyspnoea on exertion, *PSM* Pansystolic murmur, *Gr* Grade, *L* Left, *CTR* Cardiothoracic ratio, *NSR* Normal sinus rhythm, *LAD* Left axis deviation, *PML* Posterior mitral leaflet, *LVEF* Left ventricular ejection fraction, *LV* Left ventricle, *MR* Mitral regurgitation, *TR* Tricuspid regurgitation, *LA* Left atrium, *SMA* Submitral aneurysm

after opening the left atrium, mitral valve was assessed. The submitral left ventricular aneurysm was opened from outside (external approach) and excess wall of the aneurysm was excised. The 'neck' of the aneurysm was closed with interrupted pledgetted 3–0 Polypropylene horizontal mattress sutures in such a way that, the sutures goes through the neck of the aneurysm and through the posterior mitral annulus. The defect in the

left ventricle was narrowed down with 2–0 Polypropylene purse string suture and the defect was closed with Hemashield patch using 2–0 Polypropylene interrupted pledgetted sutures. Mitral valve was tested and was found to be competent. Left atrium was closed directly. In case-2, the approach was through the right atrium-interatrial septum and after opening the chamber the mitral valve and aneurysm were accessed. There was a

**Fig. 1** Transoesophageal echocardiogram. "+"—Aneurysm neck with bulge in left atrium



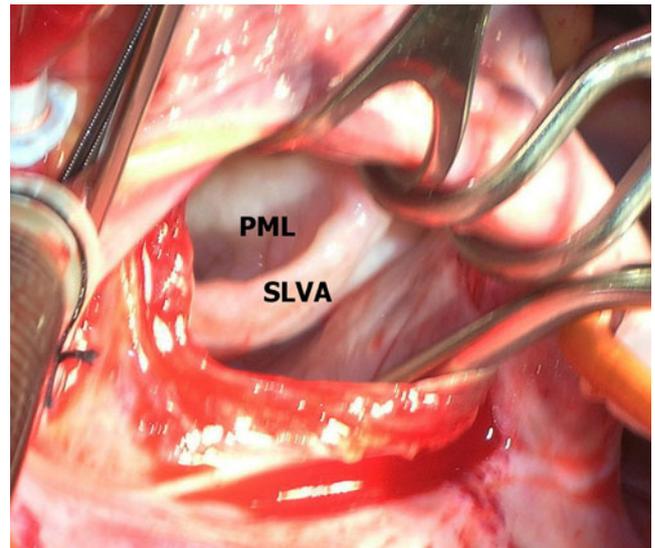


**Fig. 2** Left Ventriculogram of submitral left ventricular aneurysm. LA-Left atrium, LV- Left ventricle, SLVA- Submitral left ventricular aneurysm

large submitral aneurysm which was formed due to separation of the posterior mitral leaflet from the annulus. The aneurysm bulge was seen in the left atrium and had a communication with the left ventricle through a one centimeter opening (neck). The aneurysm was excised and the cut edges were resuspended along with posterior mitral annulus using 3-0 Polypropylene suture. The annulus was supported with 27 mm St Jude mitral annuloplasty ring using 2-0 Ethibond sutures. On saline testing the mitral valve showed trivial mitral regurgitation. In case-3, approach was through the Left Atrium (LA). Intra-operative findings were, large sub mitral aneurysm arising near the posterior mitral annulus (Fig. 3) and projecting into the left atrium (Fig. 4), Mitral valve was normal. Aneurysm was excised (Fig. 5) and posterior mitral leaflet was resuspended to the annulus with 2-0 Polypropylene interrupted sutures and reinforced with 4-0 Polypropylene suture. The mitral valve was tested and was found to be competent (Fig. 6). LA was closed with 3-0 Polypropylene suture. All cases were weaned off cardiopulmonary bypass in usual way with Dopamine 5 to 10 micrograms on board. Intra operative echocardiogram data listed in Table 2.

## Results

Postoperative course of all patients were uneventful except the case-1 that developed left ventricular dysfunction in immediate post operative period and responded well with

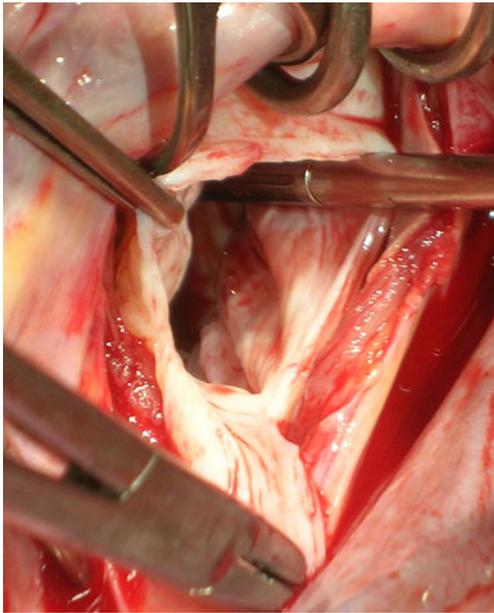


**Fig. 3** Left atriotomy. PML- Posterior mitral leaflet, SLVA- Submitral left ventricular aneurysm

inotropic support and anti-failure treatment. The hospital stay was 7 days each for case 2 and 3 but was 19 days for case 1 because of left ventricular dysfunction. Post operative echocardiogram before discharge is listed in Table 2. All patients came for their first follow up at 3 months, all were asymptomatic and their echocardiogram data are listed in Table 3. The case-3 showed tiny residual aneurysm cavity. The case-1 came back after 6 months of surgery with palpitation and echocardiogram showed moderate to severe mitral regurgitation. Case-2 came at 3 years follow up and was asymptomatic with normal echocardiogram. Follow up data are listed in Table 3. The histo-pahological findings of aneurysm wall showed fibrotic changes.



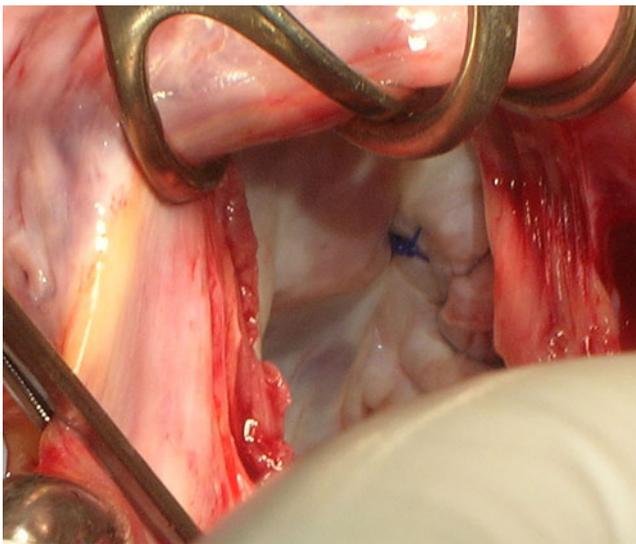
**Fig. 4** Submitral aneurysm bulging into Left atrium



**Fig. 5** Cut edges of submitral left ventricular aneurysm

## Discussion

Submitral Left Ventricular Aneurysm (SLVA) is a rare lesion that occurs most often in the black population [1–3]. The prevalence of this lesion among blacks appears to indicate a congenital origin or predisposition [2]. Submitral left ventricular aneurysm seems to be caused by a junctional defect between the cardiac muscle and the fibrous structure of the heart [3]. The anatomy of the lesion is quite complex and its size can vary from a few millimeters up to several centimeters. It can extend behind



**Fig. 6** Competent mitral valve after repair

**Table 2** Intra operative and post operative results

Cases	Intra operative TEE	Post operative course	Post operative echocardiogram
Patient-1	Obliterated LV-LA pouch	LV dysfunction	Obliterated LV-LA pouch
	Trivial MR	Responded to ionotropes and AFT	Mild MR
Patient-2	Not done	LVEF>65%	Normal LVEF
		H Stay 19 days	
Patient-3	Not done	Uneventful	No Residual Aneurysm
		H Stay 7 days	Mild MR
Patient-3	Not done	Uneventful	Normal LVEF
		H Stay 7 days	No Aneurysm
			Moderate MR (posterior jet)
			Normal LVEF

*LA* Left atrium, *LV* Left ventricle, *LVEF* Left ventricular ejection fraction, *MR* Mitral regurgitation, *H* Hospital, *AFT* Anti-failure treatment

the left atrium, the left ventricle or both [3]. Pathophysiologically, sub-mitral left ventricular aneurysm involves the fibrous mitral annulus and with enlargement displaces the posterior mitral annulus and sub-valvular supporting apparatus apart, resulting in restriction of the posterior mitral leaflet and failure of leaflet coaptation with secondary mitral regurgitation [3]. Finally, loss of support for the posterior leaflet, together with cardiac failure due to systolic expansion of the aneurysm, worsens mitral regurgitation. Clinical symptoms arise as a result of valvular regurgitation or occasionally from compression of cardiac structures [3]. Because a submitral left ventricular aneurysm can be asymptomatic for many years; it may not be detected unless routine echocardiography is performed [5]. In our patients presentation was in the form of shortness of breath on exertion probably due to the development of mitral regurgitation. Sometimes, the 1st sign of the disease is ventricular tachycardia, central or peripheral embolism or sudden death [3]. Diagnosis by chest x ray is easy if the calcification is present in the aneurysm wall [4]. At present, the transthoracic and transesophageal echocardiography are the most accurate diagnostic tools [5]. The typical location of the aneurysm and the absence of coronary artery disease on angiography confirms the diagnosis of SLVA. Surgical treatment is mandatory as soon as the diagnosis of SLVA is made, in order to treat the cardiac failure that arises from expansion of the aneurysm and to avoid other potential cardiovascular events.

Surgical intervention is the only method of treatment of sub mitral left ventricular aneurysms and was first reported in

**Table 3** Follow up data

Cases	3 months		6 months		3 years		Comments
	Clinical findings	Echocardiogram	Clinical findings	Echocardiogram	Clinical findings	Echocardiogram	
Patient-1	Asymptomatic	No Aneurysm	Palpitation	Akinetic basal, inferior and lateral wall			Awaiting MV repair/MVR
	No murmur	Mild to moderate MR Normal LVEF		No aneurysm PML Prolapse Severe MR LVEF >70%			
Patient-2	Asymptomatic	No Aneurysm Mild MR Normal LVEF			Asymptomatic	No Aneurysm Mild MR Normal LVEF	
Patient-3	Asymptomatic	Residual aneurysmal cavity Mitral valve apparatus intact Trivial MR Normal LVEF					

MR Mitral regurgitation, LVEF Left ventricular ejection fraction, PML Posterior mitral leaflet, MV Mitral valve, MVR Mitral valve replacement

1963 by Shrire and Barnard; the aneurysm was approached via an extra cardiac approach [6, 7]. Inherent difficulties associated with the extracardiac approach included inadequate exposure of the mitral annulus, residual mitral regurgitation, and technical difficulties in approaching the aneurysm due to adhesions. Antunes described the transatrial approach in 1987 [3]. In our series two cases were approached transatrially and one case was approached through both extra and intra cardiac approach. In our experience sub-mitral aneurysms could not always be approached exclusively by one technique, because of the extent of involvement of the posterior mitral annulus, aneurysm size and degree of mitral valve incompetence. Surgical failure was related to the failure to identify additional aneurysm necks or inadequate closure of the aneurysm and lack of support to the mitral annulus leading to aneurysm formation. Successful repair is dependent on the appropriate understanding of the relationship between the aneurysm, the mitral valve and its annulus. The fibrous structure in the neck of the aneurysm usually allows direct suturing but annuloplasty ring helps in giving support to the mitral annulus which is already diseased or weak. Mitral Valve Replacement (MVR) is one more option in cases where mitral valve leaflets are distorted or damaged and when it is non-repairable. Also the MVR may be an option in cases of post operative severe mitral regurgitation.

## Conclusion

SLVA is a rare cardiac lesion. Echocardiography is sufficient to make the diagnosis. Surgery is the treatment of choice. We recommend the use of mitral ring annuloplasty after submitral aneurysm excision to avoid the post-operative mitral regurgitation and the residual aneurysm cavity. Option of MVR to be kept in mind for non-repairable valve and post operative mitral regurgitation.

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