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SUBAORTIC MEMBRANE;
SURGICAL RESULTS OF RESECTION. A SINGLE CENTRE EXPERIENCE.

Tariq Waqar[1], Yasir Khan[2], Muhammad Usman Riaz[3]

1. FCPS, FRCS
Associate Prof,
Pediatric Cardiac Surgery,
CPE Institute of Cardiology, Multan.
2. FCPS, MRCS
Senior Registrar,
Cardiac Surgery,
CPE Institute of Cardiology, Multan.
3. FCPS,
Senior Registrar,
Pediatric Cardiac Surgery,
CPE Institute of Cardiology, Multan.

Correspondence Address:
Dr. Tariq Waqar
House No. 1, Street No. 7,
Income Tax Officers Colony
Bosan Road Multan.
drtariqwaqar@yahoo.com

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ABSTRACT... Objectives: In this study, we presented our results regarding outcomes of surgical correction of sub-aortic membrane. **Study Design:** Retrospective observational study. **Period:** June 2012 to June 2017. **Setting:** CPEIC Multan, Pakistan. **Methods:** 51 patients operated for resection of sub aortic membrane. The resection of sub aortic membrane was done through the aorta. Evaluation of the aortic valve done in all patients. The aortic valve was either replaced or repaired in cases of severe aortic regurgitation. Associated lesions such as ventricular septal defects (VSD's) were repaired with a dacron patch through the right atrium while ASD's were repaired with a pericardial patch. Post-operative echocardiography was done before discharge and post-op LVOT gradients and aortic insufficiency were recorded for all the patients. **Results:** There were 36 males and 15 females whose mean ages were 16.29 years. On post-op echocardiography there was no residual significant LVOT gradient in any patient. Three (3) patients developed mild to moderate aortic regurgitation post operatively but none of them warrant any surgical intervention. There was only 1 death in the series which was due to VSD patch dehiscence. None of the patients developed conduction problems post operatively needing any permanent pace maker. Mean pre-op LVOT gradient was 94.7 mmHg while it reduced to 20.7 post operatively (p-value <0.001). **Conclusion:** We concluded that early resection of sub aortic membrane can be safely accomplished with good results and significant drop in the mean LVOT pressure gradients post operatively.

Key words: Left Ventricle Outflow Obstruction, Aortic Regurgitation, Bacterial Endocarditis.

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INTRODUCTION

Discrete obstruction of the left ventricular outflow tract (LVOT) just below the aortic valve is defined as sub-aortic membrane (SAM) stenosis.1 This discrete membrane obstruction occurs in 0.25 per 1000 live births and is responsible for 15-20% off all cases of LVOT obstruction.[1] In reality, sub-aortic membrane is not congenital but an acquired lesion that forms due to steep angel between left ventricle and aorta.[2] Turbulence of blood flow at this angel results in endocardial injury that initiates fibrosis and ultimately membrane formation.[3,4] Most of the times it is associated with a VSD, PDA, a bicuspid aortic valve, AVSD or coarctation of aorta. It usually presents in the first decade of life with features of progressive Left Ventricle obstruction and Left Ventricle hypertrophy.[5]

SAM in the long run leads to aortic regurgitation in more than 50% patients that is usually progressive in nature.[6] Surgery in indicated in patients with mean gradient at LVOT > 30 mmHg or in moderate to severe aortic insufficiency patients.[7,8] Patients of SAM without symptoms (LVOT gradient <30 mmHg or without aortic insufficiency) are kept under observation and serial echocardiographies are performed in these patients to detect progression of the disease. Some authors however suggest early surgical excision of SAM to prevent aortic insufficiency or LVH.[9] In developing countries like Pakistan, the patients of SAM usually present after development of symptoms such as easy fatigability, chest pain or syncope attacks. We present here our early results of resection of the sub aortic membrane combined with septal myectomy at CPEIC Multan.

METHODS

It is a retrospective observational study conducted at CPEIC Multan, Pakistan. Due permission was

taken from the hospital ethical committee and no ethical issues were raised. The data of all the patients operated in our institution in the past year 5 years (from June 2012 to June 2017) was retrieved from the cardiac surgery database. Only the patients with sub-aortic stenosis were included and patients having other causes of LVOT obstruction were excluded. All patients were analyzed for both the pre-operative and post-operative variables like bypass time, cross clamp time, ventilation time, ICU stay, chest drainage and echocardiographic data especially the LVOT gradients along with the demographics. All the patients were operated by standard midline sternotomy on cardiopulmonary bypass with maximum temperature down to 28 degrees centigrade. Antegrade cold blood cardioplegia was used for cardiac arrest. The aorta was opened and evaluation of the aortic valve was done. Resection of subaortic membrane was done in all patients. To avoid injury to conduction pathway, radial incision was made into membrane on left side of imaginary line coming from right coronary ostium and membrane was excised on counter clockwise direction. We peeled off membrane carefully to avoid injury to aortic valve leaflets and mitral valve. The aortic valve was replaced with appropriate size in cases of severe aortic regurgitation. Associated lesions such as ventricular septal defects (VSD's) were repaired with a dacron patch through the right atrium while ASD's were repaired with a pericardial patch. The detailed information regarding concomitant lesions is given in Table-I. Post-operative echocardiography was done before discharge and post-op LVOT gradients and aortic insufficiency were recorded for all the patients. All the data was analyzed using SPSS and a p value of less than 0.05 was considered significant.

Concomitant lesion	Number
Coarctation of aorta	1
Atrial septal defect	1
PDA	7
Ventricular septal defect	17
Severe AR resulting Aortic valve replacement	8
Tricuspid repair	1

Table-I. Concomitant Lesions Along with Sub Aortic Membrane

RESULTS

There were 36 males and 15 females whose mean ages were 16.29 years. Seven of these patients had a concomitant PDA which was ligated during the same setting. 17 patients had a VSD which was repaired with a dacron patch. The aortic valve in 8 patients was severely regurgitant and was replaced with a mechanical valve. On post op echocardiography, there was no residual significant LVOT gradient in any patient while 3 patients developed mild to moderate aortic regurgitation post operatively but none of them warrant any surgical intervention. There was only 1 death in the series which was due to VSD patch dehiscence but none of the patients developed conduction problems post operatively needing any permanent pace maker. Table-II shows the pre-op and post-op characteristics of the patients. Mean pre-op LVOT gradient was 94.7mmHg while it reduced to 20.7 post operatively. This comparison is elaborated in Table-III. These patients are under follow up of pediatric cardiologists for onset of cardiac symptoms and any change in echocardiographic finding regarding increase in LVOT gradient or aortic regurgitation.

Variable	Mean	Standard Deviation
Age (years)	16.29	8.8
Bypass Time (min)	86	30
Clamp Time (min)	52.47	25.34
ICU Stay (hours)	39.41	26.36
Ventilation Time (hours)	5.8	3.49
Days in Hospital (Days)	6.59	2.5
Chest Drainage (ml)	391.8	303.9

Table-II. Operative and Post-Operative Characteristics

Variable	Variable	P-value
LVOT Pre-op	94.72±15.11	<0.001
LVOT Post-op	20.72±10.61	

Table-III. Comparison of Pre-op and Postop LVOT Gradients.

DISCUSSION

Sub-aortic membrane is responsible for 8% to 30% of all causesof left ventricular outflow tract obstruction.[10] Discrete sub-aortic stenosis occurs due to a geometric anatomic alteration

in the LVOT. Both the sub aortic ridge and the leaflets of the adjacent valves are involved in this abnormality.[11]

The patients with DSS usually complain of diminished exercise tolerance. Many are asymptomatic, even with increased gradients. Rayburn and colleagues[12] reported no symptoms in 70% of their patients whereas according to Kuralay and coworkers[13] 64.4% of the patients present with exertional dyspnea. In our patients, 52% patients were symptomatic before surgery. The main symptoms were shortness of breath and decreased exercise tolerance but a few patients with concomitant VSD's presented with recurrent chest infections.

Many surgeons have confirmed better early and long-term results with myectomy. Brauner and colleagues,[9] showed higher recurrence rate with high early postoperative gradients. We did resection of the membrane without myectomy in all the patients with no significant residual gradients immediate post operatively.

The most common lesion found with discrete sub aortic stenosis (DSS) is acquired aortic insufficiency which can be prevented by timely resection of the DSS as has been encouraged by several investigortors.[14] Oliver et al did not support this concept by showing a higher prevalence of aortic regurgitation in patients in whom early surgical repair was done,[15] In our opinion early surgical correction may preserve the integrity of the aortic valve to avoid later valve replacement. In our series 10 patients needed aortic valve replacement due to severely regurgitant valve. All these patients presented late when no repair could be done. Our studyresults and early follow-up supported the concept that early repair of DSS slows or even can stop the worsening of the AV regurgitation. In our series only three patients had moderate aortic regurgitation post operatively but none warranted any surgical intervention. In our study, there was no effect of age at the time of surgery on future outcomes of aortic insufficiency and insufficiency is usually improvedafter resection of membrane.

Various techniques are available for treating aortic insufficiency depending on the size and function of the valve. We do not treat these aggressively initially so no patients in our series had a septalmyectomy as a first procedure. In most patients, excision of the membrane with myotome cures the Subaortic stenosis. In those patients who have high post op LVOT gradients, recurrence is common. Therefore recording the intra-operative left ventricle- aorta gradients helps in quantifying the adequacy of resection. Similarly high recurrence is also seen in patients who had a previous operation for an aortic coarctation. According to Pickard et al, risk factors for reoperation by multivariable analysis included younger age at resection (HR 1.24, $p=0.003$), peeling of membrane off aortic valve or mitral valve (HR 2.52, $p=0.01$), preoperative gradient $\geq$60 mm Hg (HR 2.23, $p=0.04$), AS (HR 2.58, $p=0.01$) and distance of membrane to aortic valve$<$7.0 mm (HR 4.03, $p=0.03$).[16]

The primary results of DSS resection in our study were good. Like other studies the LV-aorta gradients decreased significantly studies similar to ours.[17] Despite residual gradients in some of our patients, we did not see any progression during the early follow up. In older series, the incidence of bacterial endocarditis,[18] was comparatively high, although it has reduced in recent studies. Many studies have found lower rate of peri-operative mortality and cardiac-related late deathsin these patients. Incomplete resection of fibro-muscular diaphragm is the main cause of residual gradients after DSS resection. On the other hand, extensive resection leads to complete heart block and bundle branch block.[19] None of our patients had a heart block requiring a permanent pacemaker. We also did not encounter any bacterial endocarditis in our patients. On the contrary according to a multi centre study additional myectomy did not reduce the risk for reoperation ($P=0.92$) but significantly increased the risk of a complete heart block requiring pacemaker implantation (8.1% versus 1.7%; $P=0.005$).[20] Tunnel subaortic stenosis is also a one of the cause of LVOT obstruction. We did not see any such patient in our series.

CONCLUSION

Early resection of sub aortic membrane can be safely accomplished with good results and significant drop in the mean LVOT pressure gradients post operatively.

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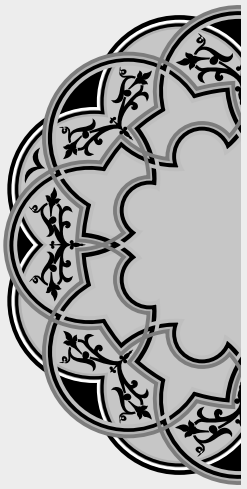

"If opportunity doesn't knock, build a door."

Milton Berle

AUTHORSHIP AND CONTRIBUTION DECLARATION

Sr. #	Author-s Full Name	Contribution to the paper	Author=s Signature
1	Tariq Waqar	Designed, research, methodology, paper the manuscript.	
2	Yasir Khan	Did data analysis, writing manuscript.	
3	M. Usman Riaz	Did data analysis, review the manuscript.	