COMPARATIVE STUDY BETWEEN INTERRUPTED AND CONTINUOUS SUTURE TECHNIQUES IN VENTRICULAR SEPTAL DEFECT PATCH CLOSURE - A RETROSPECTIVE ANALYSIS

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CERTIFICATE

This is to certify that this dissertation titled **"COMPARATIVE STUDY BETWEEN INTERRUPTED AND CONTINUOUS SUTURE TECHNIQUES IN VENTRICULAR SEPTAL DEFECT PATCH CLOSURE – A RETROSPECTIVE ANALYSIS"** is a bonafide work done by **DR.T.MUTHUVIJAYAN**, Department of Cardiothoracic Surgery, Government Rajaji Hospital and Madurai Medical College, Madurai under my guidance and supervision in partial fulfillment of the regulations of The Tamilnadu Dr.M.G.R.Medical University for the award of **MCh, Branch I (Cardiothroracic Surgery)** during the academic period of **October 2010 August 2013.**

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DECLARATION

I, **Dr.T. MUTHUVIJAYAN** solemnly declare that the dissertation titled **"COMPARATIVE STUDY BETWEEN INTERRUPTED AND CONTINUOUS SUTURE TECHNIQUES IN VENTRICULAR SEPTAL DEFECT PATCH CLOSURE – A RETROSPECTIVE ANALYSIS"** has been prepared by me. This is submitted to The Tamilnadu Dr. M. G. R. Medical University, Chennai in partial fulfillment of the rules and regulation for the award of **MCh, Branch I (Cardiothroracic Surgery)** to be held in **August 2013.**

Place : Madurai **Dr.T. MUTHUVIJAYAN**

Date :

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CONTENTS

INTRODUCTION

In this study we propose to follow up patients undergoing repair for ventricular septal defect over a two year period and look at the variables in relation to the different techniques of operation, materials used for closure, and eventual morbidity and mortality related to the operation.

Ventricular septal defect is the most common congenital cardiac anomaly that may occur as an isolated anomaly or as a part of complex of anomaly such as tetralogy of fallot. Small defects may close spontaneously, and others may cause no significant disability in an entire lifetime. Patients with cardiomegaly and large left to right shunts are unquestionable candidates for the operation. By operating electively, the tendency to develop valvulitis and Bacterial Endocarditis is virtually eliminated.

AIM

A comparison of Interrupted and Continuous Suture technique for closure of Ventricular septal defects.

OBJECTIVES

To study our experience regarding the effectiveness, postoperative complication rates and the total outcome comparing Interrupted and continuous suturing for closure of Ventricular septal defects done in Department of Cardiothoracic surgery, Government Rajaji Hospital from October 2010 to December 2012.

MATERIAL AND METHODOLOGY

All Patients for ventricular septal defect closure was done by professor. All patients undergoing repair for ventricular septal defect in Department of Cardiothoracic surgery, Government Rajaji Hospital during October 2010 to December 2012 were included in the study. Patients with VSD associated with complex anomalies and muscular type VSDs were excluded from this study. One group used continuous suture for VSD closure and the other group used Interrupted techniques for VSD closure.

After median sternotomy, the thymus was dissected from the pericardium. Pericardium harvested as a free graft taking care to avoid injury to the phrenic nerves. It was treated with 0.6% glutaraldehyde solution for 20 minutes and rinsed 3 times in 0.9% saline solution for 5 minutes.

Cardiopulmonary bypass was started after AORTA, SVC, IVC cannulation. Under moderate hypothermia, cross clamp applied, antegrade cold blood cardioplegia given. Heart arrested in diastole Right atrium was opened and the VSD was inspected. The pericardial/Gore-Tex patch was trimmed to match the size of the VSD. The defect was closed with the pericardial patch using 4/0 or 5/0 polypropylene continuous suture; starting from the inferior margin and proceeding towards the antero superior margin and superiorly towards the aortic valve, avoiding injury to the aortic cusps. With the second arm of the suture, the postero-inferior margin was closed up to the septal leaflet of the tricuspid valve.

The tricuspid margin of the defect was closed with a reinforcing strip of pericardium. When using interrupted sutures pledget supported interrupted mattress sutures are first placed around all margins of the defect and then passed through an appropriately tailored patch, which is lowered down and tied in.

ADDITIONAL PROCEDURES

Two patients underwent simultaneous aortic valve repair. Mitral valve repair was done is two patients.

POSTOPERATIVE PROTOCOL

Patients with an uneventful recovery were discharged after ten days. Echocardiography was done before discharge and documented.

DATA COLLECTION

The information collected regarding all the selected cases were recorded in a Master Chart. Data analysis was done with the help of computer using Epidemiological Information Package developed by Centre for Disease Control, Atlanta.

Using this software range, frequencies, percentages, means standard deviations, chi square and ‘p’ values were calculated. Kruskul Wallis chi-square test was used to test the significance of difference between quantitative variables. A ‘p’ value less than 0.05 is taken to denote significant relationship

FOLLOW UP

Major and minor complications monitored and the period of Hospital stay of the patients were followed.

LITERATURE REVIEW

Ventricular septal defect is a hole or multiple holes in the ventricular septum that may vary in size, number, or location on the septum. All three determine its physiology, but the location determines its nomenclature.

VSD occur at a rate of 0.5 per 1000 live births and in 4.5 to 7 of 1000 premature infants, with a slightly higher prevalence in females. About 5 percent of VSDs are related to chromosomal syndromes such as 22q1 deletion and trisomy 21, in which VSD is the most common cardiac defect identified.

It is the most commonly Identified congenital cardiac defect excluding bicuspid aortic valve. Approximately 20 percent of patients with congenital defects have isolated VSDs and if one includes VSD in combination with other defects, VSD are diagnosed in 50 percent of all patients with congenital heart disease.

Ventricular septal defect is the only cardiac malformation except persistent ductus where a normal life expectation may be restored by the defect closing spontaneously.

The doubly committed sub arterial or juxta-arterial defect is more common in Asian populations, but muscular and multiple defects are less common in the same populaton[4]. According to Wilkinson, the frequency of the doubly committed sub arterial defect which needs repair is at least 30% in an Asian population compared with an incidence of 5% patients requiring surgery in western societies, Genetics certainly influences the type of defect.

Wilkinson state that while muscular defects account for 30% of cases operated in the western world[6]. these are uncommon in the Asian surgical population. Multiple ventricular septal defects are rare in Asians when compared to an incidence of 10% in the Western population.

HISTORY

In 1879, Roger described the clinical & pathologic findings of a VSD. In 1897 Eisenmenger identified the natural history of an unrestrictive VSD as a postmortem findings in a cyanotic patient aged 32 who died with a large VSD, and pulmonary hypertension. However the term Eisenmenger's syndrome was not introduced until Abbott delineated the pathophysiology of a VSD in 1930. In 1958 Heath and Edwards described the morphologic changes associated with pulmonary vascular disease.

In 1952 Muller first surgically addressed a VSD, by placement of a pulmonary artery band. Lillehei using controlled cross circulation was the first to perform a VSD repair in 1954[5]. DuShane reported transventricular repair in 1956, but a transatrial approach was introduced the following year by Stirling. In 1958, Truex described the location of specialized conduction tissue in hearts with VSD.

Kirklin and associates established in 1961 the ability to repair VSDs in small infants, therefore avoiding the two staged approach of banding of the pulmonary artery followed by VSD closure.

In 1957, Lillehei done VSD repair through an atrial approach. By using hypothermic circulating arrest and rewarming by a pulse oxygenator was done by Okamoto to Infants with VSD in 1969. In small sick infants, primary repair was found to give better results than pulmonary artery banding by Barratt – Boyes in 1969 – 1971.

INDICATIONS FOR VSD REPAIR

- Large VSDs in Infants with intractable congestive heart failure despite medical treatment[5]
- Moderate sized VSD with large L-R shunt (>2:1) are operated by the age of 2 years[5]
- Small VSDs with associated infective endocarditis when the defect remains open once the infection has been cured
- Doubly committed sub arterial VSD
- VSD associated with aortic regurgitation or prolapse
- Mal alignment type VSD

RELATIVE CONTRAINDICATIONS

- VSD associated with severe pulmonary hypertension
- Surgery is not normally indicated for persistent small defects
- Banding is considered for infants with multiple VSDs of the Swiss-cheese variety, some VSDs and coarctation of the aorta, and VSDs with straddling of one atrioventricular valve
- In addition, infants with very low body weight and those who are not fit for cardiopulmonary bypass because of an intercurrent illness are considered for pulmonary artery banding

JUSTIFICATION

Generally VSDs are repaired with synthetic materials; either Dacron or GoreTex depending on the surgeon's preference. Dacron excites a fibrous reaction that is probably helpful in sealing off tiny residual VSDs that are often seen by echocardiogram in the early postoperative period. However, if the VSD closure is more of a baffle as for VSD closure for

DORV, then the fibrosis that is stimulated can be a disadvantage since it may increase the risk of left ventricular outflow tract obstruction(LVOTO). Also synthetic patches carry a small but definite risk of endocarditis.

Autologous and xenograft pericardium, which was also be used for VSD closure. Fresh, untreated pericardium is difficult to handle and with time can both shrink as well as stretch. Aneurysm, formation was reported by Schoof et al, which can occur due to not only the use of fresh autologous pericardial patches but also intra-operative patch oversizing. Some degree of enlargement is evidenced by its use to construct conduits.

Alain Carpentier Introduced Glutaraldehyde in cardiac surgery. Cross linking of collagen molecules and strengthening with fixing of the shape and reduction in elasticity results after treating the pericardium with 0.6% glutaraldehyde. There are several benefits derived from fixing pericardium. The patch can be cut and shaped with the expectation that when it is exposed to pressure it will retain approximately the same shape and size.

Fixation reduces the risk of aneurysmal dilation. Bovine pericardium may evoke an immune response and is expensive. There is limited experience with use of bovine pericardium as a patch material for congenital VSD. Cultural and religious beliefs of using bovine pericardium may not be acceptable in some societies.

Autologous pericardium which was treated with glutaraldehyde is safe, easy to handle and is comparable in results to synthetic patch when used for VSD repair in children was reported by Murthy Kona et al.

SURGICAL APPROACH

VSD closure can be done through: right atrial, Transpulmonary, Trans aortic, right ventricular and left ventricular approach.

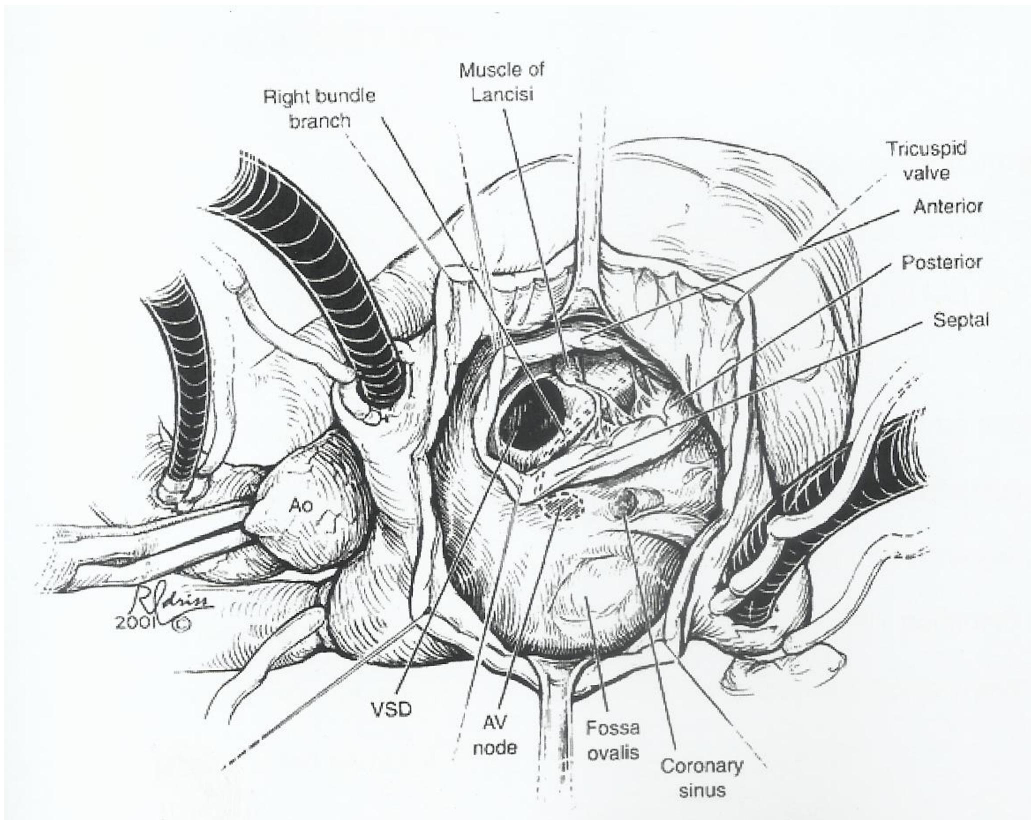
RIGHT ATRIAL APPROACH

The frequently used approach is through right atrium and is usually applicable to the paramembranous, inlet and the left ventricle to right atrium type of VSDs.

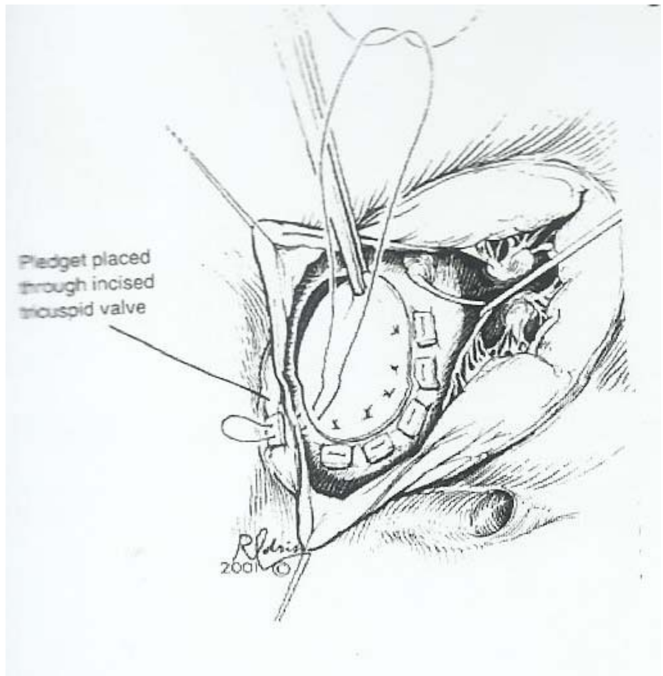
VSD is exposed by retracting the tricuspid valve leaflets. 2-3 mm away from the edge of the defect (5-0 or 6-0) double armed pledgetted sutures are placed on the right ventricular side. The conduction bundle, which runs near the crest is avoided there by with wider area of contact between Myocardium and the patch.

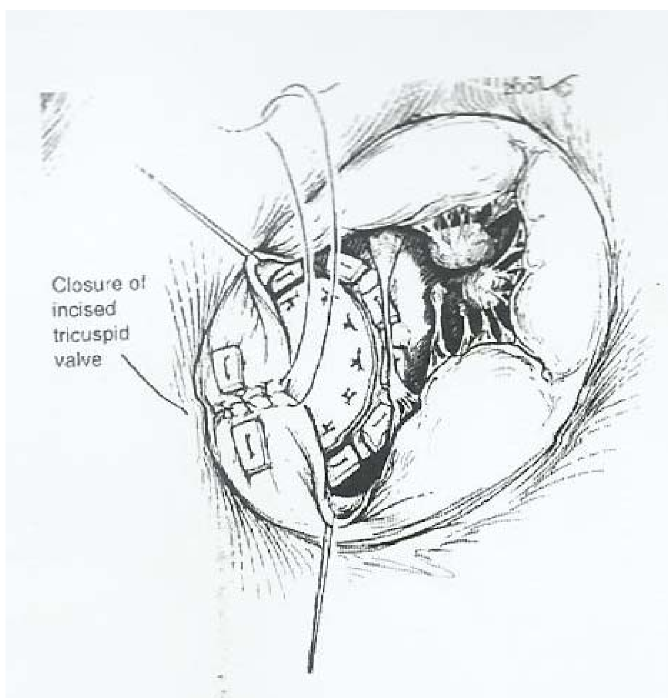
The defects in the membraneous area, covered by septal leaflet of Tricuspid valve and may not be visualized immediately. This is mostly seen in patients, when chordal attachment of tricuspid valve to the edges of defect are short and tight or if a pouch by accessory tricuspid valve tissue is formed. In order to avoid residual shunt, tricuspid valve should be opened in a radial fashion to expose true perimeter of the defect when incising tricuspid valve, it is important to extend carefully from free edge to 3-4mm from the annulus, according to the need of exposure. Aortic valve leaflet may have prolapsed, which should be avoided while cutting the tricuspid valve. Some authors prefer circumferential incision of tricuspid valve for large paramembraneous VSDs with inlet extension. Sutures should be taken superficially along postero inferior margin of defect from insertion of muscle of Lancisi to Tricuspid valve annulus near the apex of Kochs triangle. Buttressed sutures, taken from the right atrium side through the septal leaflet of tricuspid valve about 1-2 mm way from annulus. Placing the sutures through fibrous looking rim of crest of defect is avoided, because it lacks tissue holding properties.

The pledget helps to bolster the attachment to the often friable endo myocardium that surrounds the VSD. When the VSD is large, the sutures can be placed without having the patch material in the field, allowing more accurate placement and sizing of the VSD patch. The interrupted suture technique allows the surgeon to visually assess each suture during placement. The patch is inspected to assess closure at the end of placement of sutures.



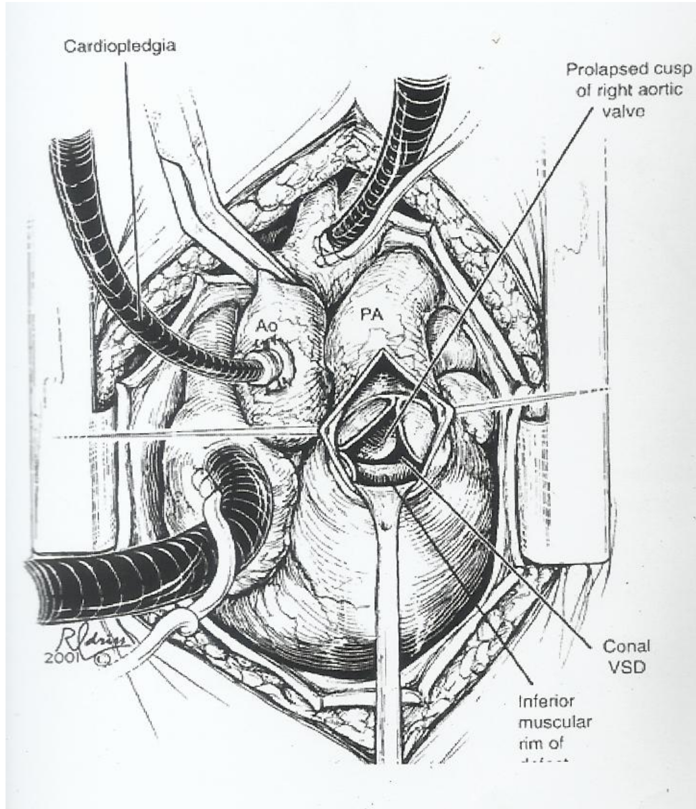
Muscle of
Lancisi
Right bundle
branch
Tricuspid
valve
Anterior
Posterior
Septal
Ao
R Idriss
2001 ©
VSD
AV
node
Fossa
ovalis
Coronary
sinus

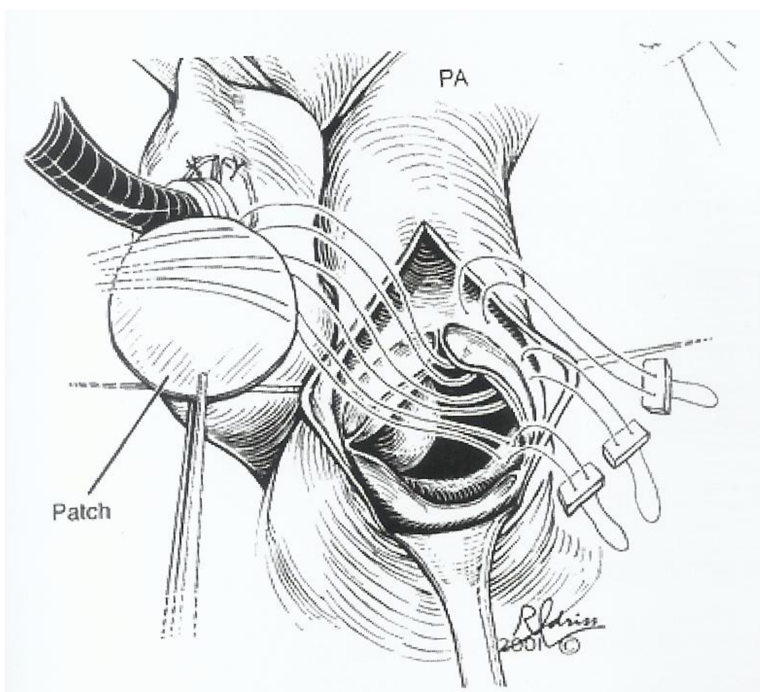

Pledget placed
through incised
tricuspid valve
2001 ©

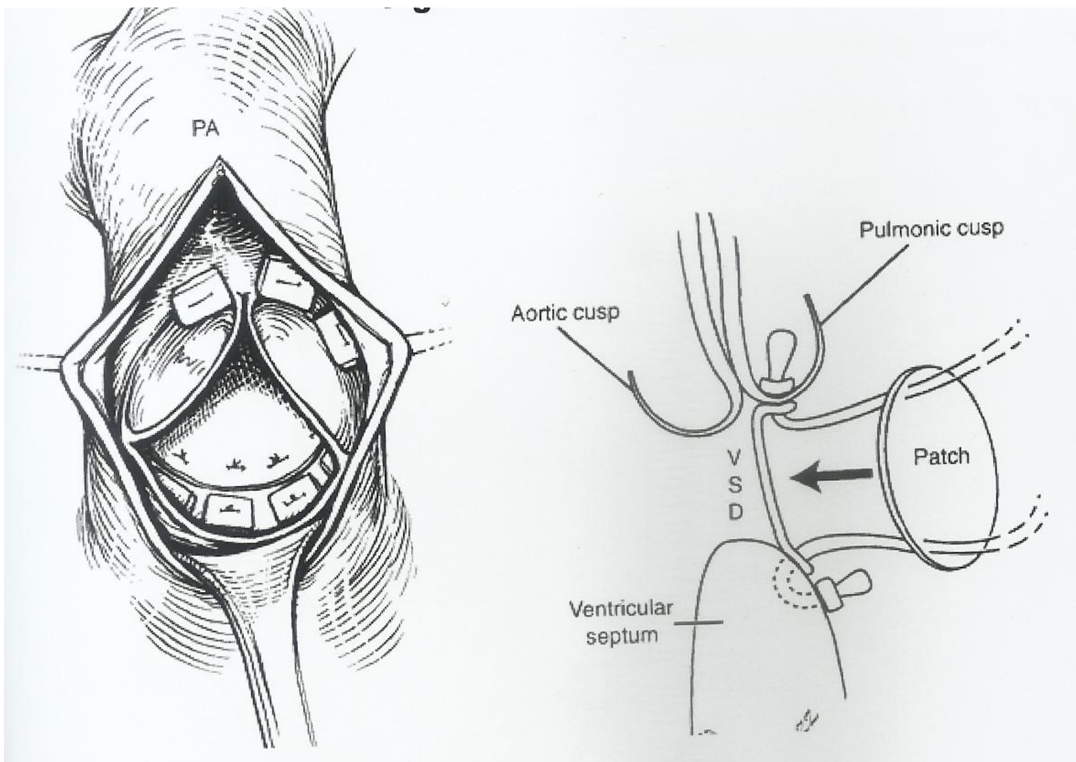

Closure of
incised
tricuspid
valve

TRANSPULMONARY ARTERY APPROACH

A vertical incision is made in the pulmonary artery for transpulmonary approach repair for conal defects. Interrupted pledgetted sutures are placed circumferentially around the defect and then through a Gore-Tex patch. Few sutures are anchored through the base of pulmonary valve cusp at the junction with valvar sinuses because of the narrow rim on the superior aspect of VSD (aortic-pulmonary valve junction). At this point, the small pledgets rest against the arterial wall, which decreases the chance of the sutures tearing the thin tissue. The pulmonary valve function should not be Interfered by the patch and the previously prolapsed aortic valve should be supported by it. The Pulmonary artery is primarily closed.

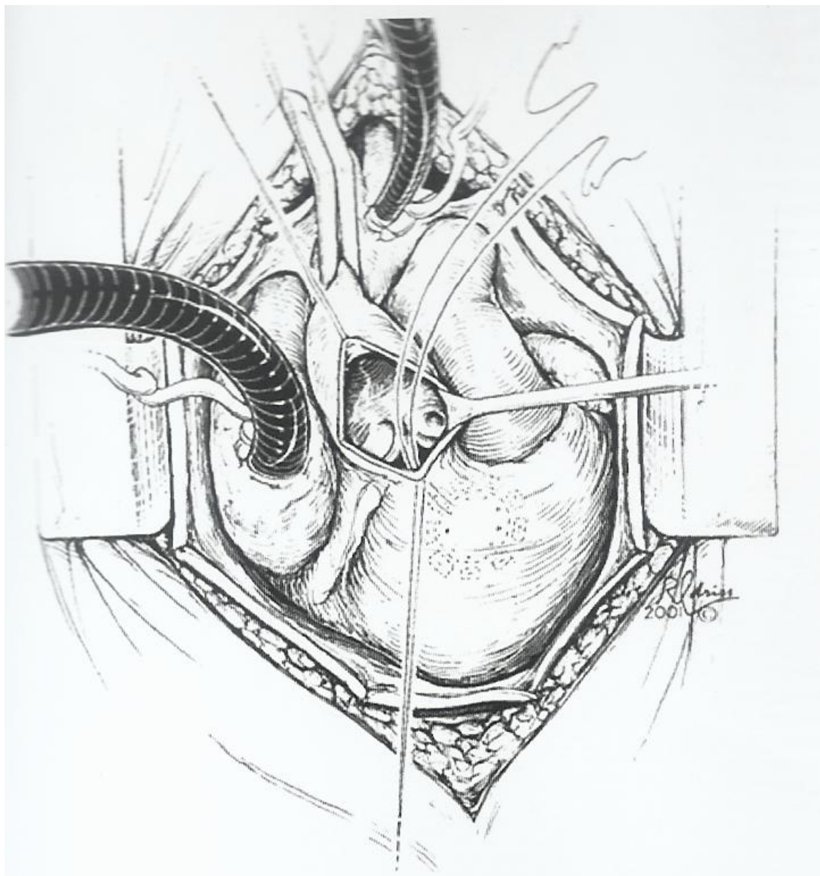

Cardiopledgia
Prolapsed cusp of right aortic valve
Ao
PA
Conal VSD
Inferior muscular rim of
R Idriss 2001 ©


PA
Patch
R Idriss 2001 ©


PA
Pulmonic cusp
Aortic cusp
Patch
V
S
D
Ventricular
septum

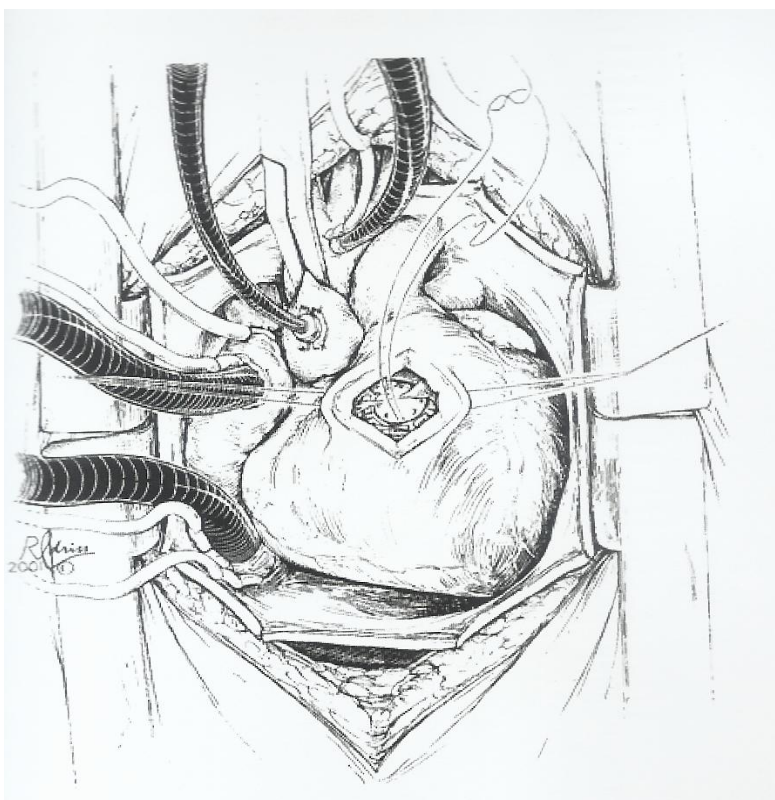
TRANSAORTIC APPROACH

VSD closure through an aortic Incision is performed usually, when concomitant correction of associated lesions is needed such as aortic valvuloplasty for prolapse or for relief of valvar or subvalvar stenosis. An obliquely curved incision is made beginning on the anterior aspect of the ascending aorta above the aortic valve commissure at a level above the center of the right coronary sinus. Towards the center of non coronary sinus, the incision is extended Inferiorly and to the right. 1-2 mm above the aortic commissure aorta can be transected. The aortic valve leaflets are retracted carefully to expose the defect. Suture placement is difficult due to absence of superior muscular or fibrous rim of the defect. For this reason, through the aortic wall from inside the aortic valve sinuses pledgetted mattress sutures taken.



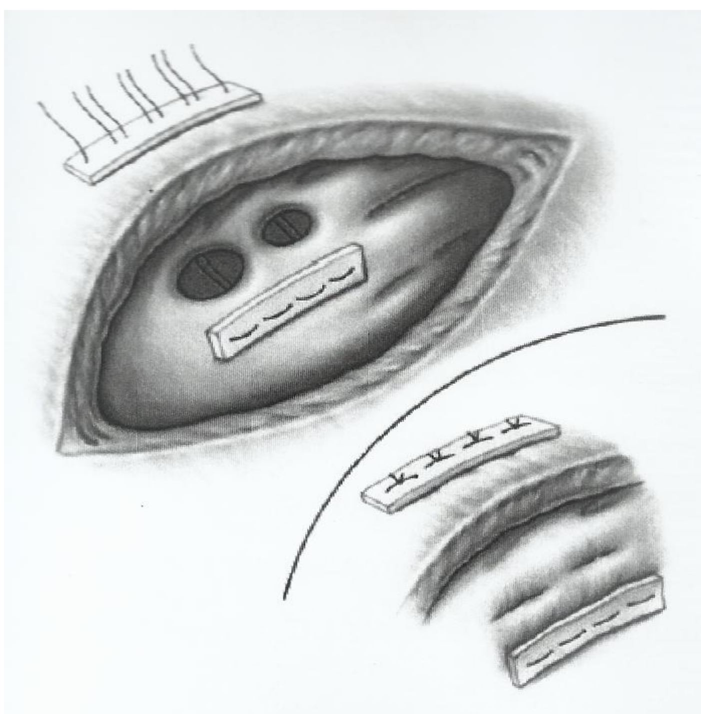
RIGHT VENTRICULAR APPROACH

The distribution of epicardial coronary arteries should be examined first before ventriculotomy. It may be done either through transverse or vertical. Limitation of circular muscle fiber injury is seen through a transverse incision, but it is inadequate when patch enlargement of infundibulam is needed and may restrict exposure. From the middle of anterior infundibular wall, a vertical incision is started usually between traction sutures and extended downward towards the right ventricular sinus portion or upward in the direction of pulmonary artery.



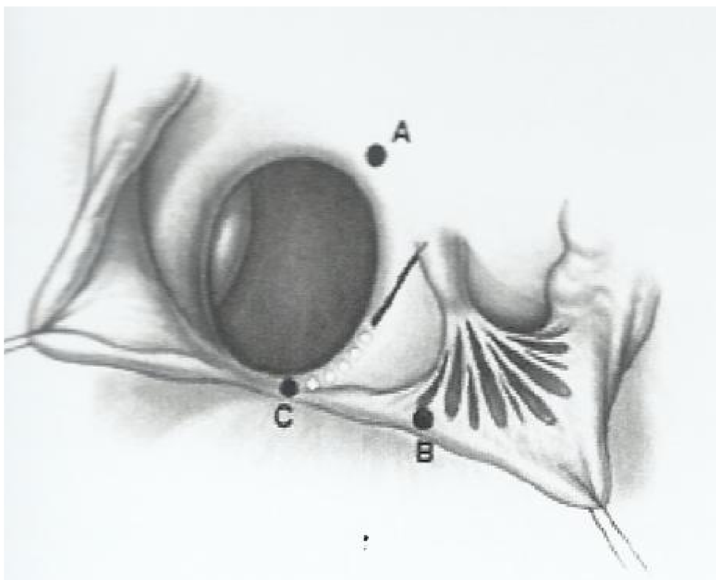
LEFT VENTRICULAR APPROACH

Left ventricular approach is rarely used for ventricular septal defect of trabecular type, like multiple perforations (swiss cheese) of apical sieve like variety. Since the septum is relatively smooth, these defects may be easily patched from left ventricular side, in contrast to trabeculation and papillary muscle attachments of the right ventricle. Vertical or transverse incision may be used, of which vertical incision is frequently used, starting in the left ventricular avascular apical area with limited extension superiorly. Distribution of coronary artery is noted to minimize injury in both incisions.



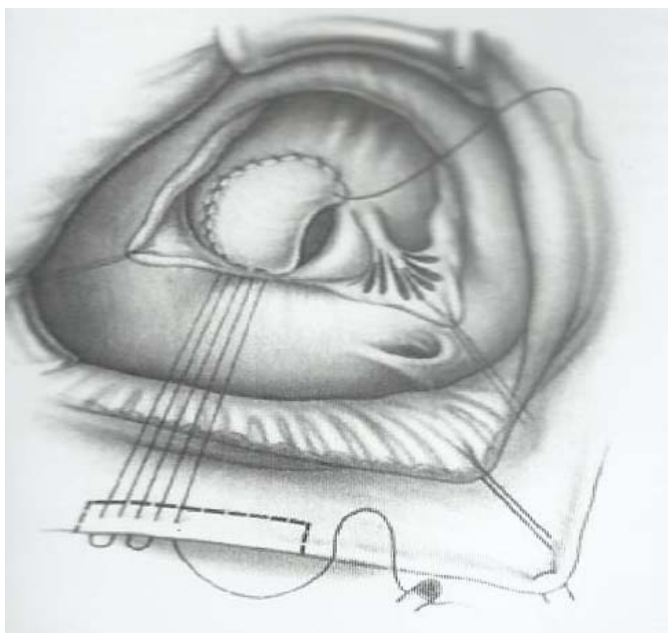
PATCH CLOSURE WITH CONTINUOUS SUTURES

To cover the triangular area containing conduction tissue, posteriorly or inferiorly the patch must be wider than the defect. The patch should be tailored to appropriate shape and size.

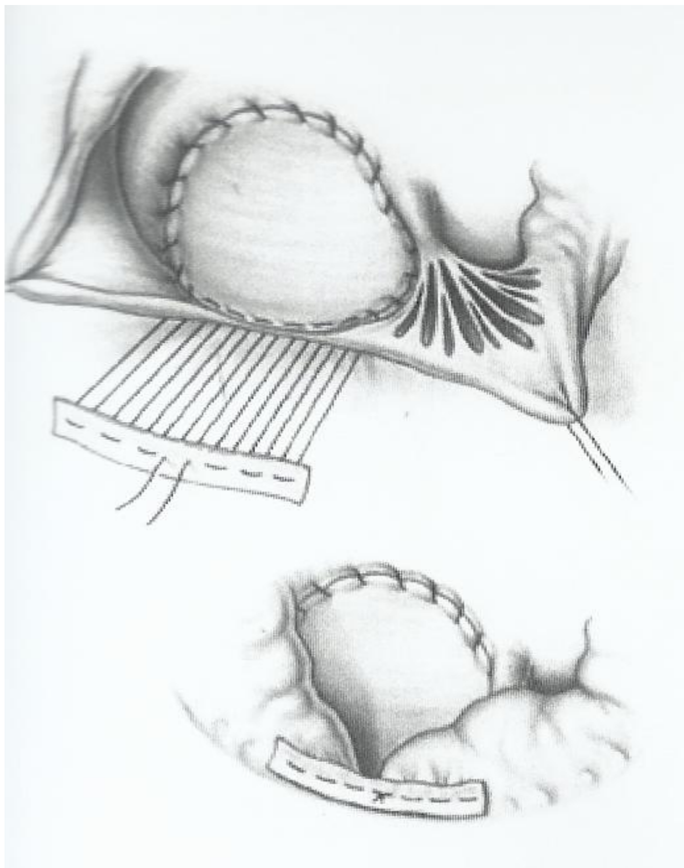


By taking deep bite in the infundibular septum, suturing should be started at 12’o clock position, 5-0 polypropylene suture with 13 mm semicircular, round bodied needle is used. Continuous suturing is then carried out superiorly.

The patch is then pulled down into position as the surgeon works towards the tricuspid valve annulus. When this point has been reached, through the base of septal leaflet of tricuspid the suture is passed and then through the right side of the edge of the pericardium. Two or three mattress stitches are placed back and forth through the pericardial edge, the tricuspid leaflet, and the patch. The suture is held with a rubber-shod clamp.[15]

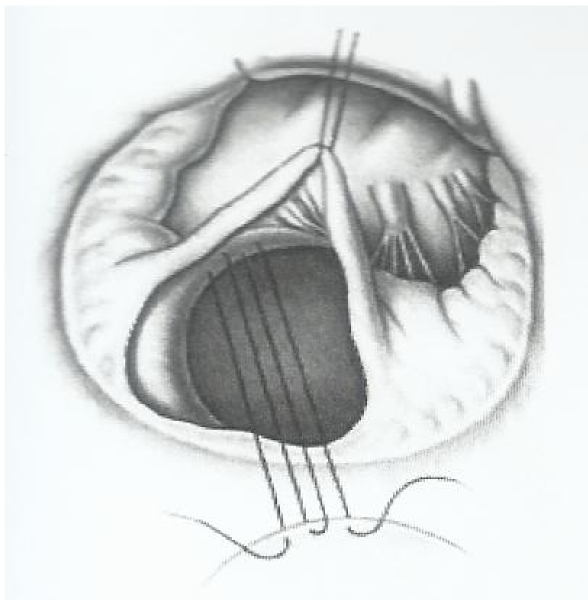


Working now with the second arm of the suture and towards himself, the surgeon takes a few deep bites in the trabeculaseptomarginalis. The stitches are placed superficially along line AB 4-6 mm away from the inferior margin of defect, to avoid bundle branch when the papillary musule or the antero-inferior angle of defect is reached. Stitch is penetrated through the base of septal leaflet of tricuspid (point B) and then through the edge of pericardium.

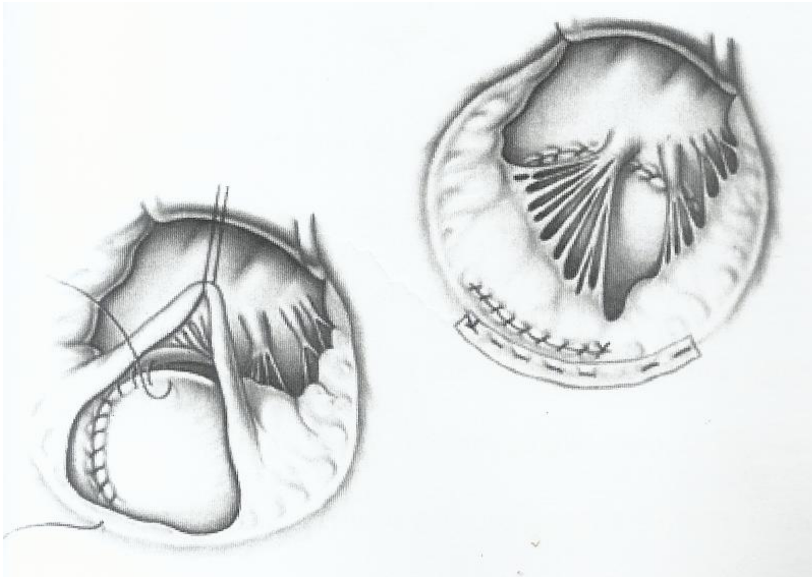


The snugging of pericardial strip done along the base of tricuspid leaflet, sutures are then pulled taut and the strip is sandwiched securely between the patch and pericardium.

When the VCD is obscured by numerous chordae tendineae, septal leaflet is detached for better access of closure. The incision is made parallel to, and 2-3 mm from, the annulus, taking great care not to disconnect the leaflets one from the other.



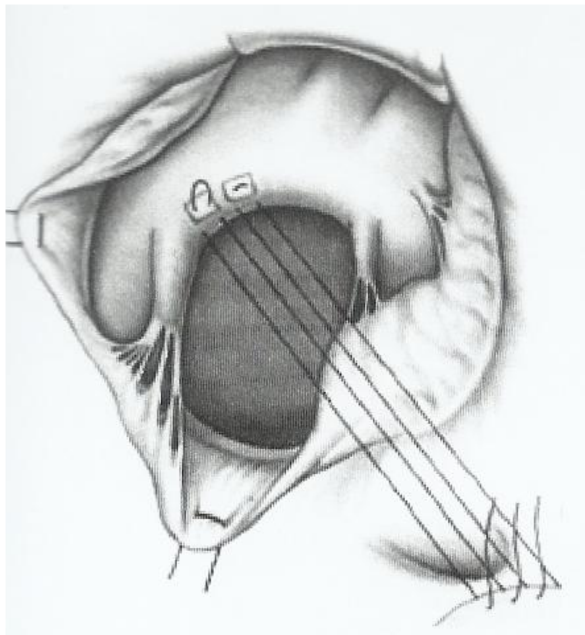
The detached leaflets are reflected into the right atrium, and the VSD is closed. The tricuspid valve is then repaired with a continuous suture of fine material.[17]



PATCH CLOSURE WITH INTERRUPTED SUTURES

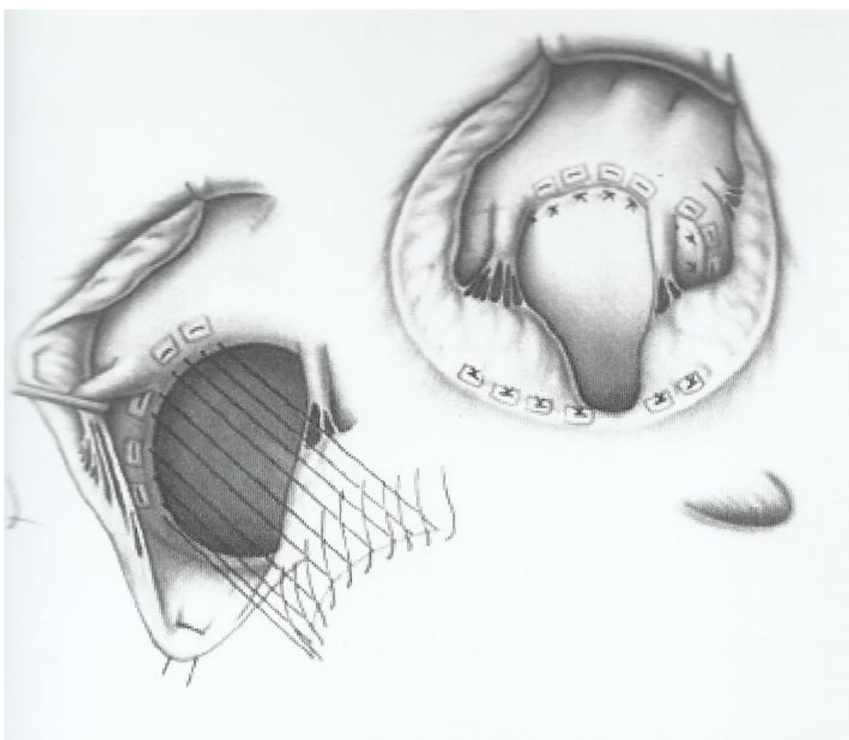
Interrupted mattress pledget sutures are placed first all around the margins of defect and then through the appropriately tailored patch, which is brought down and tied. In infants, 5-0 double ended synthetic sutures are used, mounted on small semi circle needles and buttressed with small Teflon or pericardial pledgets.

The first stitch is placed deeply in the margin of defect that is most distant from surgeon, on trabeculaseptomarginalis. The sutures are placed on a rubber-shod clamp.



Until the area of central fibrous body is reached. Successive sutures are placed. Through the septal leaflet of tricuspid, about 1-2 mm from annulus, next 2 or 3 stitches are placed. Then the sutures are placed on inlet septum and trabeculoseptomarginalis on the right side margin of defect, caudally. These sutures do not pass through the full thickness of the septum but grasp only its right surface; they should be placed 3-5 mm, away from the edge of the defect to avoid the branching bundle in case it does not bifurcate immediately after penetrating the central fibrous body.

The prosthetic patch is trimmed to an appropriate shape and size. The sutures which was taken completely covers the margin of defect. The patch should be greater than the actual defect, because the suture line in posterior-inferior angle is away from the margin. Through the patch, the interrupted sutures are passed and lowered in to position and then tied.



PREPARION OF PERICARDIAL PATCH

After routine median sternotomy, the thymus is carefully dissected. Pericardium harvested as a free graft, taking care not to injure the phrenic nerves. Wrinkles in the graft removed by stretching it out on a stiff, sterile cardboard paper. Pericardium is treated with 0.6% glutaraldehyde for 20 minutes and it is rinsed 3 times in 0.9% saline for 5 minutes gluteraldehyde treated autologous pericardium used in sixty children by Murthy Kona et al. Trivial leak noted in ten patients and nodal rhythm in three patients that needed temporary pacing but resolved in a week. None of them required permanent pacing. There was no mortality at the end of six months follow up period.[17]

22 patients were followed up by Guler, who underwent VSD closure using bovine pericardium for five years. Two patients needed temporary pacing for nodal rhythm resolved within ten days. There was no mortality, After 3 months of surgery, Echo study carried out which, showed no calcification of aneurysm formation of the patch. A lower risk of endocarditis is there by using bovine pericardium.

INFECTIVE ENDOCARDITIS

Infective endocarditis is a well known risk in patients with a ventricular septal defect, and also can occur after surgery in the patient with a residual defect. Incidence of overall bacterial endocarditis rate of 0.38 per 10,000 person years was reported in one population based study.

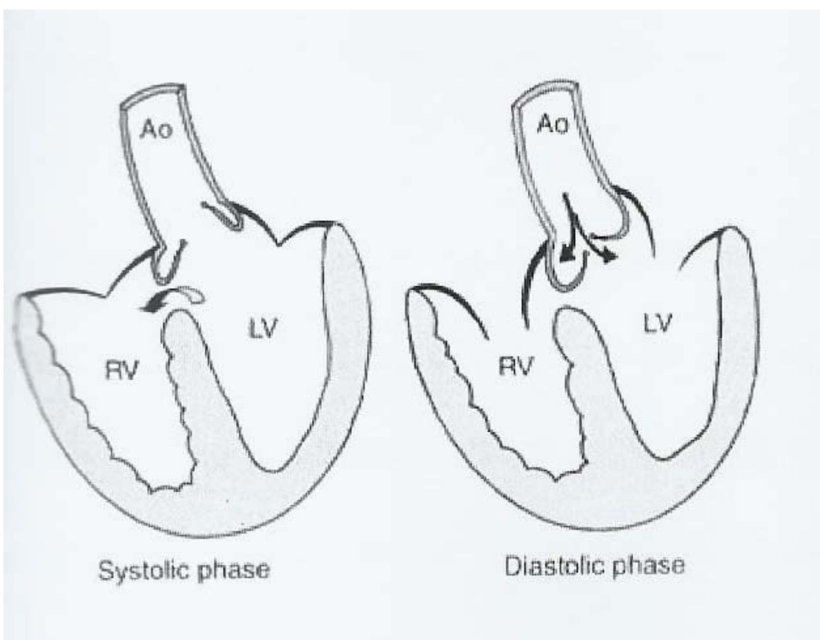
In patients operated for ventricular septal defect, the incidence of endocarditis was 7.3 over 10,000 person years of follow up, but for patients with non-operated ventricular septal defect, the incidence of endocarditis was 18.7 per 10,000 person years of follow up.

The higher probability of the risk of endocarditis noted with a smaller defect, and the lower risk probability during childhood, increasing in the adolescent and adult. Patients with a proven episode of endocarditis are considered at increased risk for recurrent infection. After a previous epidode of proven endocarditis in small ventricular septal defect, cardiologists recommend surgical closure.

AORTIC VALVE PROLAPSE

In ventricular septal defects which are in direct contact with aortic valve, Aortic valve prolapse and regurgitation are important complications, with 2-7% incidence in one reported series.

In some patients in the first year of life, the elongation of aortic cusp from prolapse is noted and some may show trivial or more aortic regurgitation in colour flow Doppler.



Most of the muscular outlet defects and all the perimembranous and doubling committed juxta-arterial defects are virtually in direct contact with the aortic valve. Among these subaortic defects, those that have more extensive contact with the aortic valve are the most prone to develop aortic valve prolapse because of the muscular deficiency that inadequately supports the aortic cusps. Right coronary cusp is commonly involved and less commonly the non-coronary cusp in aortic valve prolapse.

SURGICAL COMPLICATIONS

Complications from surgical VSD closure are infrequent; they include the following

When the sutures in the superior aspect of patch damage the leaflets of aortic valve, there is a possibility of aortic valve insufficiency.

When the tricuspid valve leaflet is entrapped by VSD patch, or distortion of leaflet if incised and due to chordal shortening, tricuspid valve insufficiency may occur.

If the bundle of His is damaged or transected by sutures, complete heart block may occur. Due to careless suctioning or manipulation around the AV nodal area with instruments, temporary heart block may occur. The decision of when to place a pacemaker depends on the individual situation. Factors in one's decision include preoperative AVN function, the nature of the procedure and cardiac anatomy, and the postoperative course. The frequency of this complication should be approximately one percent. In thirty five percent of cases, right bundle branch block is frequently seen.

With the help of intraoperative TEE, residnal VSD has been greatly reduced. It is difficult to decide whether a small residul defect is physiologically and clinically significant enough to warrant re-arresting the heart and attempting complete closure. A Qp:Qs of less than 1:5:1 is used as a general guideline for a residual VSD shunt that could be observed. The decision to leave a residual VSD is multifactorial and based on such aspects of the case as the difficulty of the VSD closure, ones perception of how the heart will tolerate another arrested period and the residual shunt that is left.

For isolated VSD closure, the operative mortality is low from 0-3 percent. Acute heart failure is the most common mode of death which may be due to pulmonary hypertensive crisis, poor intra operative myocardial protection a preoperative viral infection or combination of these with a small malnourished infant with heart failure.

Multiple VSDs, location, PAB, young age, patient size and aortic insufficiency, all have been predictive of hospital mortality at various times in the past, are no longer risk factors. Major associated cardiac anomalies, especially when associated with multiple VSDs are risk factors for hospital mortality, in the current era

The surgical repair of an isolated VSD before complications begin to arise (usually before two year of age) can return a patient to a normal life expectancy with full functional activity and normal growth. In less than 2.5 percent of cases, late mortality after repair occurs, when pulmonary pressures are low and most of these death result from ventricular arrhythmias.

RESULTS

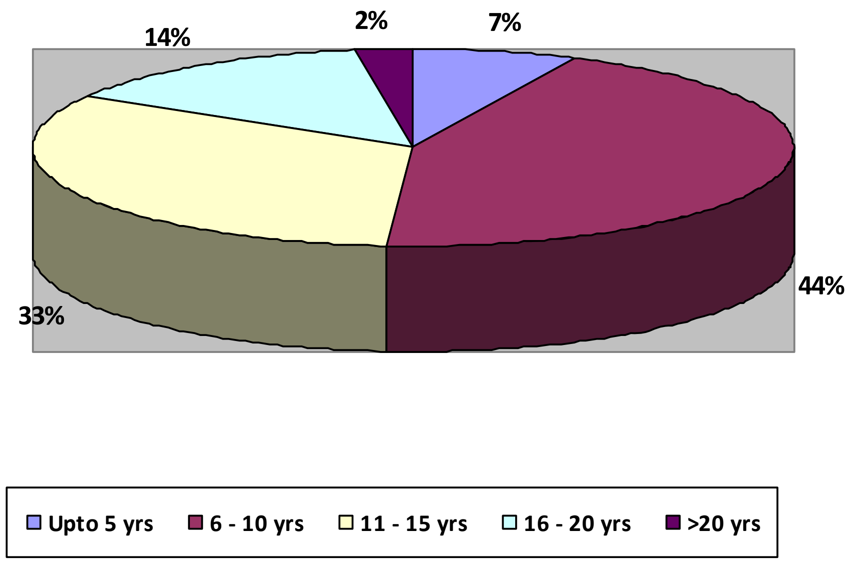
PROFILE OF CASES STUDIED

Table 1: Age distribution

Age (in Years)	Cases	
	No.	%
Upto 5 yrs	3	6.9
6- 10 yrs	19	44.2
11- 15 yrs	14	32.6
16- 20 yrs	6	13.9
>20	1	2.4
Total	43	100
Range Mean S.D.	5 – 29 yrs 11.30 yrs 5.21 yrs	

A total of 43 patients were recruited for the study. Of these 18 had VSD repair using glutaraldehyde treated autologous pericardial patch and 25 had VSD repair using Gore-Tex patch.

Age Distribution



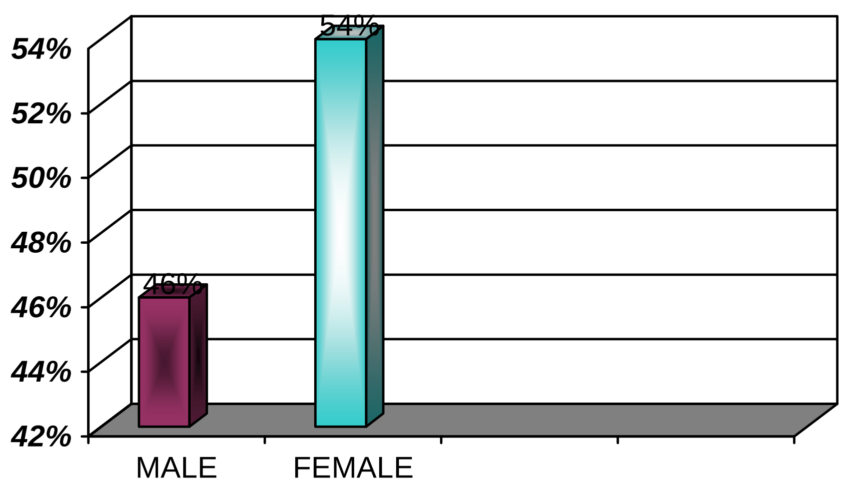
There majority of patients were in the age group of 6 – 10 years comprising 44 percent of the total study. Children under five years of age comprised less than ten percent of the study group.

SEX DISTRIBUTION

Table 2: Sex Distribution

Sex	Cases	
	No.	%
Male	20	46.4
Female	23	53.6
Total	43	100

Sex Distribution

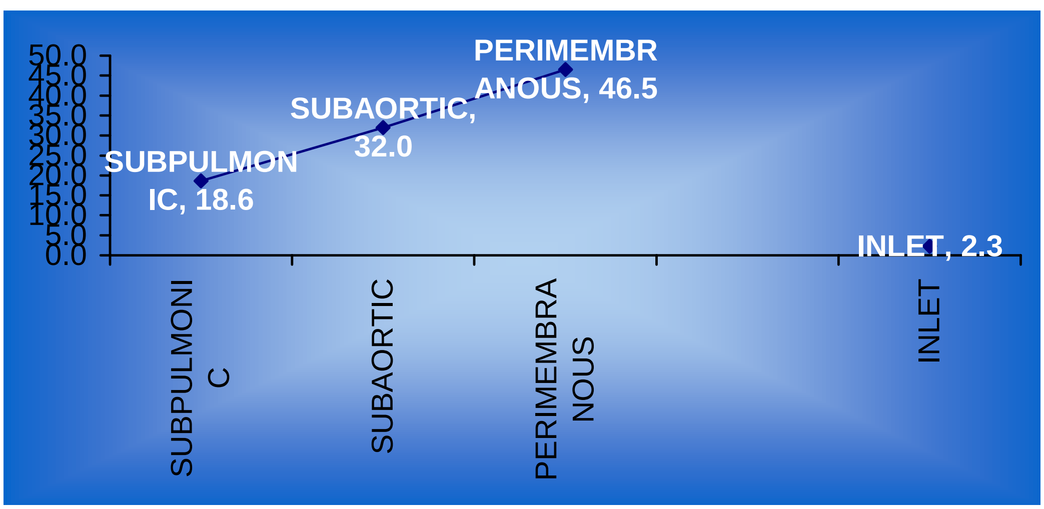


TYPE OF VSD

Table 3: Diagnosis

Diagnosis	Cases	
	No.	%
Subpulmonic	8	18.6
Subaortic	14	32.6
Perimembranous	20	46.5
Inlet	1	2.3
Total	43	100

Type of VSD

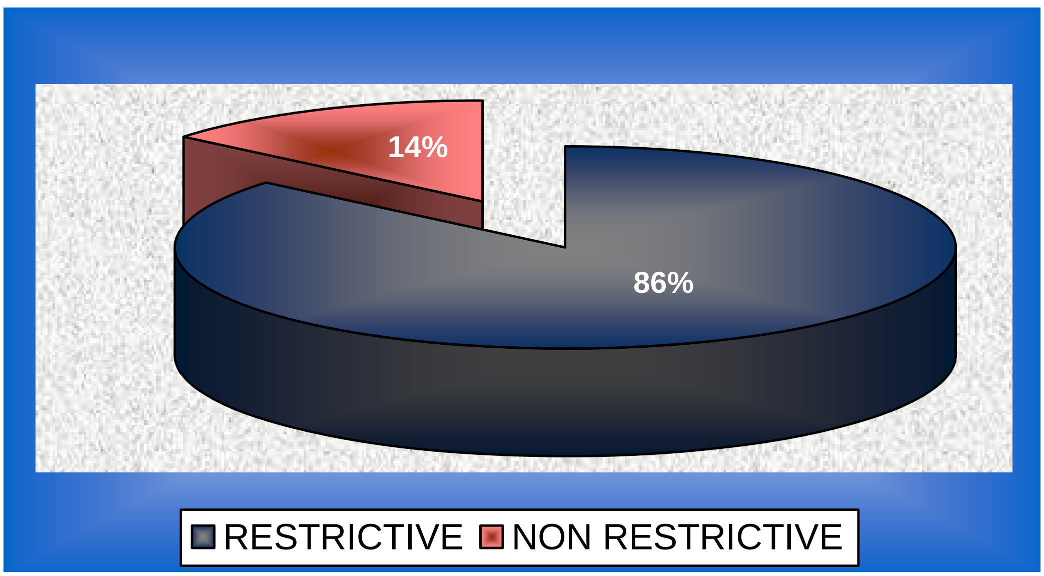


HEMODYNAMICS

Table 4: Type of Hemodynamics

Type of Hemodynamics	Cases	
	No.	%
Restrictive VSD	37	86.1
Nonrestrictive VSD	6	13.9
Total	43	100

HEMODYNAMICS



Most of the VSD operated were of restrictive physiology. The non-restrictive type included mainly the VSD of outlet type.

ASSOCIATED ANOMALIES

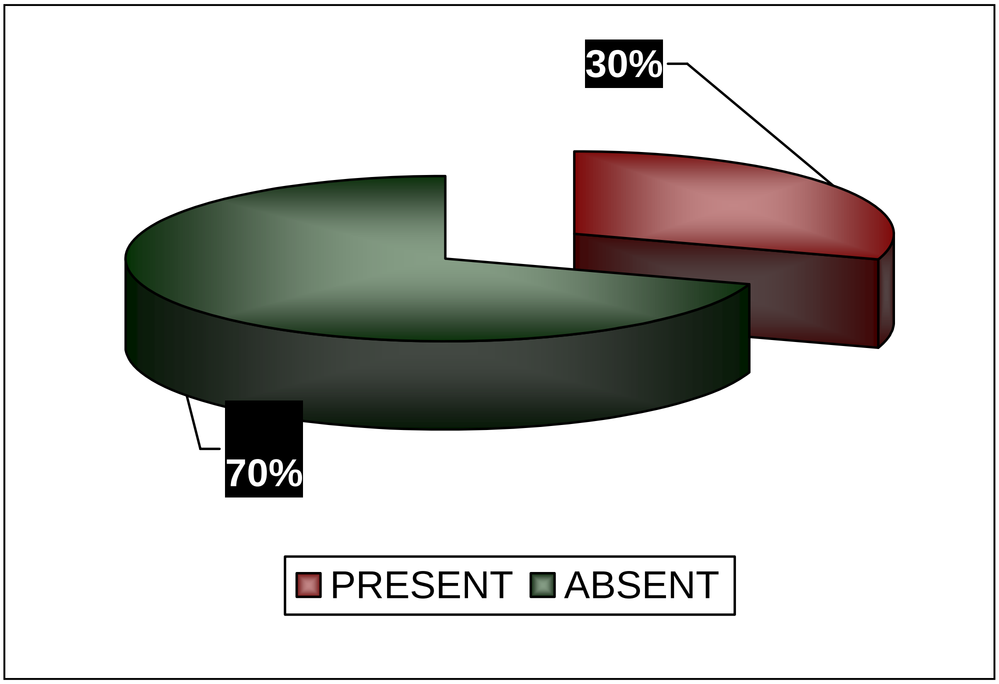
Table 5: Associated Anomalies

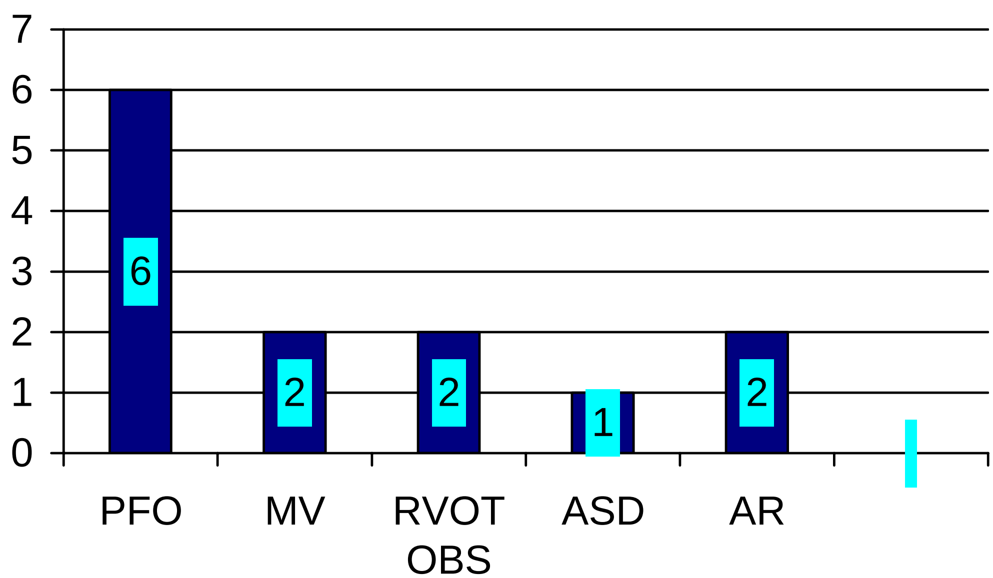
Associated Anomalies	Cases	
	No.	%
Present	13	30.2
Absent	30	69.8
Total	43	100

PFO	MV	RVOT OBS	ASD	AR
6	2	2	1	2

The commonest associated anomaly was congenital mitral valve abnormality, mainly cleft mitral valve and chordal prolapsed leading to significant mitral regurgitation requiring mitral valve repair. RVOT obstruction was due to hypertrophied RV muscle bundle which required division of the muscle bundle to relieve the obstruction. Two patients had significant aortic regurgitation due to aortic valve prolapse.

Anomalies





Associated Anomalies

Suturing Technique	cases

	No	%
Continuous	17	39.5
Interrupted	26	60.5
Total	43	100

SUTURING TECHNIQUE

Table 6: Suturing Technique

Suturing technique

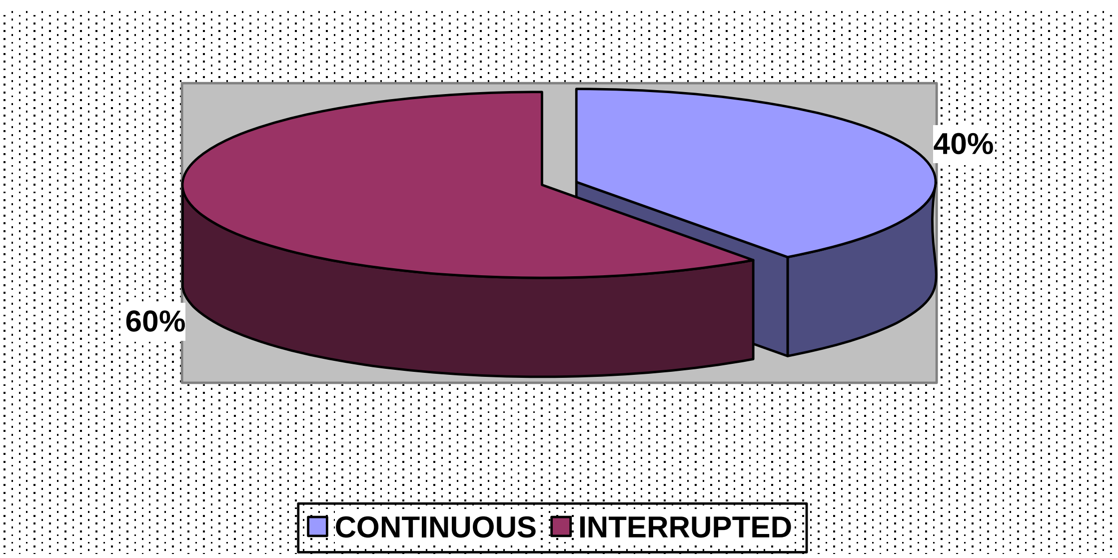
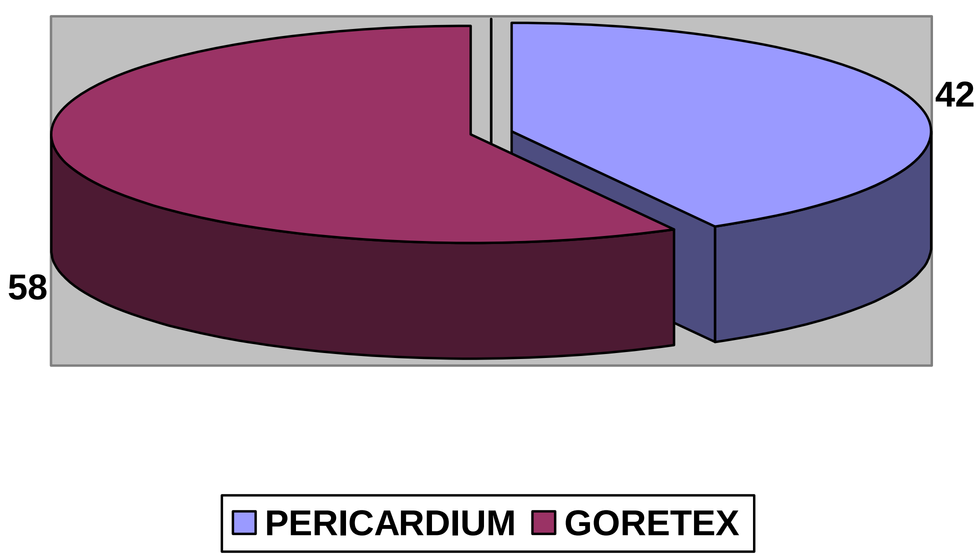


Table 7: Patch material used:

Patch material used:	**cases**	
	No:	**%**
Pericardium	18	42
Goretex	25	58
Total	43	100

Patch material



COMPLICATIONS

Table 8: Complication

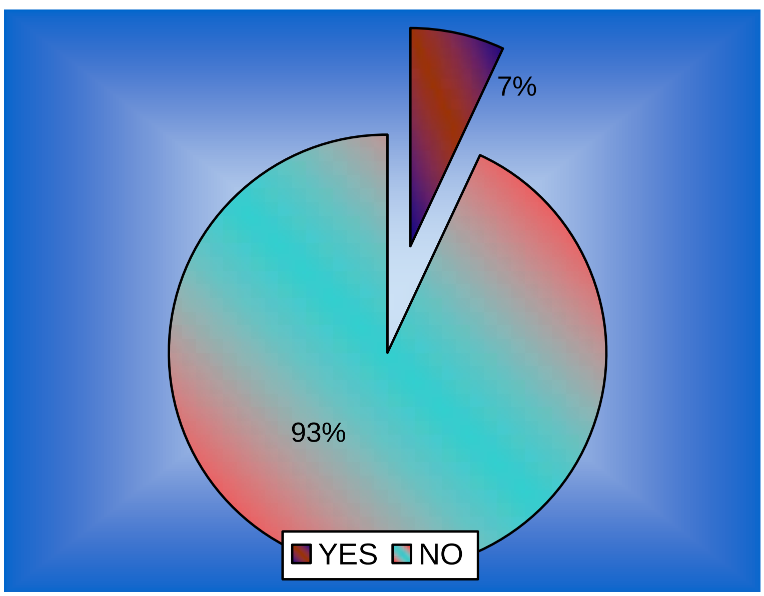
Complication	Cases	
	No:	%
Block	1	2.3
Stroke	2	4.7
IE	2	4.7
Renal failure	1	2.3
Residual Shunt	3	7
Other complications	14	32.5
Death	3	6.9
Total cases with complications	24	55.8
Total cases without complications	19	44.2
Total	43	100

Some cases had more than one complication.

Table 9: Residual shunt

Residual shunt	Cases	
	No	**%**
Yes	3	7
No	40	93
Total	43	100

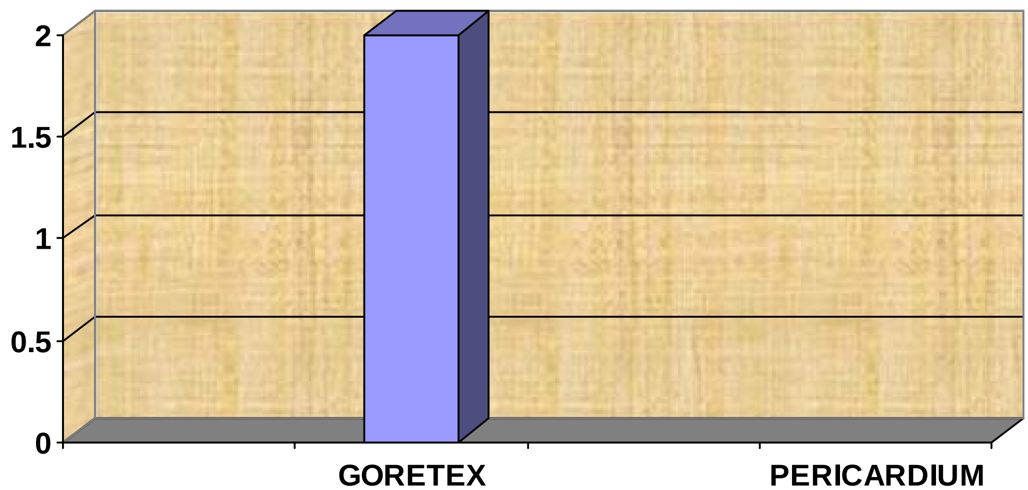
Residual shunt



	Cases

	Continuous	Interrupted
Residual shunt	1	2
Infective endocarditis	0	2

INFECTIVE ENDOCARDITRIS

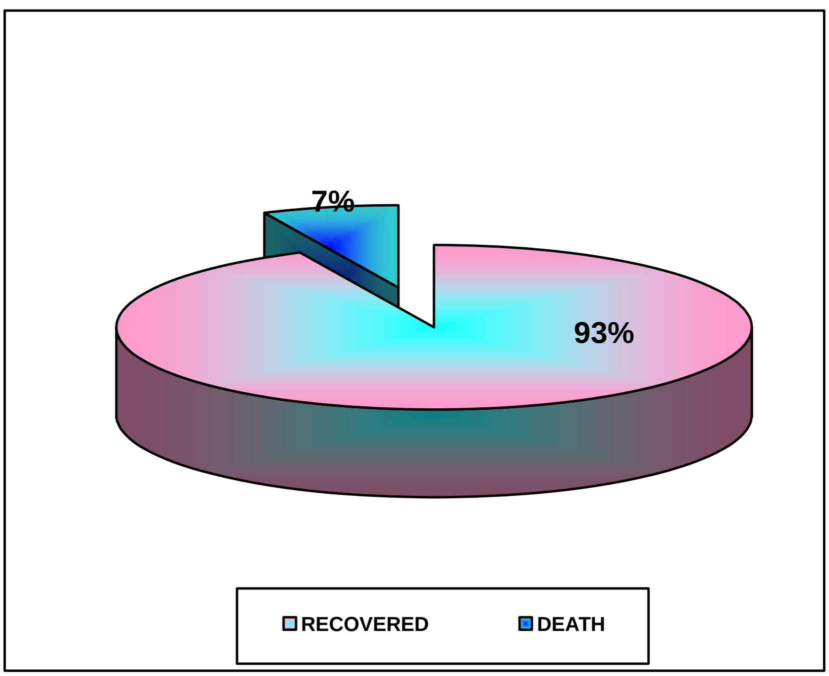


Two patients had infective endocarditis in Gore–tex patch group. Residual shunt was present in three patients; none of them significant enough to warrant re–exploration and closure one patient had nodal rhythm in gore-tex patch group and received temporary pacing, they recovered after one week.

Table – 10 Outcome

Outcome	Cases	
	No	**%**
Recovered	40	93
Death	3	**7**
Total	43	100

Outcome



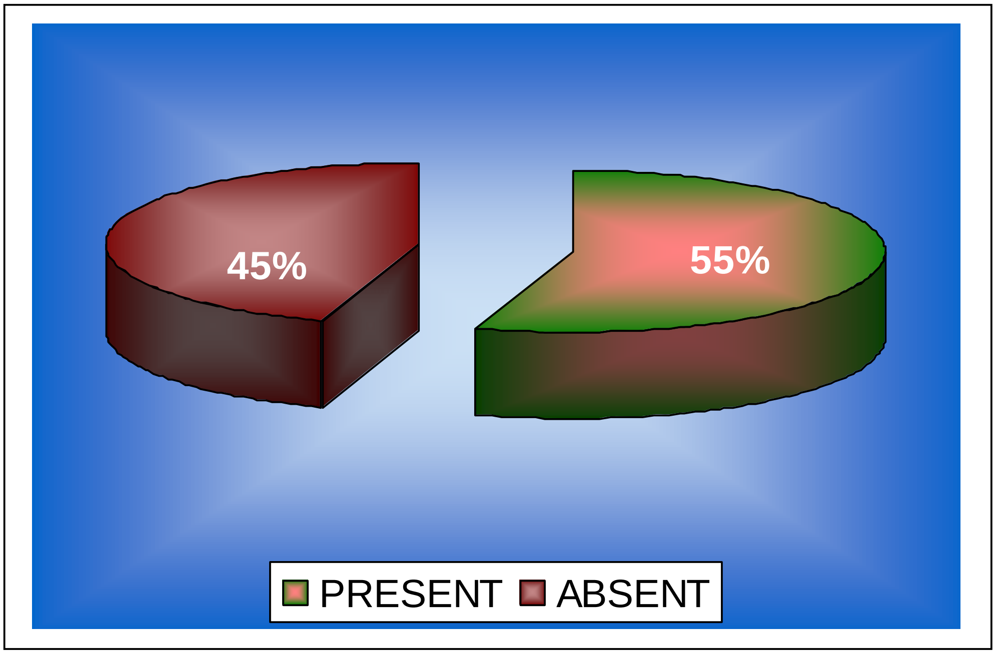
RECOVERED -DEATH

B. RELATIONSHIP BETWEEN OUTCOME AND OTHER VARIABLES

Table 11: Age and Outcome:

Age group	**Outcome**			
	Recovered		**Death**	
	No.	**%**	**No.**	**%**
Upto 5 yrs (3)	2	67	1	33%
6-10 yrs (19)	18	94.7	1	5.3%
11-15 yrs (14)	13	92.9	1	7.1%
16-20 yrs (6)	6	100	-	-
>20 yrs (1)	1	100	-	-
Mean Age S.D.	11.48 5.29		9.0 4.0	
'p'	0.434 Not significant			

Complications



Age and outcome

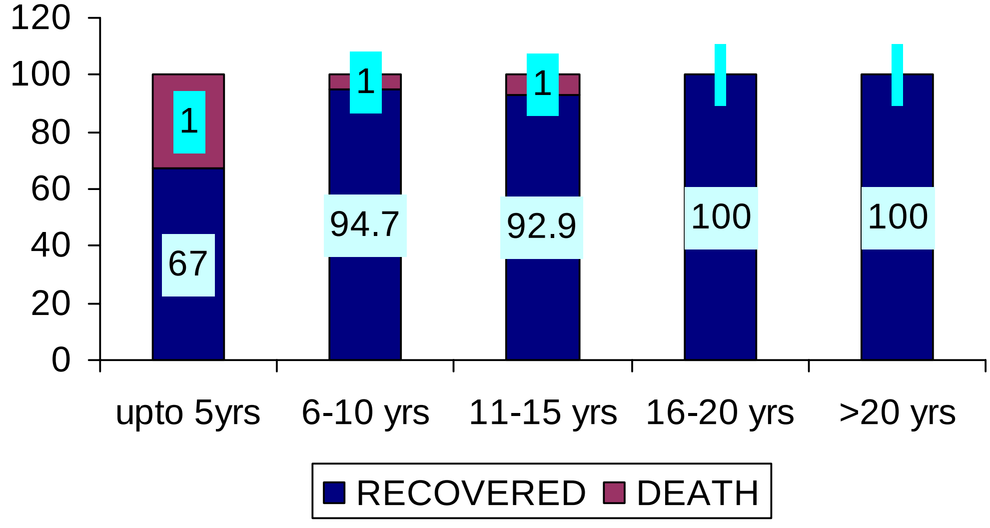


Table 12: Sex and outcome

Sex	Outcome			
	Recovered		Death	
	No.	%	No.	%
Male (20)	19	95.0	1	5.0
Female (23)	21	91.3	2	8.7
'p'	0.897 Not significant			

Sex and outcome

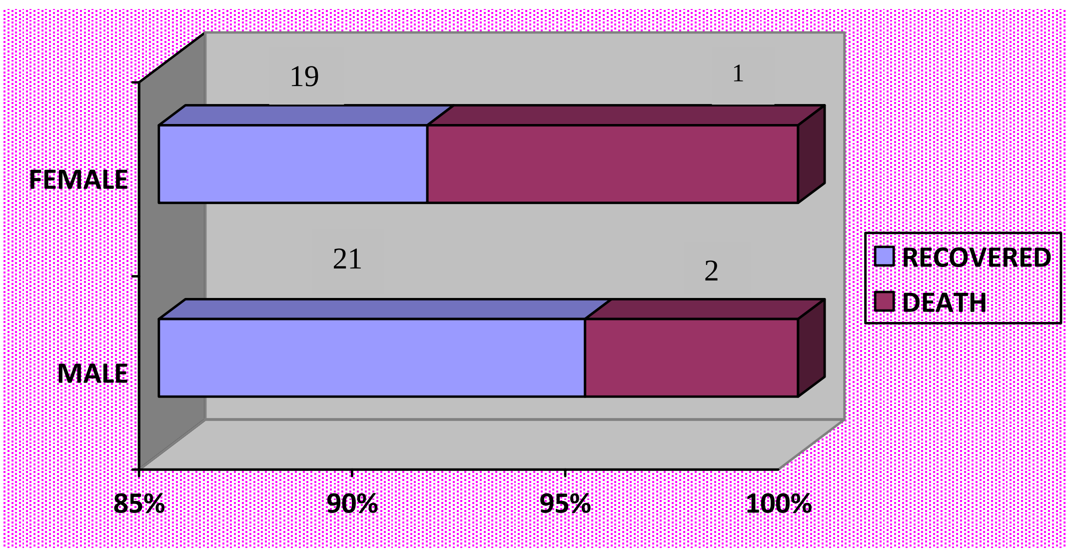


Table 13: Diagnosis and outcome

Diagnosis	Outcome			
	Recovered		Death	
	No.	%	No.	%
Subpulmonic (8)	7	87.5	1	12.5
Subaortic (14)	13	92.9	1	7.1
PM (20)	19	95	1	5
Inlet (1)	1	100	-	-
Total			3	

Diagnosis and outcome

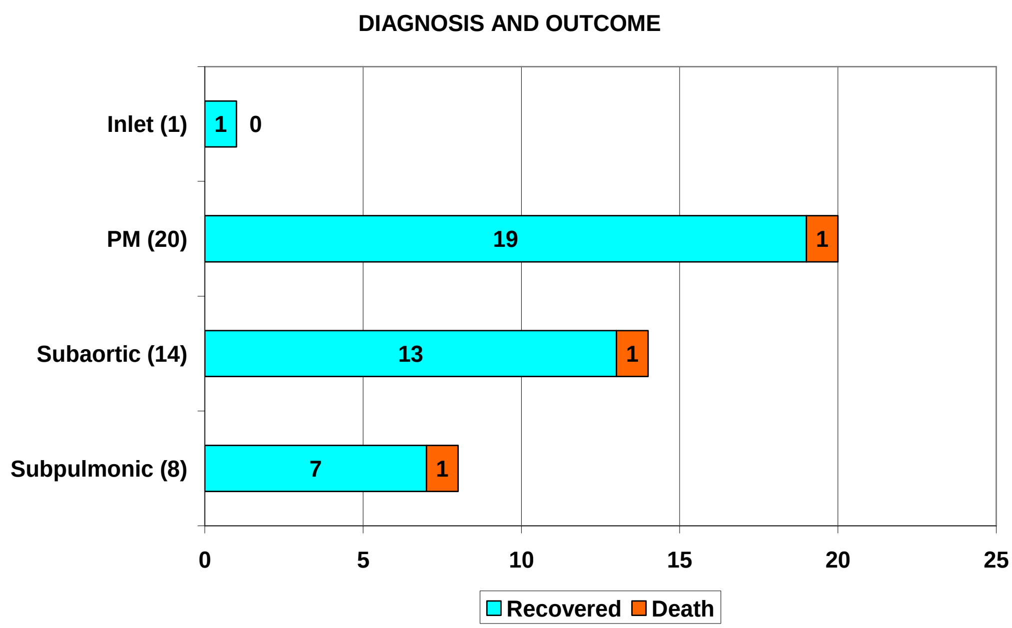


Table 14: Other variables and outcome

Variable	Outcome			
	Recovered		Death	
A. Type of VSD				
Outlet (22)	20	91	2	9
Perimembranous (21)	20	95	1	5
B. Patch Material				
Pericardium (18)	17	94.4	1	5.6
Goretex (25)	23	92	2	8

Variable	Outcome				'p'
	Recovered		Death		
	No.	%	No.	%	
A. Type of Hemodynamics					
Restrictive VSD (37)	35	94.6	2	5.4	0.898 Not significant
Non Restrictive VSD (6)	5	83.3	1	16.7	
B. Anomalies					
Present (13)	12	92.3	1	7.7	0.829 Not significant
Absent (30)	28	93.3	2	6.7	
C. Suturing Technique					
Continuous (17)	16	94.1	1	5.9	0.856 Not significant
Interrupted (26)	24	92.3	2	7.7	
D. Residual Shunt					
Yes(3)	3	100	-	-	0.989 Not significant
No(40)	37	92.5	3	7.5	

Table 15: Complications and other variables

Variable	Complications				'p'
	Present		Absent		
	Yes	No	Yes	No	
A. Type of Hemodynamics					
Restrictive VSD (37)	20	54.1	17	45.9	0.756 Not significant
Non Restrictive VSD (6)	5	83.3	1	16.7	
B. Anomalies					
Present (13)	10	76.9	3	23.1	0.499 Not significant
Absent (30)	14	46.7	16	53.3	
C. Suturing Technique					
Continuous (17)	6	35.3	11	64.7	0.351 Not significant
Interrupted (26)	18	69.2	8	30.8	

Table 16: Complications and other variables

Variable	Complications			
	Present		Absent	
	No.	%	No.	%
A. Type of VSD				
Outlet (22)	12	54.5	10	45.5
Perimembranous (21)	12	57.1	9	42.9
B. Patch Material				
Pericardium (18)	10	46.7	8	44.4
Goretex (25)	14	56	11	44

Table 17: Patch Material and Residual Shunt

Patch Material used	Residual shunt			
	Yes		No	
	No.	%	No.	%
Pericardium (18)	1	5.6	17	94.4
Goretex(25)	2	8	23	92
	3		40	

Table 18: Type of VSD and Residual Shunt

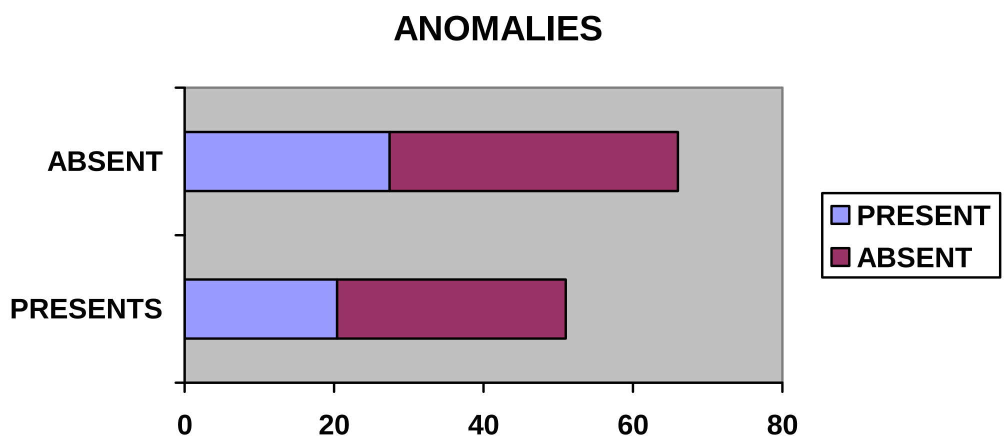
Type of VSD	Residual shunt			
	Yes		No	
	No.	%	No.	%
Outlet (22)	2	9	20	91
Perimembranous(21)	1	4.8	20	95.2

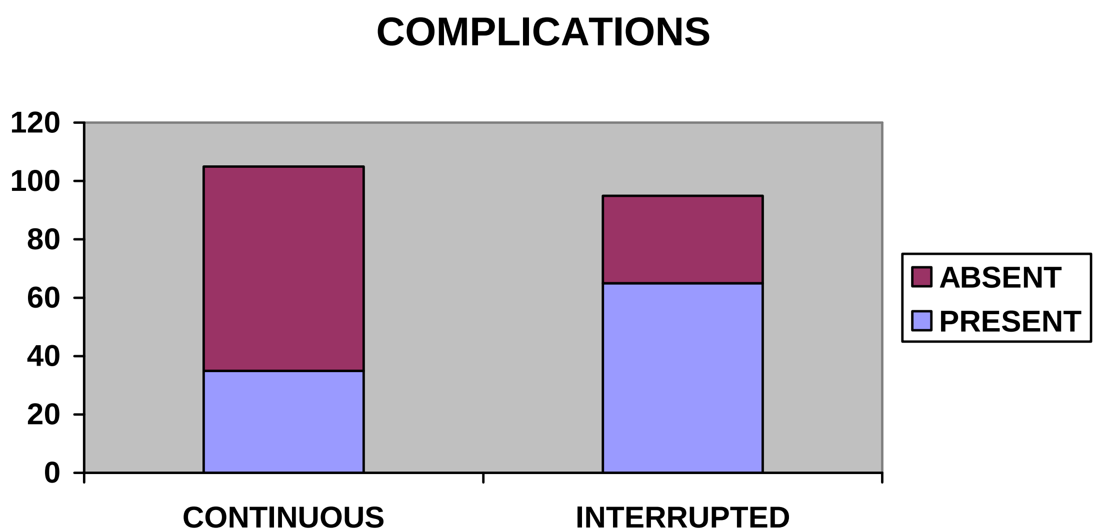
Table 19: Type of Hemodynamics and Residual Shunt

Type of Hemodynamics	Residual shunt			
	Yes		No	
	No.	%	No.	%
Restrictive (37)	1	2.7	36	97.3
Non Restrictive (6)	2	33.3	4	66.7
	0.747 Not significant			

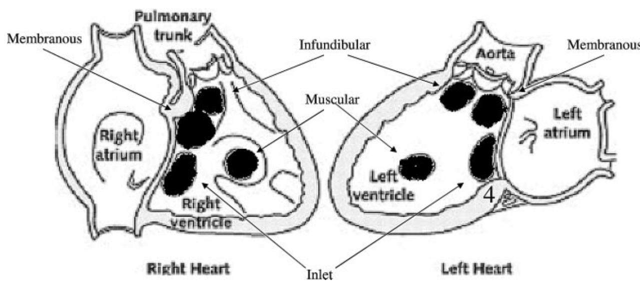
Table 20: Patch Material and Suture Techniques

Patch Material used	Suture Techniques			
	Continuous		Interrupted	
	No.	%	No.	%
Pericardium (18)	10	55.6	8	44.4
Goretex (25)	7	28	18	72


ANOMALIES
ABSENT
PRESENTS
0
20
40
60
80
PRESENT
ABSENT

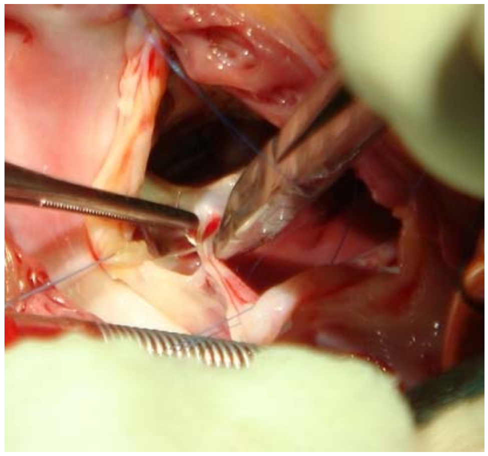

COMPLICATIONS
120
100
80
60
40
20
0
CONTINUOUS
INTERRUPTED
ABSENT
PRESENT

Positions of VSD

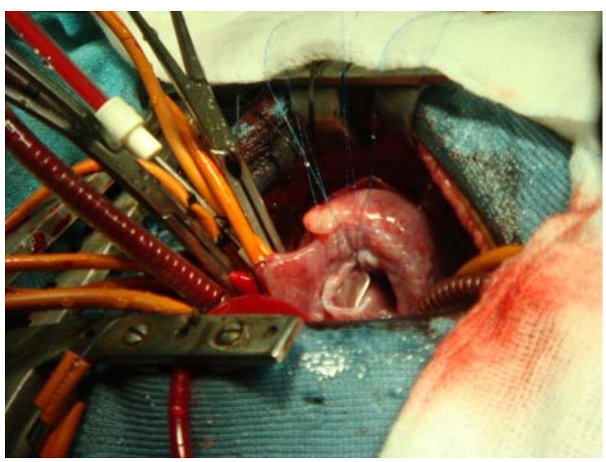


Perimembranous VSD

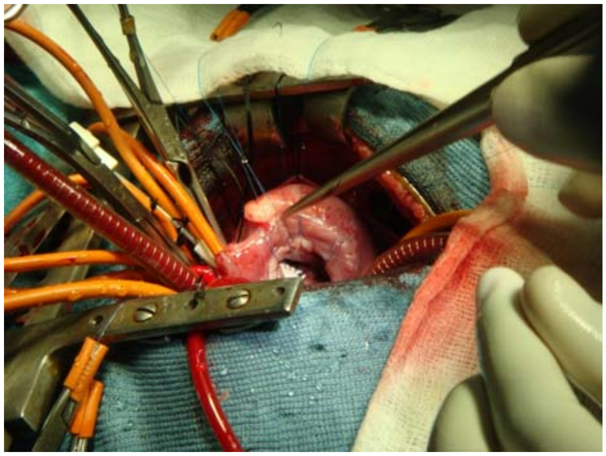
Going around chordae



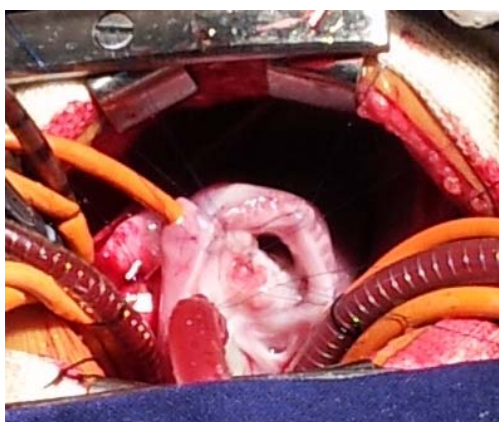
Delivery of patch into VSD after 1st stitch



Travel on patch in continuous suturing technique



PM VSD closure with pericardial patch



DISCUSSION

A total of 43 patients were recruited for this study, Out of these 17 had VSD repair using continuous and 26 had repair using interrupted suture technique.

Continuous suture technique was employed in forty percent of the study group. For most of patient in this group, pericardial patch was applied. Glutaraldehyde treated pericardial patch was more flexible and had better handling properties when compared to Gore-tex patch, for ease of surgery. For the remaining patients, interrupted suture technique was used and most of them were from goretex group. They were mainly operated upon by a professor, during the study.

Twentyfive patients had VSD repair using Goretex patch and eighteen patients had VSD closure using glutaraldehyde treated autologous pericardial patch.

Congenital mitral valve abnormality was the commonest associated anomaly, mainly chordal prolapse and cleft mitral valve with significant mitral regurgitation requiring repair. AML cleft was closed with 5-0 polypropylene sutures and the chordal shortening was done.

The commonest VSD was outlet type which comprises fifty one four percent of the study population. Perimembranous type comprises forty nine percent in the study population.

Trans-atrial approach was used for most of the patients. Two patients requiring aortic valve repair were approached through aortic exposure, MV repair was done through inter atrial septal approach.

One patient had nodal rhythm in Goretex patch group with Interrupted suture technique and temporary pacing was done, but recovered after 6 days. Residual shunt was present in three patients, but none of them are significant for re exploration.

Infective endocarditis was noted in two patients in Goretex patch group with interrupted sutures.

Aortic valve prolapse with aortic regurgitation was noted in two patients. Through transaortic route they are approached and modified Trussler's repair was done to correct the prolapsed right coronary cusp. RVOT obstruction was commonly due to RV muscle bundle hypertrophy, the obstruction was relieved by dividing the muscle bundle. Two patients had anomalous muscle bundle in RV which was excised. PFO were closed.

One patient suffered neurological deficit in the immediate post operative period. Definite areas of infarct was noted in CT scan of brain, but the patient recovered successfully. Patient regained full functional recovery after a period of two months.

Two patients had prerenal failure in the postoperative period and conservatively managed. In three days period, his renal parameters returned to normal base line.

Two patients from the interrupted suture technique group with goretex patch had infective endocarditis and were successfully treated for three weeks with antibiotics based on culture reports.

Three patients died in the immediate post operative period, of which two died of postoperative cardiac failure and one died due to pulmonary hypertensive crisis.

Residual shunt was noted in three patients. No patient warranted re-exploration. Two patients were from the continuous suture technique group with Goretex patch, irrespective of the type of VSD.

LIMITATIONS

This study is limited by its non-randomized nature and the inherent limitations of non-randomized studies. Only those patients who were referred for surgery and underwent surgical repair were reviewed. Indications for surgery are based on the retrospective review of the referring cardiologist's clinical notes and the surgical preoperative note. Although this study did not address long term follow up for these patients, long-term survival and clinical outcomes for patients after surgical closure of isolated VSD are consistently excellent, and we would anticipate the same for this study population. In addition, we intentionally excluded patients with multiple VSDs. We recognize that patients with multiple VSDs can be a challenging group for surgical repair. However, the focus of this study was patients with isolated, single VSD.

CONCLUSION

Continuous and interrupted suture techniques are equally effective in closure of ventricular septal defect. Eventhough residual shunt is common with continuous suture techniques in VSD closure, 7 percentage cases of residual shunt occurred in interrupted suture techniques in our institutions which is statistically insignificant.

Incidence of infective endocarditis is slightly higher in interrupted when compared to continuous suture techniques in our institutions, could be explained by more number of pledgets used in interrupted technique which is also statistically insignificant.

Because of the small number of groups included in our study, we are unable to come to conclusion and suggesting large randomized control study to ascertain this.