

Original Article

Surgical Closure of ASD's and Concomitant Procedures Needed in Adults: A 3-Year Cardiac Centre Experience

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Abstract

Objective The study aims to evaluate the surgical closure of Atrial Septal Defect (ASD) and concomitant surgical procedures needed at Cardiac Care Centre. **Introduction** An ASD is a hole of variable size in the atrial septum. A patent foramen ovale that is functionally closed by overlapping of limbic tissue superiorly and the valve of the fossa oval inferiorly (in response to the normal left-to-right atrial pressure gradient) is excluded. ASDs generally permit left-to-right shunting at the atrial level. Partial anomalous pulmonary venous connection (PAPVC) is a condition in which some but not all pulmonary veins connect to the right atrium or its tributaries, rather than to the left atrium. **Methodology** A prospective cohort study was done at Tabba heart institute. 115 consecutive patients were reviewed and investigated. All the patients with surgical closure of ASD and concomitant surgical procedures who returned for follow-up from June 2011 to May 2016 in the study were included as population sample. **Results** Total ASD repair only patients were 80 and patients who needed concomitant procedures too were 35. The size of the defect ranged from 3mm to 58mm, with a mean of 26.96 ± 11.02 mm. The relative frequencies of different ASDs were secundum 57 (80.2%), primum 4 (5.6%), and sinus venosus 10 (14.08%). Major post-operative complications by Age group and by procedure were evaluated and presented. **Conclusion** It was concluded from our results that surgical repair of atrial septal defects and its variants is associated with very low morbidity in different age groups due to its excellent results.

Keywords

Surgical Closure, Atrial Septal Defect Repair, Partial Anomalous Pulmonary Venous Connection, Cardiopulmonary Bypass Duration, Aortic Cross Clamp Time.

Introduction

An atrial septal defect (ASD) is a hole of variable size in the atrial septum. A patent foramen ovale that is functionally closed by overlapping of limbic tissue superiorly and the valve of the fossa oval inferiorly (in response to the normal left-to-right atrial pressure gradient) is excluded. ASDs generally permit left-to-right shunting at the atrial level. Partial anomalous pulmonary venous connection (PAPVC) is a condition in which some but not all pulmonary veins

connect to the right atrium or its tributaries, rather than to the left atrium. The term connection is preferred to the term "return," because the connection is anatomic and return is governed by hemodynamic factors. PAPVCs may occur as isolated anomalies or may be combined with ASDs. Atrial septal defect (ASD), one of the congenital heart diseases found in 33% of the adults with coronary heart disease (CHD). ASD's are frequent in females and can be found at any age and can be missed in childhood due to

the low severity of symptoms. Signs and early symptoms of ASD depend upon the size of ASD and reverse shunting whereas big sized ASDs can be presented in infancy or later with heart failure signs (Shibata, Y., et al, 1996). Increasing signs and symptoms of untreated ASD can lead to early death in middle-aged adults. The clinical course of this congenital disease is slow as compared to most of other congenital heart diseases. It has been observed that adults with ASD's and preoperative arrhythmias usually don't revert to normal sinus rhythm and chances of new onset of arrhythmia are around 8% in middle-aged patients (Nasrallah, A. T., et al, 1976). ASD has been surgically repaired for almost more than half century. When ASD is closed surgically, the aim is reversal of hemodynamic abnormalities thus preventing heart failure and irreversible obstructive changes in pulmonary vasculature which makes improvement in patient symptoms. Surgery for ostium secundum and sinus venosus ASDs performed before the age of 25 could be considered effective as it is without significant residual lesions. It has been shown in various studies that surgical closure of ASD has good immediate postoperative and long-term results (Horvath, K. A., et al 1992). In addition, all studies conclude that surgery is the most beneficial medical treatment for patients with grave symptoms, but still, the data is not convincing for patients who are less symptomatic (Vecht, J. A., et al, 2010).

The current study reviewed data of 115 patients who had undergone isolated surgical repair of ASD, to investigate the presentation and outcomes according to the type of ASD including the three major forms: ostium secundum, ostium secundum and sinus venosus (with or without partial anomalous pulmonary venous connection)

and its concomitant surgical treatment needed (Helber, U., et al, 1997).

Methodology

A prospective Cohort Study, the data was collected prospectively throughout their hospital course. 115 consecutive patients were reviewed and investigated. All the patients with surgical closure of ASD and concomitant surgical procedures who returned for follow-up from June 2011 to May 2016 at the Tabba Heart Institute, Karachi were included in the study. The diagnosis was established on trans-thoracic echocardiography. Pre-operatively, type and size of the ASD was assessed. The presence of any residual ASD of >2mm shunt via a post-op echo was considered significant. All the procedures have been done using median sternotomy followed by cardiopulmonary bypass using bi-caval cannulation. Antegrade cold blood or crystalloid cardioplegic solutions were used. The method of closure was decided according to the type of ASD. Isolated ASDs (ostium secundum only) underwent autologous pericardial patch closure, while bovine pericardium and PTFE patches with Prolene 4/5-0 suture were also used primarily for sinus venosus ASD's. Partial anomalous pulmonary drainage was also corrected in the required cases and superior vena cava correction was carried out using warden's procedure.

Results

Total number of patients was 115, out of those 47 (41%) were males and 68 (59%) were females. The mean age at operation was 34.08 ± 14.28 years. Total ASD repair only patients were 80 and patients who needed concomitant procedures too were 35. The size of the defect ranged from 3mm to 58mm, with a mean of 26.96 ± 11.02 mm. The relative frequencies of different ASDs were

secundum 57 (80.2%), primum 4 (5.6%), and sinus venosus 10 (14.08%). Primary Pre-Operative, Operative and Post-Operative data results are presented in Table 1.

The mean cardiopulmonary bypass (CPB) time was 74.12 ± 37.77 minutes and mean aortic cross clamp time was 53.77 ± 31.01 minutes. After each surgery, a post-operative echo was done on 3rd Post-operative day to check for the presence of any haemodynamic abnormality or for any residual patch defect (significant $>2\text{mm}$). There were no cases in which the residual patch shunt was found. Major post-operative complications and frequencies were also reviewed. There was no mortality in

patients' undergone ASD repair only. There was 2 (2.5%) case of atrial fibrillation in ASD repair only which were managed medically. Patients who developed pericardial and pleural effusion were treated by tube thoracostomy. The patients who underwent isolated ASD repair showed minimal complications and morbidities whereas only 1 patient were reopened for bleeding. There was 2(1.7%) case of complete heart block which resolved spontaneously. Major post-operative complication by Age group and by procedure were evaluated and presented in Table 2 and 3 respectively.

Table - 1: Primary Pre-Operative, Operative and Post-Operative data(n=115)

Variable	Mean \pm SD
Preoperative	
Height (cm)	158.25 \pm 9.75
Weight (kg)	59.16 \pm 18.46
Age (years)	34.08 \pm 14.28
Age Group	
< 25 Years	39 (33.9%)
25-40 Years	37 (32.2%)
> 40 Years	39 (33.9%)
Gender	
Male	47 (40.9%)
Female	68 (59.1%)
Operative	
CPB Time (min)	74.12 \pm 37.77
Aortic Cross Clamp Time (min)	53.77 \pm 31.01
Procedure	
ASD only	80 (69.6%)
Valve + ASD	28 (24.3%)
CABG + ASD	7 (6.1%)
Post OP Variables	
Length of CICU stays (Hrs)	23.17 \pm 9.86
Length of Hospital Stay (Days)	4.81 \pm 1.41
Post-Operative Results	
Complication (on-patient basis)	15 (13%)
ASD requiring Reoperation	3 (2.6%)

ASD: Atrial Septal Defect. CPB: Cardiopulmonary Bypass.

Table – 2: Major post-operative complication by Age group

Morbidity	< 25 Years n=39	25-40 Years n=37	> 40 Years n=39	Over all
Re-Operative	-	-	3 (7.7%)	3 (2.6%)
Ventilation Support > 24 Hrs	-	-	7 (17.9%)	7 (6.1%)
Atrial Fibrillation	-	1 (2.7%)	5 (12.8%)	6 (5.2%)
Ventricle Tachycardia	-	1 (2.7%)	1 (2.6%)	2 (1.7%)
Complete Heart Block	1 (2.6%)	1 (2.7%)	-	2 (1.7%)
Heart Failure	-	1 (2.7%)	1 (2.6%)	2 (1.7%)
Cardiac Arrest	-	1 (2.7%)	2 (5.1%)	3 (2.6%)
Inotropic Support > 24 Hrs	1 (2.6%)	-	7 (17.9%)	8 (7%)
Mortality	-	1 (2.7%)	2 (5.1%)	3 (2.6%)

*n (%)

Table - 3: Major post-operative complication by Procedure

Morbidity	ASD n=80	Valve + ASD n=28	CABG + ASD n=7	Over all
Re-Operative	1 (1.3%)	1 (3.6%)	1 (14.3%)	3 (2.6%)
Ventilation Support > 24 Hrs	3 (3.8%)	3 (10.7%)	1 (14.3%)	7 (6.1%)
Atrial Fibrillation	2 (2.5%)	3 (10.7%)	1 (14.3%)	6 (5.2%)
Ventricle Tachycardia	-	1 (3.6%)	1 (14.3%)	2 (1.7%)
Complete Heart Block	-	2 (7.1%)	-	2 (1.7%)
Heart Failure	-	1 (3.6%)	1 (14.3%)	2 (1.7%)
Cardiac Arrest	-	2 (7.1%)	1 (14.3%)	3 (2.6%)
Inotropic Support > 24 Hrs	3 (3.8%)	4 (14.3%)	1 (14.3%)	8 (7%)
Mortality	-	2 (7.1%)	1 (14.3%)	3 (2.6%)

*n (%)

Discussion

There are 3 major types of ASDs or interatrial communications: ostium secundum, ostium primum, and sinus venosus defects. The ostium secundum is a true defect of the atrial septum and involves the region of the fossa ovalis. The ostium primum defect is within the spectrum of the atrioventricular (AV) septal defects, the complete form of which also includes a large ventricular septal defect and a common AV valve (Swan, L., & Gatzoulis, M. A., 2003). The sinus venosus defect is usually

located at the junction of the right atrium and superior vena cava and is almost always associated with partial anomalous pulmonary venous return. Two very uncommon types of ASDs may be mentioned briefly: the inferior vena cava form of the sinus venosus defect and the coronary sinus septal defect (in which a defect between the coronary sinus and the left atrium allows a left-to-right shunt to occur through an “unroofed” coronary sinus). ASDs are common and can present at any age. Females constitute 65% to 75% of

patients with secundum ASDs, but the gender distribution is equal for sinus venosus and ostium primum ASDs. Down syndrome is associated primarily with AV septal defects, but secundum defects also occur with increased frequency (Swan, L., & Gatzoulis, M. A., 2003). Approximately 40% of subjects with Down syndrome have congenital heart disease. Of these, 40% have an AV septal defect, usually the complete form. Ostium primum ASDs may also be associated with DiGeorge syndrome and Ellis-Van Creveld syndrome.

Adults with AV septal defects have an approximate 10% risk of recurrence of heart disease in their offspring. ASDs are the most common cardiac manifestation of Holt-Oram syndrome, which has been shown to be caused by mutations of TBX5.3. The familial forms of secundum ASDs have also been associated with GATA4 and NKX2.5 mutations. Conduction abnormalities are very common among them. The superior form of the sinus venosus ASD constitutes 5% to 10% of all ASDs. Its posterior aspect is the right atrial free wall, and its superior border is often absent because of an overriding superior vena cava. Anomalous connection of some or all of the right pulmonary veins to the SVC or the right atrium is very common. Diagnosis is often more difficult than for other forms of ASD and may require special imaging, such as transesophageal echocardiography, magnetic resonance imaging (MRI), and computed tomographic scanning, and the possibility of a sinus venosus ASD should be considered for any patient with unexplained right atrial and right ventricular dilation. Catheter closure is not possible, and the treatment is surgical.

The individuals with atrioventricular Septal Defects shared the anomalies of a common

AV junction with abnormalities of the AV valves (separate valves in partial AV septal defect, common AV valve in the complete form). The left AV valve is trileaflet composed of the mural leaflet and the inferior and superior leaflets, which are fused and point toward the left ventricular outflow (“11th hour”). The distance from the left AV valve annulus to the left ventricular apex is appreciably less than that from the apex to the aortic annulus, whereas normally the 2 distances are equal.

This inlet to outlet disproportion creates the characteristic “gooseneck deformity” that used to be a major diagnostic feature on left ventriculography. Furthermore, this elongation of the left ventricular outflow tract, combined with the fact that there are chordal attachments of the left AV valve to the ventricular septum in these patients, forms the basis for the development of discrete sub-aortic obstruction, which may occur even late after successful repair of the defect (Ghosh, S., et al, 2002). The abnormal AV junction results in an “unwedged” aorta and leads to a displacement of the AV conduction tissue, which in turn produces the characteristic left-axis deviation and predisposes these patients to heart block. The most common associated anomalies are a secundum ASD and a persistent left SVC draining into the coronary sinus.

Most primum ASDs are relatively large and lead to right heart dilation. Because of the trileaflet nature of the left AV valve (the so-called cleft mitral valve), variable degrees of valvular regurgitation are exceedingly common, whereas valvular stenosis is rare (Masura, J., et al, 1997). A parachute type or double-orifice “mitral” valve may be present and may have prognostic implications. Depending on the severity of dysfunction of

the left AV valve, patients with ostium primum ASDs may become symptomatic at a much younger age than patients with other types of ASDs. Surgical repair includes closure of the interatrial communication and restoration or preservation of left AV valve competence. The magnitude of and direction of flow through any ASD depend on the size of the defect and the relative diastolic filling properties of the left and right ventricles (Kreutzer, J., et al, 1999). Conditions that cause reduced left ventricular compliance (e.g. left ventricular hypertrophy or scarring) and mitral stenosis will increase left-to-right shunting. Conditions that cause reduced right ventricular compliance (e.g. pulmonary hypertension or pulmonary stenosis) and tricuspid stenosis will have the opposite effect of reducing a left-to-right shunt and/or causing a right-to-left shunt.

As a rule, an ASD must be at least 10 mm in diameter to carry a significant left-to-right shunt, although most ASDs are not circular, and maximum diameter may be difficult to measure accurately. A left-to-right atrial shunt is considered significant when the Qp/Qs ratio is greater than 1.5/1.0, or if it causes dilation of the right heart chambers. Although there are limitations in estimating Qp/Qs with any method, this level of shunting is usually associated with right heart dilation and has been associated with adverse long-term outcomes (Speechly-Dick, M. E., et al, 1993). ASD leads to the volume overload due to interatrial opening that leads to further dilatation of the right ventricle and increases pulmonary pressure. The effect on life is variable, but most of the cases progress to right ventricular dysfunction and cardiac insufficiency. Surgical repair remains the standard for closure of secundum ASD. Typical surgical ASD closure offers excellent results with a very low operative mortality and morbidity

(Butera, G., et al, 2006). It has been shown in various studies that Long-term follow-up after surgical closure is excellent if the closure has been done until second decade of life or before the onset of severe symptoms of pulmonary hypertension. Size and location of the ASD; haemodynamic impact of the left-to-right shunt and associated right-sided cardiac volume overload; and the presence and degree of pulmonary hypertension are the factors on which the decision of repairing the ASD has been made (Murphy, J. G., et al, 1990). Recent Advances in ASD closure are transcatheter closures provide less complications and short hospital stay but device dislocation and embolization is the catastrophe which requires emergency surgery for retrieval of device and repair of the defect (Kreutzer, J., et al, 1999; Cowley, C. G., et al, 2001).

In our study most of the patients had been unsuitable for device closure as they have deficient inferior rims, or the size of ASD was too large. We compared the outcomes of 71 patients. There were no deaths in the patients who underwent ASD closure only. This study clearly shows that the younger patients had less morbidity and complications as compared to the patients aged >25. It is suggested in studies that surgery should be performed in the younger age group and probably before structural changes in the myocardium or pulmonary vasculature occur. We found that hemodynamic and electrophysiological results of the surgical repair of ASD's after the age of 25 years are suggestively poorer to those who underwent surgery before this age. Closure is associated with extremely low morbidity and mortality in older patients and almost none in younger patients. Our study suggested that surgical repair of ASD has very low morbidity and mortality, as it is

very safe procedure with very good outcome.

Conclusion

We conclude from our results that surgical repair of atrial septal defects and its variants are associated with very low morbidity in different age groups due to its excellent results.

Conflict of Interest

N/A

Acknowledgement

N/A

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