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A Comparative Analysis of Pulmonary Artery Systolic Pressure Between the Preoperative and on the Postoperative Period of Surgical Closure of Atrial Septal Defect

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Abstract

Background: Atrial septal defect (ASD) is a common congenital disorder characterized by abnormal blood flow from the left atrium to the right atrium. This, in turn, causes histological changes in the pulmonary vasculature and ultimately results in pulmonary hypertension. Without surgical intervention, ASD can significantly reduce life expectancy and functional capacity. The aim of this study was to assess and compare the changes in pulmonary different after surgical closure of the atrial septal defect. **Material & Methods:** This observational study was done in the department of cardiac surgery, Bangabandhu Sheikh Mujib Medical University from June 2020 to June 2022. Sample size was 24 Patients were evaluated preoperatively, 1st week postop-erative period and after 6 weeks of operation through a clinically, ECG, color doppler echocardiography. The statistical analysis was performed by using SPSS version 26.0 for windows software. Statistical analysis was done with in paired t-test for comparing between preoperative and postoperative data, Chi-square test for categorical data, Wilcoxon signed ranks test for ordinal data, McNemar change test for nominal data. The observations were recorded as statistically significant when p-value became ≤0.05. **Results:** In my study, the mean age of the patients was 33.33±11.3 years, male female ratio was 1:2. The mean pulmonary artery systolic pressure got decreased from 57.54±7.9 mmHg to 53.29±8.30 mmHg on 1st week postoperative peri-od and 57.54±7.9 mmHg to 48.58±8.30 mmHg after 6 weeks of surgery, which was statistically significant. 75% patients improved into New York heart association class 2 on 1st week post operative period, 66.7% improved into class 1 after 6 weeks of surgery. Significant improvement was seen in functional capacity of the patients. 29.2% patients had atrial fibrilation preoperatively, after surgery on 1st week post operative period it became 25% and af-ter 6 weeks it became 4.2% which was statistically significant. **Conclusions:** ASD patients with pulmonary hypertension (PH) benefit from surgical closure, particularly in younger individuals. Advanced treatments and risk assessments

Keywords:- PASP, ASD, Surgical Closure.

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INTRODUCTION

Atrial septal defect (ASD) is the second most common congenital heart defect, occurring in approximately 1.6 out of every 1000 live births.1 It accounts for 10% to 15% of congenital heart defects in children and 20% to 40% of cases in adults.[1,2] Long-term complications associated with ASD include pulmonary hypertension (PH), right ventricular (RV) failure, atrial arrhythmias, and paradoxical emboli.[2,3] Women are affected twice as often as men.[4] Atrial septal defect can be influenced by maternal exposure to substances like alcohol, hydantoin, valproic acid, and amphetamines. Infections during pregnancy, such as cytomegalovirus or rubella, as well as conditions like dia-betes, older maternal age, multi-gestational births, and obesity, are also associated with ASD. Low-birth-weight and premature infants have a higher prevalence of ASD compared to the general population.[5]

During embryonic development, the common atrium in the heart is partitioned by the formation of two overlapping septa: the septum primum and the septum secundum. The septum primum originates from the roof of the common atrium and initiates the septation process. The ostium primum, a gap between the septum primum and the atrial floor, nearly closes as the septum primum develops. A new defect forms when a portion of the superior aspect of the septum primum resorbs, creating the ostium secundum. The septum secundum forms parallel to and immedi-ately rightward of the septum primum. Eventually, the fusion of the septum primum and the septum secundum forms the complete atrial septum. A flap from the foramen ovale, known as the septum primum, is also formed. After birth, increased left atrial pressure causes the flap to close.[6] Atrial septal defects can also be diagnosed in adulthood. In such cases, more than 60% of patients older than 40 years of age are classified as New York Heart Association (NYHA) class III to IV prior to ASD closure. However, after closure, more than 80% of patients im-prove to NYHA class I to II. A study involving 117 patients older than 60 years who underwent ASD closure showed an improvement in functional class, immediate and late reduction in pulmonary artery pressure, and increased survival rates at 5 and 10 years.[7,8] These findings suggest that ASD closure is beneficial regardless of age for most patients.

The majority of ASD patients do not experience symptoms and may only develop atrial fibrillation and congestive heart failure in later stages. Occasionally, children with large ASDs may exhibit dyspnea during extreme exertion, and recurrent respiratory infections are common.[9] Closure of ASD through surgery can improve the patient's functional status by reducing right ventricular volumes and pressures.[10] It may also lead to a slight reduction in left ventricular volumes and an improvement in left ventricular ejection fraction. Pulmonary hypertension is classified as mild (41–49 mmHg), moderate (50–59 mmHg), or severe (60 mmHg and above) based on pulmonary artery sys-tolic pressure (PASP) calculated through echocardiography. A PASP of 40 mmHg is considered normal.[11] The aim of this study was to assess the surgical intervention on pulmonary artery systolic pressure by comparing preoperative and postoperative measurements.

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Objectives: The objective of this study was to evaluate and compare the changes in pulmonary artery systolic pressure before and after a surgical procedure.

MATERIAL AND METHODS

This was an observational study and was conducted in the Bangabandhu Sheikh Mujib Medical University (BSMMU, Dhaka, Bangladesh during the period from June 2020 to June 2022.

A total of 24 patients who were male and female, aged 15 years above were included in the study. A standardized semi-structured data collection sheet was used to collect necessary information and face to face interview. Necessary information was collected by reviewing related medical reports. A semi structured questionnaire was developed in English. The questionnaire was developed using the selected variables according to the specific objectives. The questionnaire contained questions related to socio-demographic characteristics, preoperative and post-operative outcomes. A checklist was also developed to record desired variables from admission record, history sheet and related medical records. The preformed structured questionnaire and checklist was pre-tested on 5 patients. Data were checked immediately after completing interview and review of necessary investigation reports. All relevant data were collected from each respondent by use of an interview schedule, measured parameters, and investigations in a predesigned format. We included patient having secundum variety of atrial septal with pulmonary. All patients who admitted into the cardiac surgery department for surgical closure of ASD with pulmonary hypertension without exclusion criteria were taken for the study population. Patients who were fulfilled the inclusion criteria and willing to enroll in the study were included in the study after receiving the proper consent. All patients were operated through a median sternotomy approach. After completion of the surgery, all patients were transferred to intensive care unit (ICU). In ICU patients were monitored for heart rate and rhythm with continuous. Post-operatively patients were evaluated by color doppler echocardiography for pulmonary artery systolic pressure at 1st week POD and after 6 weeks, clinically for NYHA functional class, ECG for atrial fibrilation.

Statistical Analysis: All data were recorded systematically in preformed data collection form and quantitative data was expressed as mean and standard deviation and qualitative data was expressed as frequency distribution and percentage. Statistical analysis was carried out by using Statistical analysis was done by using SPSS (Statistical Package for Social Science) Version 26 for windows 10. P value <0.05 was considered as statistically significant. Ethical clearance was obtained from Institutional Review Board (IRB) of BSMMU to undertake the current study.

RESULTS

[Figure 1] the patients of PASP shows that 20.8% patients had systemic hypertension. The mean pulmonary artery systolic pressure of hypertensive patients was 57.8 mmHg and normotensive patient's was 57 mmHg.

[Table 2] postoperative outcomes showed that the mean duration of mechanical ventilation is

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5.29 ± 0.9 hours. This measure indicates the average amount of time patients required mechanical ventilation support following their sur-gery. The mean duration of ICU stay is 4.5 ± 0.5 days. This measure represents the average length of time patients spent in the Intensive Care Unit (ICU) after their surgery and the duration of hospital stays is 8.25 ± 0.79 days. This measure represents the average length of time patients remained in the hospital overall after their surgery. The mean age of the patient was 33.33 ±11.3 years.

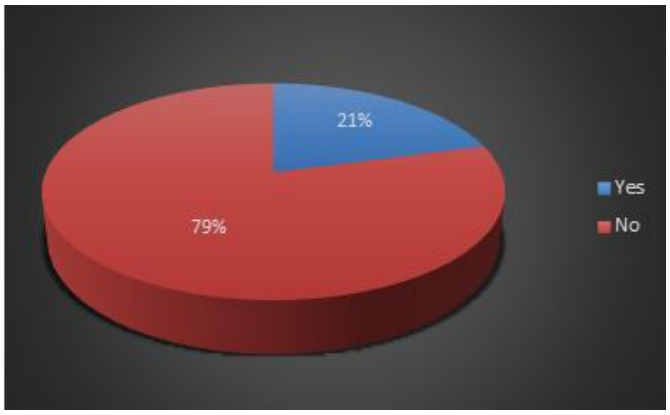

Figure 1: Comparison of PASP between hypertensive and normotensive patients.

[Table 3] clinical features shows that the preoperative period 8.3% patients were in NYHA functional class IV, 50% patients were in class III, 33.3% patients were in class II, 8.3% patient were in class I. On 1st wk post operative day, improvement in functional capacity had been observed, 75% patients were improved into NYHA class II, 12.5% in NYHA class I, least 12.5% remained in class III which was statistically significant. After 6 weeks 66.6% patients were improved into class I remaining 33.3% patients remained in class II. As for 29.2% patient had atrial fibrillation preoperatively and on 1st wk postoperative day it turned into 25% and after 6 weeks it decreased in 4.2%. On pre-operative period 50% patients had severe, 25% patients had moderate, 25% patients had mild pulmonary hyper-tension. On 1st wk post-operative day 41.7% patients labeled as moderate pulmonary hypertension, 29.2% as se-vere pulmonary hypertension, 29.2% as mild pulmonary hypertension. The mean preoperative PASP was 57.54 ±7.9 mmHg but in post operative day it decreased in 53.29 ±8.30 mmHg. Post operatively PASP was decreased but not statistically significant. After 6 weeks 29.2% patient's pulmonary hypertension became normal, 12.5% patients remained mild, 50% moderate and 8.3% patients remained severe pulmonary hypertension. The mean PASP re-duced from 57.54 ± 7.9 mmHg to 48.58 ±8.30 mmHg. Improvement was seen after 6 weeks which was statistically significant.

Table 1: Postoperative variables of the patients

Post-operative outcomes	**Mean**
Age	33.33 ± 11.3
Duration of mechanical ventilation	5.29 ± 0.9 hours
Duration of ICU stay (Days)	4.5 ± 0.5 days
Hospital stays (days)	8.25 ± 0.79 days

Table 2: Comparison between preoperative and post-operative data

Features		**Preoperative f (%)**	**1st week f (%)**	**P value**	**6 weeks f (%)**	**P value**
NYHA	I	2(8.3%)	3(12.5%)	0.001	16(66.7%)	0.001

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class	II	8(33.3%)	18(75%)		8(33.3)	
	III	12(50%)	3(12.5%)		0	
	IV	2(8.3%)	0		0	
Atrial fibrillation	Yes	7(29.2%)	6(25%)	1.00	1(4.2%)	0.031
	No	17(70.8%)	18(75%)		23(95.8%)	
PASP	Normal	0	0	0.07	7(29.2%)	0.001
	41-49	6(25%)	7(29.2%)		3(12.5)	
	50-59	6(25%)	10(41.7%)		12(50%)	
	60 and above	12(50%)	7(29.2%)		2(8.3%)	

DISCUSSION

The surgical closure of the atrial septal defect with pulmonary hypertension have been done successfully. The obtained result from the study showed the mean age of the patient was 33.33 ±11.3 years. Jose Suarez and his colleagues done a study on 2002 in spain over twenty nine atrial septal defect patients, their mean age was 56 ±14 years. O H Balint and his colleague had done a study on 2007 in torento general hospital over fifty four patients and their mean age was 59±15 years.[11] In post operative periods, the mean duration of mechanical ventilation was 5.29±0.9, duration of ICU stay was 4.5± 0.5 days, mean hospital stay was 8.25±0.79 days. Post operative periods of all the patients were uneventful. There was no mortality. In the study 25% patients had systemic hypertension. The mean pulmonary artery systolic pressure of hypertensive patients was 57.8 mmHg and normotensive patient's was 57 mmHg. There was no significant difference in PASP between them. In the study of O H Balint and his associates showed 26% had systemic hypertension and there were no mean difference between hypertensive and nor-motensive patient's pulmonary hypertension.[11] In my study, on preoperative period 8.3% patients were in NYHA functional class IV, 50% patients were in class III, 33.3% patients were in class II, 8.3% patient were in class I. On 1st week post operative period, improvement in functional capacity had been observed, 75% patients were im-proved into NYHA class II, 12.5% in NYHA class I, least 12.5% remained in class III which was statistically signifi-cant. After 6 weeks 66.6% patients were improved into class I remaining 33.3% patients remained in class II. Which was also statistically significant. Improvement in the functional capacity after ASD closure had been reported previously.[10] O H Balint and his colleagues showed 59% of the patients had limitation of functional capacity (New York Heart Association class >II) before atrial septal defect closure and after 6 weeks of closure 20% of patients remained in New York Heart Association class II.[11] In my study 29.2% patient had atrial fibrillation preoperatively. On 1st week postoperative day it turned into 25% and after 6 weeks it decreased in 4.2%. There was significant improvement seen among the patient after surgical closure.[12] Earlier observations have suggested that chronic volume overload with pulmonary hypertension and right ventricular dysfunction may be the factors associated with ar-rhythmogenesis.[13] Two previous studies have reported higher systolic pulmonary artery pressures in patients with atrial

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arrhythmia undergoing ASD surgery that resolved after surgical closure.[14] This improvement may in part be due to decreases in the volume load to the right ventricle and subsequent improvement in left ventricular diastolic and systolic function.[15] De Lezo and his associates showed that after ASD closure the prevalence of atrial fibrilla-tion reduced from 41% to 24% and this was related to the decrease in PASP.10 On preoperative period 50% patients had severe, 25% had moderate, 25% had mild pulmonary hypertension. On 1st week post operative period 41.7% patients had moderate pulmonary hypertension, 29.2% remained severe pulmonary hypertension. The mean 34 PASP became decreased from 57.54 ±7.9 mmHg to 53.29 ±8.30 mmHg in 1st week post operative period. Post operatively PASP got decreased but not statistically significant. After 6 weeks 29.2% patient's pulmonary hypertension became normal, 12.5% patients remained mild, 50% moderate and 8.3% patients remained severe pulmonary hypertension. The mean PASP reduced from 57.54 ± 7.9 mmHg to 48.58 ±8.30 mmHg. Improvement was seen after 6 weeks which was statistically significant. O H Balint and his colleagues reported in their study that, the mean PASP decreased from 57 ± 11 mmHg to 51± 17 mmHg (p=0.003) in early follow up after 6 weeks. Twenty-six percent patient's PASP became normal.11 In the study of Jose Suarez and his colleague described that mean PASP just after atrial septal defect closure reduced from 64±23 mmHg to 54±21 mmHg (p<0.001).[12]

Limitations of the study

Our study was a single centre study. We could only study a few adverse effects within a short study period. The sampling was not a randomized. The Sample size was limited.

CONCLUSIONS

This study underscores the importance and effectiveness of surgical intervention for atrial septal defect (ASD) in patients with pulmonary hypertension. By comparing preoperative and postoperative measurements, we have demonstrated significant improvements in functional capacity and reductions in pulmonary artery systolic pressure (PASP), indicating successful outcomes following ASD closure. These findings contribute to our understanding of the management of ASD and highlight the potential benefits of timely surgical intervention in improving patients' quality of life and reducing the burden of associated complications. Further research and long-term follow-up are essential to validate these results and optimize treatment strategies for individuals with ASD and pulmonary hyper-tension.

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