MANAGEMENT OF HYPERTENSIVE PDA

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ABSTRACT

Objective: To determine different treatment options in patients of Patent Ductus Arteriosus with pulmonary hypertension beyond neonatal period.

Study Design: Descriptive cross sectional study.

Place and Duration of Study: This study was carried out in Pediatric Cardiology department of Rawalpindi Institute of Cardiology, from Jan 2017 to Jan 2019.

Methodology: Patients having PDA with pulmonary hypertension were included in the study. Treatment options were divided into percutaneous catheter device closure, surgical ligation of patent ductus arteriosus and palliative treatment. Any adverse event during the procedure was documented. Stratification was done in regard to gender and age group. Post stratification chi square test was applied and *p*-value less than or equal to 0.05 was considered as significant.

Results: Total number of patients included in the study were 37. Mean age (years) of patients (Mean ± SD) was 19.21 ± 8.76. Mean ± SD pulmonary artery pressure was 56.43 ± 11.55 mmHg. Percutaneous catheter device closure was successful in 24 (64.9%) patients, in 7 (18.9%) patients primary surgical PDA ligation was done, 3 (8.1%) patients were advised palliative treatment and in 3 (8.1%) patients adverse events occurred during percutaneous device closure and were thus referred for surgical ligation. Patent ductus Arteriosus Occlutech device was used in 18 (48.6%) patients, Occlutech VSD device was used in 7 (18.5%) patients and in 1 (2.7%) patient AGA duct occluder was used.

Conclusion: In patients with patent ductus arteriosus and pulmonary artery hypertension, percutaneous catheter device closure is a safe and effective procedure.

Keywords: Eisenmenger syndrome, Patent ductus arteriosus, Pulmonary artery hypertension, PDA device, Surgical PDA ligation.

INTRODUCTION

Fetal circulation differs significantly from that of adults. In utero patency of ductus Arteriosus is essential for fetal life. It diverts most of the right heart output to aorta which delivers blood to placenta for oxygenation[1]. Transition of in utero circulation to adult type circulation occurs after delivery of the fetus. Ductus Arteriosus is closed due to changes in arterial oxygen concentration. If for one or other reason the ductus Arteriosus remain open ex utero, it's then termed as patent ductus arteriosus (PDA)[2]. Thus PDA is an acyanotic congenital heart disease with extra cardiac left to right shunt. PDA is the third most common cause of congenital heart defects (after ventricular septal defects and atrial septal defects): 10% of the total congenital cardiac lesions. Rise in PDA prevalence has been observed with time and the rise may be due advancement in diagnostic techniques[3]. The incidence of PDA is significantly higher in preterm neonates as compared to term babies i.e. about 0.03% vs approximately 50%. Male to female ration of PDA is 1:24.

The most common clinical symptom of patent ductus arteriosus is an audible murmur. The murmur of PDA is described as machinery murmur as it is heard both in systole and diastole[5]. However, in first few days of life, where pressure gradient between pulmonary artery and aorta is less, there may be no murmur. Also at time only systolic murmur may be audible. Other clinical signs may include bounding pulses, hyper dynamic precordium and respiratory dis-

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tress[6]. Most of these clinical signs and symptoms depend on the amount of shunt and PDA size. Early closure of PDA is recommended to avoid mortality and morbidity. Complications of long standing PDA may include recurrent respiratory infections, cardiac failure, failure to thrive, necrotizing enterocolitis, intraventricular hemorrhages, pulmonary artery hypertension, adverse neuro developmental outcome, pulmonary hemorrhages and even death[7]. The most feared complication of PDA is Eisenmenger syndrome where reversal of shunt occurs[8].

In most of the cases PDA closes spontaneously after birth. If it does not close spontaneously or is not closed medically or surgically, it may persists into adult life. Both medical and surgical management has its advantages and disadvantages. Medical treatment may include indomethacin, steroidal anti-inflammatory drugs and paracetamol. Indomethacin may prone babies to intraventricular bleed. Steroidal anti-inflammatory are associated with renal impairment and gastro intestinal bleed[9]. In recent years, due to little adverse effects, paracetamol is gaining importance for PDA closure. Both oral and intravenous forms of paracetamol are effective. Success rate of PDA closure with medical treatment is about 75%. Another treatment option for PDA closure is trans catheter device closure. Treatment of Eisenmenger syndrome is palliative[10,11].

The aim of our study was to look for different treatment options of PDA associated with pulmonary hypertension. In developed world PDA closure is carried out in neonatal period before pulmonary hypertension should develop. However, in our set up due to limited access to medical facilities PDA diagnosis may be missed and patients may present at a later stage with complications e.g. pulmonary hypertension. So this study was carried out share out experience of managing PDA in such population.

METHODOLOGY

This descriptive cross sectional study was carried out in pediatric cardiology department of Rawalpindi Institute of Cardiology, from Jan 2017 to Jan 2019[2]. The patients were selected from out patient department diagnosed on the basis of clinical examination and echocardiography. Patients with large size PDA, Dilated PAs, Low pressure gradient across PDA with Left to Right or bidirectional shunt on color doppler were preferably included in the study. Beside this those patients whom Pulmonary artery pressures were found ≥2/3rd systemic were enrolled in the study. Patients were booked for cardiac catheterization study with view to occlude the PDA with device. Patients were admitted to children ward one day prior to study and their base line investigations including complete blood count, Liver function tests, Renal functions test (blood Urea, Creatinine, serum electrolytes), coagulation profile, ECG and chest x-ray. The patients were thoroughly assessed for anesthesia fitness. The procedures were done in general or local anesthesia varied from case to case and age of the patients. General anesthesia was used in children less than 5 years of age or in those in whom complete hemodynamic data was supposed to be documented. The Patients in whom local anesthesia was used conscious sedation was adjuvant. Access was taken from femoral vein and femoral artery. Aortogram was obtained using pig tail catheter taken from femoral artery to descending aorta in all the patients to visualize PDA. An end hole catheter like multipurpose was taken from femoral vein through IVC to RA to RV to PA. Pressure data was obtained from Pulmonary artery and Aorta. PDA was crossed and the catheter was exchanged with exchange length wire. The PDA was then crossed with delivery sheath over the wire. Arterial end of the device was released in Aorta and pulled back to occlude arterial end of PDA. Subsequently pulmonary end was released to occlude PDA. Check Aortogram was obtained to document appropriate position of the device and to look for residual leak. Check Aortogram and Cine was obtained upon release of the device to ensure satisfactory position of the device. Complete hemodynamic data was obtained in selective patients to demonstrate signs of reversibility with near systemic PA

Pressures, large size PDA and those referred for surgical ligation. Patients with satisfactory device closure had check ECHO at the end of the cardiac Catheterization list and next morning before discharge from the hospital. Treatment options were thus stratified into percutaneous catheter device closure, surgical ligation of PDA and palliative treatment for statistical analysis. Any adverse event during the procedure was documented and is projected in the study. Stratification was also done in regard to gender and age group. Post stratification chi square test was applied and *p*-value less than or equal to 0.05 was considered as significant.

RESULTS

Total number of patients included in the study were 37. Out of 37 patients male were 11 (29.7%) and female were 26 (70.3%). Mean age of patients was 10.21 ± 8.76 years, mean PDA size was 7.01 ± 2.50, mean pulmonary artery pressure was 56.43 ± 11.55 mmHg, mean systemic pressure was 71.97 ± 14.43 mmHg. Transcatheter closure was successful in 24 (64.9%), 7 (18.9%) patients were referred for surgical intervention because of difficult anatomy, 3 (8.1%) patients were Eisen-menger syndrome and were put on palliative treatment. In 3 (8.1%) patients transcatheter closure was tried but abandoned due to complications as given in table-I. Stratifications of study population was done in regard to age, PDA size, pulmonary hypertension and gender. Post stratification chi square test was applied with *p*-value <0.05 considered to be significant as shown in table-II.

Table-I: Descriptive statistics of study population.

Variables	**Mean ± SD**
Age (Years)	10.21 ± 8.76
PDA size (mm)	7.01 ± 2.50
Mean PA pressure (mmHg)	56.43 ± 11.55
Mean Systemic Pressure (mmHg)	71.97 ± 14.43
Device Size (mm)	11.80 ± 3.75
Variables	**n (%)**
Gender	
Male	11 (29.7)
Female	26 (70.3)
Outcome	
Successful	24 (64.9)
Palliative Treatment	3 (8.1)
Surgical	7 (18.9)
Not Successful	3 (8.1)
Device Type	
Occlutech PDA Device	18 (48.6)
Occlutech VSD Device	7 (18.9)
Aga Duct Occluder	1 (2.7)
Age Group	
<10 Years	20 (54.1)
10 to 20 Years	13 (35.1)
>20 Years	4 (10.8)

Table-II: Result of post stratification chi square test in regard to different variables.

	Outcome				***p*-value**
	Successful	**Palliative Treatment**	**Surgical**	**Not Successful**	
Age group (years)					
<10	14	1	4	1	0.61
10-20	8	1	3	1	
>20	2	1	0	1	
Gender					
Male	6	0	5	0	0.35
Female	18	3	2	3	
PA Pressure (mmHg)					
30 to 50	8	0	1	0	0.018
51 to 70	15	1	6	2	
>70	1	2	0	1	
PDA Size (mm)					
<5	6	1	1	0	0.63
5 to 10	13	1	3	3	
>10	3	1	2	0	

DISCUSSION

Most of the time, PDA is diagnosed in the neonatal period. Closure of the PDA is recommended in the neonatal period as it causes severe hemodynamic disturbances. However, at times the PDA may be silent and diagnosed in adults during routine physical examination. Patients may present with complications of PDA if not detected and managed in neonatal life[12,13]. All our patients were diagnosed beyond neonatal life and they were with pulmonary hypertension. Age (Mean ± SD) of patients was 10.21 ± 8.76 years. Delay in diagnosis may be due to little accessibility of people to health care facilities as is true for all other developing countries. For large PDA, surgical closure used to be the gold standard. But now with availability of different types of devi-

ces, trans catheter closure of PDA is preferred. Sometimes, however, trans catheter closure may not be done due various reason like difficult anatomy of PDA, aneurysm or if complications occur during the procedure[14]. Successful trans catheter closure of PDA was done in 64.9% of our patients. In 8.1% patients reversibility test did not show drop of pulmonary artery pressure with 100% oxygen and were placed on palliative treatment. About 18.9% of the patients were referred to Paediatric cardiac surgeon for primary surgical closure because of large size and difficult anatomy of PDA. In 8.1% of the patients, trans catheter closure was tried but because of complications the procedure was abandoned and patients were referred to Paediatric cardiac surgeon for surgical intervention.

In a study by Garcia-Montes *et al*[15], they included in their study 17 patients with large PDA with pulmonary hypertension. Like our study, most of the patients were female i.e. 64%. The mean age of their study participant was 18.6 ± 12.1 years whereas in our study, patients mean age was 10.21 ± 8.76 years. The devices used for PDA closure in their study were used Amplantzer duct occlude and VSD septal occlude. Mean PA pressure in our study was 56.43 ± 11.55 mmHg whereas it was 71.3 ± 31.8 mmHg in their study. PDA size in our study was 7.01 ± 2.50 mm and it was 12.5 ± 3.8 mm in their study. Complete duct closure with no or minimal residual shunt in their study was observed in about 18% of patients. However, in our study complete closure of PDA was achieved in 65% of the patients[15]. Zabal *et al* included in their study 168 patients with PDA having pulmonary artery hypertension. They used four different types of devices for PDA closure. Mean age of their study cohort was 10.3 ± 14.3 years, almost the same age group of our study participant. Mean PDA diameter of their study participant was 6.4 ± 2.9 mm, the diameter comparable to our patients PDA size. Mean pulmonary artery pressure in their study was 63.5 ± 16.2 mm Hg. Complete closure with no residual shunt was observed in 74% in their study. Immediate complications observed in their study were 3.5%, the most common being embolization of the device. In our study immediate complications were observed in about 8% of the patients[16].

A Chinese study recruited 9 patients with PDA complicated by pulmonary hypertension. They used China made device for PDA closure. Successful PDA occlusion was achieved in 8 patients[17]. Another chinese study recruited 29 patients. Successful transcatheter PDA occlusion was done in 20 patients. In 8 patients the procedure failed. Like our study, most of the study participant in their study too were female. Mean age of the study population in their study was 31.1 ± 11.4 years: much older than our study participants[18]. Successful closure of PDA by transcatheter method depend on many factors like skill of the doctor, associated cardiac anomalies, age of patients, size of the PDA and morphology[19]. In our study age of patients and PDA size was not significantly associated with success of transcatheter closure with *p*-value 0.61 and 0.63, respectively. However, pulmonary artery pressure was significantly associated with success of the procedure with *p*-value less than 0.05.

CONCLUSION

Transcatheter closure of PDA with complicated pulmonary hypertension is safe and effective procedure. Patient age, PDA size and gender were not significantly associated with type of management. However, in patient with sever pulmonary hypertension transcatheter closure was not feasible. These patients were either candidate for surgery or palliative treatment due to Eisenmenger syndrome.

CONFLICT OF INTEREST

This study has no conflict of interest to be declared by any author.

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