https://doi.org/10.29309/TPMJ/2022.29.01.6381

The Professional Medical Journal
www.theprofesional.com
2022, Volume, 29 Issue, 01

ORIGINAL ARTICLE

Challenges in device closure of PDA (Patent Ductus Arteriosus) in adults.

Tauseef Asma Chaudhry[1], Muhammad Younas[2], Muhammad Ahsan Beg[3], Baqir Maqboool[4]

Article Citation: Chaudhry TA, Younas M, Beg MA, Maqboool B. Challenges in device closure of PDA in adults. Professional Med J 2022; 29(1):71-76. https://doi.org/10.29309/TPMJ/2022.29.01.6381

ABSTRACT… Objective: To describe the challenges and outcomes of per cutaneous closure of PDA in adolescents and adults. **Study Design:** Cross Sectional, Retrospective Analysis. **Setting:** Department of Pediatric Cardiology, CPE Institute of Cardiology, Multan. **Period:** 2017 to 2019. **Material & Methods:** A total of 111 adolescent and adult patients were included in the study. Patients with irreversible severe pulmonary hypertension were not included. Sampling with consecutive nonprobability was done. Procedure was done according to standard protocols. Different devices were used in different patients according to morphology of defect. Devices included SHSMA and Lifetech duct occluders. In two patients VSD muscular devices were also used. **Results:** Mean age was 22 + 7.88 years. Out of these 111 subjects, 72 (63%) were female and 39 (37%) were male with a ratio of 1.84:1. Two patients were of moderate size (3-5mm) PDA, 26 (27%) were of moderately large (5-7mm) size and majority of patients had large size (>7mm) PDA (55%). Majority of PDAs were type A (100, 90%), one was type B, 4 were type C and 6 were of type E according to Krichenko classification. No complications occurred except in one patient in which device was embolized. Foaming through the device was noted in 65 patients after 24 hours post procedure echocardiography. **Conclusion:** It was concluded that PDA device closure has its own challenges in adults but it is safe and effective as well.

Key words: Adolescents and Adults, Patent Ductus Arteriosus, Trans Catheter Closure.

INTRODUCTION

PDA is one of the commonest congenital heart defects representing 5-10% of all congenital heart lesions.[1] Usually it is diagnosed in early childhood and trans catheter closure is the treatment of choice.[2] In developing countries like ours, it is still common to see adult patients who were not diagnosed early. PDA can cause heart failure, eissenmenger syndrome, aneurysm formation or calcifications in later life. Also it can lead to endarteritis or spontaneous rupture of dilated pulmonary artery due to severe pulmonary hypertension in adult patients.[3] All of these complications can make surgical ligation of PDA a high risk.[4] Trans catheter closure of defect provides a safe and effective alternative, although this has its own limitations.

First transcatheter closure of PDA was reported almost 50 years ago and since then its technique and safety has improved.[5] Different types of devices are now available to choose as PDA has diverse morphology. Per cutaneous closure of PDA is widely acceptable and safe alternate to surgery in children.[6] In developing countries where diagnosis is still delayed, even adult patients are seen with this condition. In adults, surgical ligation is technically difficult and a high risk procedure owing to calcifications and aneurysms of duct.[7] This is the retrospective analysis of data of patients presenting in our hospital. The objective of the study is to describe the difficulties and effectiveness of per cutaneous closure of PDA in adolescents and adult patients.

MATERIAL & METHODS

This study is a descriptive analysis of percutaneous PDA device closure in adolescents and adults during the period of 2017 to 2019. This took place in Pediatric cardiology department of CPE

1. FCPS (Paeds), FCPS (Paeds Cardiology), Assistant Professor Pediatric Cardiology, CPE Institue of Cardioloy, Multan.
2. FCPS (Paeds), FCPS (Paeds cardiology), HOD Professor Pediatric Cardiology, CPE Institue of Cardioloy, Multan.
3. FCPS (Paeds), FCPS (Paeds Cardiology), Associate Professor Pediatric Cardiology, CPE Institue of Cardioloy, Multan.
4. FCPS (Paeds Cardiology), Senior Registrar Pediatric Cardiology, CPE Institue of Cardioloy, Multan.

Correspondence Address:
Dr. Tauseef Asma Chaudhry
Assistant Professor Pediatric Cardiology
CPE Institue of Cardioloy, Multan.
asmach@msn.com

Article received on: 23/01/2021
Accepted for publication: 11/06/2021

institute of cardiology the study was approved by ethical committee (CPEIC-89). Patients were sampled according to non-probability consecutive technique.

Inclusion Criteria

Patients aged 15 and above who underwent percutaneous closure of PDA during study period were included. Both male and females were included. All patients with moderate to large PDAs and enlarged LV were selected for device closure.

Exclusion Criteria

Patients with irreversible severe pulmonary hypertension due to PDA were excluded from study.

Patients with small PDAs, not hemodynamically significant, were not included.

Procedure

Patients were diagnosed with transthoracic echocardiography. Indication for closure of defect was according to AHA guidelines.[8]

All these patients were admitted a day before procedure. Their chest x ray, complete blood count, viral markers for HCV and HBV were obtained. Serum electrolytes and renal parameters were also noted. Procedure was done under local anesthesia and deep sedation. Both femoral venous and arterial accesses were secured. Patients were heparinized according to body weight (100 IU/kg). Aortogram was done to delineate the anatomy and morphology of duct. Aortogram was done in lateral projection (90^0) as well as in RAO 30^0. Sometimes it was difficult to visualize duct in standard views and therefore angle had to be modified to 100^0. Pulmonary artery and aortic pressures were recorded. In patients having severe pulmonary hypertension with pulmonary artery pressures near or more than systemic pressures, balloon occlusion was done to demonstrate the reversibility of shunt. If PA systolic pressures were reduced by 20% of baseline, shunt was considered reversible.[9] PDA was crossed from venous side in most cases. When there was difficulty in crossing PDA from venous side, it was crossed from aortic side and glide wire was snared to the femoral vein. Device was selected according to size and morphology of duct on echocardiography and aortogram. Usually ADO like devices were used. VSD muscular device was selected in patients with large shunt and pulmonary artery pressures near systemic pressures. Patients were discharged next day after trans thoracic echocardiography. They were called for follow up after 2 weeks and then a month after the procedure.

Data was collected using a performa recording all the details. Data was expressed as frequency and percentage. Program used for data analysis was SPSS software version 11.0 for Windows (SPSS Inc., an IBM company; Chicago, Ill).

Characteristic	No of Patients
Mean Age in years (range)	22(15-64)
Sex (%) Male Female	 40 (32) 72 (63)
Mean Weight in kg (range)	52 (30-96)
Associated abnormalities (%) Mitral valve prolapse with MR	02 (1.7) 02
ECG SVT	 01
TTE (%) Normal LV function Depressed LV function LV dilation	 104 (94) 07 (06) 92 (83)

Table-I. Demographic data.

RESULTS

From 2017 to 2019 total 354 patients underwent PDA device closure in Ch. Pervez Elahi institute of cardiology. Out of these, 111 patients were of age 15 and above. 72 (63%) were female and 40 (37%) were male. Age range was 15 to 64 years with a mean age of 22 years. 30 % (34) patients were symptomatic with class II- III NYHA while rest were asymptomatic. Two patients were labelled as cases of moderate size (3-5mm) PDA, 26 (27%) were of moderately large (5-7mm) size and majority of patients had large size (>7mm) PDA (55%). 17(15%) patients had severe pulmonary hypertension, defined as PA pressure more than 75% of systemic pressure. Balloon occlusion was done in patients with severe pulmonary

hypertension. Patients who showed no significant fall in PA pressures were excluded from the study. Four such cases were included who showed significant fall in PA pressure to less than 50% of systemic pressure.[8] Mostly patients had isolated PDA. Regarding associated conditions, one patient had SVT and another patient had Mitral valve prolapse with moderate mitral regurgitation. Procedure was done under local anesthesia and sedation. Procedure took 60 to 220 minutes with an average time of 41 minutes. Procedure time was significantly increased in cases where PDA was crossed from aortic side and wire was snared to venous side. Fluoroscopy time was 05 to 60 minutes with a mean time of 8 minutes. PDA size recorded on echocardiography was 03 to 13 mm with a mean size of 6mm. It was noted that size assessment was difficult in some cases on trans thoracic echocardiography. Size was finalized on aortogram in many different projections. Whenever sizes were measured on echocardiography, they were similar to those recorded on aortic angiograms.

Majority of PDAs were type A (100, 90%), 1 was type B, 4 were type C and 6 were of type E according to Krichenko classification.[9] In two patients, PDA was closed using VSD device. Rest of cases were closed using classical PDA occluders similar to ADO-I. We used 76 SHSMA occluder (Shanghai Shape Memory Alloy Co., Ltd.; Shanghai, PRC) and 32 Lifetech (Shenzhen, China) devices. Range of delivery sheaths (7-10f) were used during procedure. In 20 (18%) patients 7f delivery system was used while in 91 (80%) cases larger sheaths were used. Different sizes of devices were used, smallest being 4x6mm and largest device used was 16x18mm. In almost 73 % cases larger devices were used. In two patients Amplatzer™ Muscular VSD Occluder (AMVSD) (14mm) was used to close the defect (Figure-2). No complications occurred except in one patient in which device was embolized and patient was sent for surgery. Transthoracic echo was repeated 24hrs after the procedure. Foaming through the device was noted in 65 (58%) patients after 24 hrs echocardiography. No leak observed in any patient at 1 month follow up.

PDA Features on Angiogram	Number
Type of PDA (%) Type A Type C Type D	 100(90) 04(3.6) 06(05)
Size of PDA in mm (mean)	03-13 (06)
PA pressure mean	44 (20-90)

Table-II. Features of PDA on angiogram.

Charectiristic	No of Patients
Anesthesia	Local with sedation
Flouroscopy time (min, mean)	5-60 (08)
Procedure time (min, mean)	60-120 (41)
Approach (%) Antegrade Retrograde	 108 03
Device (%) SHSMA Lifetech VSD device	 76 (68.4) 32 (28.8) 02 (1.8)
Delivery sheath (fr)	7-10
Complications (%) Embolization LPA stenosis Descending aorta stenosis Arrythmias Residual shunt Foaming through device	 01(0.9) 00 00 00 00 65 (58)

Table-III. Procedure details.

No other complications like device protrusion in aorta or left pulmonary artery noticed. Device embolized in one patient. She was 15 year old female with a large PDA of type E, measuring 5mm on aortogram. 8x10 PDA SHSMA device was selected. Device was released with no residual PDA. Next day echocardiography showed that device has been embolized in RPA. Its screw was facing distally therefore snaring the device was difficult (Figure-1). Device was removed by surgeon and PDA was ligated.

DISCUSSION

In this study we evaluated the challenges encountered in percutaneous PDA device closure in adults. PDA is a congenital heart defect usually diagnosed and managed in early childhood.

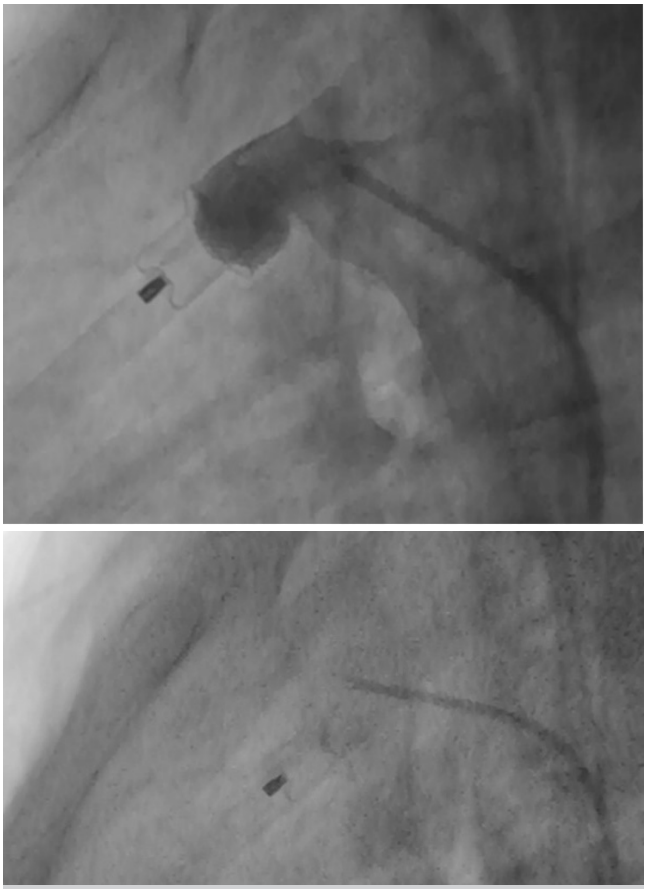

Figure-1 a). PDA device in place with complete closure of defect.
b) Embolized device in branch pulmonary artery.

If not treated early in life, it can result in chronic volume load in LV and later pulmonary hypertension. Therefore, PDA is indicated to close whenever diagnosed. PDA in adults was treated previously by surgical ligation. Due to availability of variety of devices PDA is now preferably closed per cutaneously in children as well as in adults. However, in adults device closure is a bit challenging then in children. In this study we have tried to enlist the issues encountered.

Mean size of PDA was 06mm, ranged from 3-13. Mean PA pressure was 44mmHg with a range of 20-90mmHg. 90% cases were of type A morphology. They noticed 74% cases with type A morphology. Mean ductal diameter noticed was 4mm in this study. Procedural success rate was 100 percent. These results were similar to the study conducted by Wilson WM.[10] In our study wire was crossed across PDA from antegrade approach in 108 cases (97%) but Wilson recorded a this in 79% cases. Similar results were noted in other studies too.[11,12,13]

It was noted that there was difficulty in visualization and hence sizing of the defect in standard projections as also reported by Chamié F et al.[14] They used sizing balloon in such cases. We did aniograms in different projections to overcome this problem. In addition to standard lateral projections at 90 degrees we did additional angiograms in lateral 100 degrees and in right anterior oblique 30 degrees. It was noted that in some cases size was underestimated due to natural elastic tendency in arterial PDA. This was most likely the case in one patient whose device was embolized. It is therefore recommended to oversize the device. Adult patients can easily accommodate relatively larger size of devices with almost no chances of protrusion or obstruction of neighbouring branches as noted in other studies.[15]

It can take more time and thus more radiation exposure in adults owing to morphology of defect and technique used.[16] Also in some cases of large defects with unusual anatomy and morphology surgical ligation is still preferred.

Majority of patients were females as shown in many other studies.[17,18] Patients included were age 15 and above. Maximum age included was 64 years.

Majority of patients had large size PDA, therefore relatively larger delivery sheaths were used.[19,20]

CONCLUSION

PDA device closure is a safe procedure in children as well as in adults. There are technical difficulties that can be encountered in adults, like difficulty to visualize the defect on angiograms and sometimes need to cross the defect from arterial side. Also procedure may take longer duration as compared to children and thus more radiation exposure. Advantages are that larger size sheath and devices can be used in adults without the risk of aortic or LPA obstruction. Overall, it's a safe and effective method rather preferred procedure.

There are technical difficulties that can be encountered in adults, like difficulty to visualize the defect on angiograms and sometimes need to cross the defect from arterial side. Also procedure may take longer duration as compared to children.

REFERENCES

1. Schneider DJ, Moore JW. **Patent ductus arteriosus.** Circulation. 2006 Oct 24; 114(17):1873-82.

2. Schneider DJ. **The patent ductus arteriosus in term infants, children, and adults.** In Seminars in perinatology 2012 Apr 1 (Vol. 36, No. 2, pp. 146-153).

3. Baruteau AE, Hascoët S, Baruteau J, Boudjemline Y, Lambert V, Angel CY, Belli E, Petit J, Pass R. **Transcatheter closure of patent ductus arteriosus: Past, present and future.** Archives of cardiovascular diseases. 2014 Feb 1; 107(2):122-32.

4. Zulqarnain A, Younas M, Waqar T, Beg A, Asma T, Baig MA. **Comparison of effectiveness and cost of patent ductus arteriosus device occlusion versus surgical ligation of patent ductus arteriosus.** Pak J Med Sci. 2016; 32(4):974-977.

5. Anilkumar M. **Patent ductus arteriosus.** Cardiol Clin. 2013; 31(3):417-430.

6. Sudhakar P, Jose J, George OK. **Contemporary outcomes of percutaneous closure of patent ductus arteriosus in adolescents and adults.** Indian heart journal. 2018 Mar 1; 70(2):308-15.

7. Yan C, Zhao S, Jiang S, Xu Z, Huang L, Zheng H, Ling J, Wang C, Wu W, Hu H, Zhang G**. Transcatheter closure of patent ductus arteriosus with severe pulmonary arterial hypertension in adults.** Heart. 2007 Apr 1; 93(4):514-8.

8. Stout KK, Daniels CJ, Aboulhosn JA, Bozkurt B, Broberg CS, Colman JM, Crumb SR, Dearani JA, Fuller S, Gurvitz M, Khairy P. **2018 AHA/ACC guideline for the management of adults with congenital heart disease: a report of the American College of Cardiology/ American Heart Association Task Force on Clinical Practice Guidelines.** Journal of the American College of Cardiology. 2019 Mar 25; 73(12):e81-192.

9. Vijayalakshmi IB, Setty N, Narasimhan C, Singla V, Manjunath CN. **Percutaneous device closure of patent ductus arteriosus with pulmonary artery hypertension: Long-term results.** J Interv Cardiol. 2014; 27(6):563-569.

10. Wilson WM, Shah A, Osten MD, Benson LN, Abraha N, Breitner D, Horlick EM. **Clinical outcomes after percutaneous patent ductus arteriosus closure in adults.** Canadian Journal of Cardiology. 2020 Jun 1; 36(6):837-43.

11. Adhikari CM, Bogati A, Acharya KP, Shrestha M, Shakya U, Malla R. **Safety and procedural success of transcatheter closure of patent ductus arteriosus in adults at Shahid Gangalal National Heart Centre, Kathmandu, Nepal.** Nepalese Heart Journal. 2020 Nov 5; 17(2):43-6.

12. O'Byrne ML, Smith CL, Gillespie MJ. **Device closure of patent ductus arteriosus in adults.** Canadian Journal of Cardiology. 2020 Jun 1; 36(6):795-6.

13. Behnaz F, Chegini A, Rafiian S, Rasouli M. **Complications of transcatheter closure in patent ductus arteriosus patients.** International Cardiovascular Research Journal. 2017; 11(4):125-9.

14. Chamié F, Simões LC, Chamié D, Mattos R, de Castro P. **Specific aspects of percutaneous closure of patent ductus arteriosus in adult patients.** Revista Brasileira de Cardiologia Invasiva (English Edition). 2013 Jan 1; 21(1):67-72.

15. Lehner A, Ulrich S, Happel CM, et al. **Closure of very large PDA with pulmonary hypertension: Initial clinical case-series with the new Occlutech® PDA occluder.** Catheter Cardiovasc Interv. 2017; 89(4):718-725.

16. Villemain O, Malekzadeh-Milani S, Sitefane F, Mostefa-Kara M, Boudjemline Y. **Radiation exposure in transcatheter patent ductus arteriosus closure: Time to tune?.** Cardiology in the Young. 2018 May; 28(5):653-60.

17. Alkashkari W, Albugami S, Alrahimi J, et al. **Percutaneous Device Closure of Patent Ductus Arteriosus in Adult Patients with 10-Year Follow-up.** Heart Views. 2019; 20(4):139-145.

18. Kiran VS, Tiwari A. **Prediction of left ventricular dysfunction after device closure of patent ductus arteriosus: Proposal for a new functional classification.** EuroIntervention. 2018; 13(18):e2124-e2129.

19. Behjati-Ardakani M, Rafiei M, Behjati-Ardakani MA, Vafaeenasab M, Sarebanhassanabadi M. **Long-term results of transcatheter closure of patent ductus arteriosus in adolescents and adults with amplatzer duct occluder.** N AmJ Med Sci. 2015; 7(5):208-211.

20. Yasuhara J, Kuno T, Kumamoto T, Kojima T, Shimizu H, Yoshiba S, Kobayashi T, Sumitomo N. **Comparison of transcatheter patent ductus arteriosus closure between children and adults.** Heart and vessels. 2020 Nov;35:1605-13.

AUTHORSHIP AND CONTRIBUTION DECLARATION

No.	Author(s) Full Name	Contribution to the paper	Author(s) Signature
1	Tauseef Asma Chaudhry	1st Author	
2	Muhammad Younas	2nd Author	
3	Muhammad Ahsan Beg	3rd Author	
4	Baqir Maqboool	4th Author	