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Safety and Procedural Success of Transcatheter Closure of Patent Ductus Arteriosus in Adults at Shahid Gangalal National Heart Centre, Kathmandu, Nepal.

Chandra Mani Adhikari[1], Amrit Bogati[1], Kiran Prasad Acharya[1], Manish Shrestha[2], Urmila Shakya[2], Rabi Malla[1]

[1] Department of Cardiology, Shahid Gangalal National Heart Center, Nepal.
[2] Department of Paediatric Cardiology, Shahid Gangalal National Heart Center, Nepal.

Corresponding Author:
Chandra Mani Adhikari
Department of Cardiology Shahid Gangalal National Heart Centre, Kathmandu, Nepal.
Email ID: cmadhikari@sgnhc.org.no
ORCID ID: https://orcid.org/0000-0001-5811-9977

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Abstract

Background and Aims: Transcatheter closure of patent ductus arteriosus (PDA) using either coils or device is a well-established procedure. PDA is one of the common congenital heart diseases and it is not uncommon for it to be diagnosed in adulthood. However, only few studies are conducted in our part of the world regarding the safety and procedural success of device closure of PDA in adults. We aim to assess safety and procedural success of transcatheter closure of PDA in adults at Shahid Gangalal National Heart Centre, Kathmandu, Nepal.

Methods: It was a single center, retrospective study. Cardiac catheterization laboratory records of all consecutive adult patients (age ≥ 18 years) who underwent PDA device closure between March 2007 to March 2020 were reviewed. Patients age, gender, device size and device type along with procedural success of the procedure were reviewed. Any complication recorded was reviewed.

Results: During the study period 118 adult patients were attempted for transcatheter closure of PDA. In three cases transcatheter closure was not attempted. In one patients attempt was made to close the duct with cook coil which embolized to pulmonary artery. PDA was successfully closed in 114 patients. Among the 114 patients, 87 were females and 27 were male. Age ranged from 18 to 69 years with mean age was 29.5 years. PDA size ranged from 3mm to 18mm with the mean of 6.9mm. In two patients, residual PDA after surgical closure were closed. Amplatzer duct occluder was the most commonly used device in 89 (78%) patients followed by Memopart PDA device in 11 (9.6%) patients, Amplatzer Muscular VSD occluder in four patients. Device size of "8x10" in 32 patients and "10x12" device in 29 patients, were the most commonly used device size.

Conclusion: Transcatheter closure of PDA in adults can safely be done with high success rate.

Keywords: Adult; PDA; transcatheter closure.

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Introduction

Patent ductus arteriosus (PDA) is the persistent communication between the proximal left Pulmonary Artery (PA) and the descending aorta just distal to the left subclavian artery. PDA account for approximately 9-12% of all congenital heart diseases.[1] It is estimated that PDA occurs about 1 in 2500–5000 live births.[2] It can be associated with a variety of congenital heart disease lesions. However, in the adult it is usually an isolated finding.[3]

It is not infrequent for PDA to be diagnosed in adulthood on physical examination or as an incidental finding on transthoracic echocardiography (TTE).[4] Additional problems associated with PDA include pulmonary hypertension, left ventricular volume overload,

infective endocarditis, calcification, aneurysm formation, and, rarely, rupture.[5] The mortality rate in adults with untreated PDA is estimated to be 1.8% per year.[6] Therefore, PDA with a significant left-to-right shunt or with an audible murmur should be closed to reduce complications.[4]

American College of Cardiology/American Heart Association guideline suggest that PDA closure in adults is recommended if left atrial or LV enlargement is present and attributable to PDA with net left-to-right shunt, PA systolic pressure is less than 50% of systemic systolic pressure and pulmonary vascular resistance is less than one third systemic vascular resistance.[7]

Surgical repair of PDA in adults is performed by left lateral thoracotomy, but may require a midline sternotomy, extracorporeal circulation, aortic cross-clamping, and other measures, with recovery in an intensive care unit. Surgical risk may be further increased by anatomic and histologic changes in the ductus, including calcification, aneurysm, diverticulum, shortening, and friability.[8,9] In adults, calcification of the PDA may cause a problem for surgical closure. Device closure is the method of choice, even if cardiac operations are indicated due to other concomitant cardiac lesions, and can be successfully performed in the vast majority of adults with a very low complication rate.[10,11,12] Surgery is reserved for the rare patient with a duct too large for device closure or with unsuitable anatomy such as aneurysm formation.[3]

This study aims to assess safety and procedural success of transcatheter closure of PDA in adults at Shahid Gangalal National Heart Centre, Kathmandu, Nepal.

Methods

It was a retrospective, single centre study, performed at Shahid Gangalal National Heart Centre, Kathmandu, Nepal. Cardiac catheterization laboratory records and Medical records of all consecutive adult patients (age ≥ 18 years) who underwent PDA device closure from March 2007 to March 2020 were retrospectively reviewed.

Demographics of the patients were collected. PDA size, Device type and size used for transcatheter closure of PDA was recorded. Numbers of successful and unsuccessful cases were recorded. Complications of the procedure were recorded. The study protocol was approved by institutional review board (IRB) of Shahid Gangalal National Heart Centre, Kathmandu, Nepal.

All the variables were entered into the Statistical Package for Social Sciences software, version 20 (SPSS Inc., Chicago, IL, USA) for data analysis.

Results

During the study period 118 adult patients were attempted for transcatheter closure of PDA. Two patients were thought to have unfavorable morphology so transcatheter occlusion was not attempted. In one case PDA closure was abandoned due to unavailability of appropriate device size. In one patient attempt was made to close the duct with cook coil which embolized to pulmonary artery. PDA was successfully closed in 114 patients. Among the 114 patients, 87 were females and 27 were male. Age ranged from 18 to 69 years with mean age was 29.5 years. PDA size ranged from 3mm to 18mm with the mean of 6.9 mm. In two patients residual PDA after surgical closure was closed. In one patient PDA device closure was done after the treatment of Infective endocarditis. Amplatzer Duct Occluder I (ADO I) was the most commonly used device 89 (78.0%) patients for transcatheter closure of PDA followed by Memopart PDA device in 11(9.6%) patients as shown in Table 1.

Table 1: Demographic profile and type of device:

Variable	Frequency	%
Male	27	23.7
Female	87	76.3
Device type		
Amplatzer duct Occluder (ADO) I	89	78.0
Hyperion PDA Occluder	3	2.6
Memopart PDA Occluder	11	9.6
Lifetech PDA Occluder	7	6.1
Amplatzer Muscular VSD occlude	4	3.5

PDA, Patent Ductus Arteriosus; VSD, Ventricular Septal Defect

ADO I type device with the size of 8x10 32 (28.0%) was the most commonly used size followed by 10x12 in 29 (25.4%) cases as shown in Table 2.

Table 2: Device Size

Device Size	Frequency	%
ADO I type device		
4x6	4	3.5
6x8	17	14.9
8x10	32	28.0
10x12	29	25.4
12x14	10	8.7
14x16	10	8.7
18x20	4	3.5
20x22	4	3.5
Amplatzer Muscular VSD Occluder		
16 mm	2	1.7
18 mm	1	0.8
20 mm	1	0.8

ADO I, Amplatzer Duct Occluder I

Among our subjects, we did not find any complication related to vascular access or hemolysis. There was no evidence of obstruction to the left pulmonary artery or the descending aorta, as confirmed by 2D-Doppler in the following day follow-up. No death occurred in this study.

Discussion

Study population in our study is small as in other studies with adults.[13,14,15] It may be due to early diagnosis and treatment in the childhood. Though Surgical repair has been an established method,[16] there are many advantages of PDA device closure when compared to surgical ligation; less invasive procedure, shorter hospital stay, avoidance of a scar and low morbidity are the advantages. Surgical repair of PDA may be technically more difficult in adults with possible calcification of PDA, requiring cardio-pulmonary bypass with an anterior approach through a median sternotomy.[16]

Transcatheter closure has become a first-line of treatment in most children and adults[1] with PDA[6] as it is effective and have a low complication rate. Although the transcatheter closure of PDA has been proven to be effective and safe, several complications, such as embolization, narrowing of the LPA, aortic obstruction, hemolysis, and infective endocarditis have been reported.[17,18,19] In general, the complication rate of transcatheter closure of PDA is low.[20,21,22] The incidence of residual shunts in late follow-up was reported to be 0-5%.[17,20,21] Device embolization occasionally occurs, necessitating surgical removal or transcatheter retrieval. Device embolization is one of the most important complications of transcatheter occlusion of PDA[17] The embolization rate varies between 0% and 3.1%.[17,18,19,20,21]

In our study PDA closure by coils was attempted in one case. Though the implantation of a single or multiple coils of various sizes has been a safe procedure, it has limited utility when PDA is large.[16] Migration of coils to branch pulmonary arteries was relatively common with coils. Migrated coils are usually retrieved, but even in cases in which they cannot be retrieved, adverse consequences are rare.[23] Lack of controlled delivery and inability to retrieve and reposition the coil are potential problems.[24]

The other complication of transcatheter closure of PDA with device is LPA obstruction in children.[22,25,26] Although LPA obstruction is one of the most significant complications, it is not a concern in adults because of the large diameter of pulmonary artery branches.[5] Hemolysis and infective endocarditis following transcatheter device closure are rare complications.[27]

The transcatheter closure with "ADO I" has significantly improved the outcome of the percutaneous closure of medium- and large-sized ducts. The major advantages of "ADO I" are easy implantation technique, small delivery sheath (6-8 Fr), possibility of retrieval, ability to reposition before release of the device, low complication rate, and high closure rate.[4] "ADO I" is safe and commonly used device worldwide to close PDA. In our study "ADO I" was the most commonly used device and was very effective and safe as in large series.[29] Memopart, Hyperion and Lifetech PDA occluders are "ADO I" like devices. There are case reports of large hypertensive PDA closed with the Amplatzer muscular ventricular septal defect occluder.[22,30] We have used these devices in four cases for large hypertensive PDAs.

As it is a retrospective study, it has some limitations. We could not report on the type of PDA and on pre and post procedural clinical status of the patient.

Conclusion

Our study concluded that transcatheter closure is a safe and effective mode of treatment of PDA in adults. Hence, it should be considered as a treatment of choice in adult PDAs.

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