

Hybrid approach for aortic embolization of Amplatzer duct occluder

Sudesh Prabhu¹, Shreesha Maiya², Riyan Shetty³, Keshava Murthy⁴, Prakash Ramachandra², Rishi Tiwari¹

¹Department of Paediatric Cardiac Surgery, Narayana Institute of Cardiac Sciences, Bengaluru, Karnataka, India, ²Department of Paediatric Cardiology, Narayana Institute of Cardiac Sciences, Bengaluru, Karnataka, India, ³Paediatric Critical Care Unit, Narayana Institute of Cardiac Sciences, Bengaluru, Karnataka, India, ⁴Department of Cardiac Anaesthesia, Narayana Institute of Cardiac Sciences, Bengaluru, Karnataka, India

ABSTRACT

Embolization of the patent ductus arteriosus (PDA) device is a known adverse event of percutaneous PDA closure, which can lead to complications. Embolization can occur into the pulmonary artery or into the aorta. Device embolization can be moderate adverse event (when retrieved percutaneously) or major adverse event (when retrieved surgically). We are describing a hybrid approach for aortic embolization of PDA device when the percutaneous retrieval fails, where device retrieval and PDA ligation can be done through thoracotomy incision, thus decreasing the complications.

Keywords: Amplatzer duct occluder, device embolization, hybrid approach, major adverse event

INTRODUCTION

Embolization of percutaneously placed patent ductus arteriosus (PDA) devices is a known complication, which is defined as a released coil or device that is no longer located in the PDA.^[1] As per the definition of adverse events and categorization of the complications encountered, device embolization can either be moderate adverse event (when transcatheter retrieval of embolized device is possible) or major adverse event (when device embolization requires surgical retrieval).^[1] Majority of the embolization is to the pulmonary artery (PA) than to the aorta (usually abdominal aorta due to antegrade flow) due to higher aortic pressure.

Most of the instances the embolized device can be retrieved percutaneously, followed by re-device or surgical intervention depending on the cause for embolization [Figure 1]. However, when the percutaneous retrieval fails, then the surgical intervention is required and has higher complication rate.

We are proposing the hybrid approach for the aortic embolization of PDA device, by which device retrieval and PDA ligation can be done through thoracotomy incision, preventing the need and therefore the complications of laparotomy and retroperitoneal dissection and manipulation of abdominal aorta.

CASE REPORT

A 3-year-old female child was transferred from peripheral hospital with abdominal aortic embolization of PDA device (Amplatzer ductal occluder, AGA Medical Corporation, Minnesota, USA) after failed percutaneous retrieval attempts.

Child was shifted to hybrid operating theatre and device retrieval was attempted under general anesthesia and endotracheal intubation with full heparinization (4 mg/kg). Retrieval attempts (by engaging the retention screw and snaring) failed due to the orientation of the device and also the device was snugly fitting into the

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: reprints@medknow.com

How to cite this article: Prabhu S, Maiya S, Shetty R, Murthy K, Ramachandra P, Tiwari R. Hybrid approach for aortic embolization of Amplatzer duct occluder. *Ann Pediatr Card* 2020;13:227-9.

Access this article online

Quick Response Code:



Website:

www.annalspc.com

DOI:

10.4103/apc.APC_13_20

Address for correspondence: Dr. Sudesh Prabhu, Department of Paediatric Cardiac Surgery, Narayana Institute of Cardiac Sciences, Bengaluru - 560 099, Karnataka, India. E-mail: sudesh006@gmail.com

Submitted: 26-Jan-2020 Accepted: 17-Mar-2020 Published: 02-Jun-2020

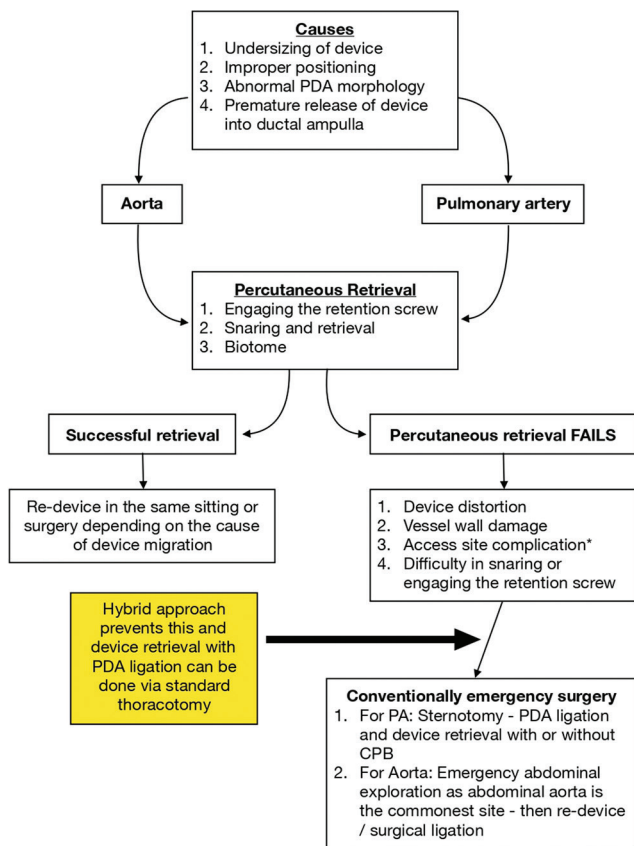


Figure 1: Algorithm for embolized patent ductus arteriosus device: In case of embolization into aorta, which cannot be retrieved by percutaneous approach, hybrid approach allows device retrieval with PDA ligation through standard thoracotomy

abdominal aorta [Figure 2]. Hence, surgical retrieval was planned. The option was device retrieval from the abdominal aorta through laparotomy and re-device or surgical PDA ligation through thoracotomy. To prevent laparotomy and its complications, hybrid approach was planned (the idea was to disengage the device from abdominal aorta and mobilize it to proximal thoracic aorta and retain it there till the aorta was looped via thoracotomy).

The ductus was crossed from the venous (antegrade) route and snared from the femoral artery to form an arteriovenous loop. Over this loop, a 12 mm TyShak® balloon (B. Braun Interventional Systems Inc. Bethlehem, PA, USA) was passed from the venous side. The inflated balloon was used to disengage the device from the abdominal aorta and mobilize it to descending thoracic aorta (DTA). The device re-embolization was prevented by keeping a partially inflated balloon (to allow distal blood flow) in the downstream of DTA through femoral artery guide wire (retrograde) [Figure 3].

Then, a left thoracotomy was performed. Left subclavian artery, aortic isthmus, DTA, and PDA were dissected and looped using rubber slings. The DTA sling was

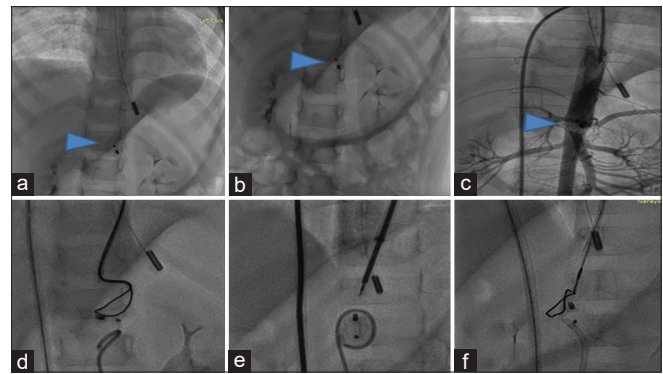


Figure 2: Failure of percutaneous retrieval: (a and b) AP projection fluoroscopy, device in abdominal aorta at T12 level, (c) AP projection with contrast, PA end of occluder stuck at superior mesenteric artery origin without any vascular compromise, (d) 5F pigtail catheter from right femoral artery, goose-neck snare through a 6F multipurpose catheter from IVC→RA→RV→PA→PDA→DTA, trying to snare the device with Pigtail catheter supporting the device, (e) Pigtail catheter holding the device in the loop, Maslanka® grasping forceps (BVM Medical Limited, Leicestershire, UK) trying to catch the device, (f) 5F Guide catheter from femoral artery used to rotate the device and trying to snare

partially snared to prevent device embolization and the TyShak balloon was deflated and withdrawn. PDA was doubly ligated using silk sutures. Then, the aorta was clamped distal to the subclavian and DTA, and device was retrieved through a small aortotomy, which was closed in 2 layers using 6-0 poly propylene sutures after de-airing. Heparin was reversed with protamine. Hemostasis confirmed and chest closed in anatomic layers with a single pleural drain *in situ*. The patient was shifted to intensive care unit and was extubated 6 h later and discharged on postoperative day 5. Bilateral femoral arteries and veins were patent at the time of discharge.

Hospital ethics committee waived of the clearance as parental consent was obtained.

DISCUSSION

Embolization of the PDA device occurs at an incidence of <1%–5% depending on the series^[1-4] and is considered as the most significant complication of PDA device procedure. Majority of the embolization is to the PA system than to the aorta. Device embolization can either be moderate adverse event (when transcatheter retrieval of embolized device is possible) or major adverse event (when device embolization requires surgical retrieval).^[1]

The direct complications of the embolized device are sudden loss of cardiac output (when in main PA), sudden strain on the left ventricle with associated increase in the left to right shunt (when in aorta), and ischemic complications such as bowel gangrene and/or renal failure.^[2] Then, there are complications associated with percutaneous retrieval of embolized devices,^[1] which

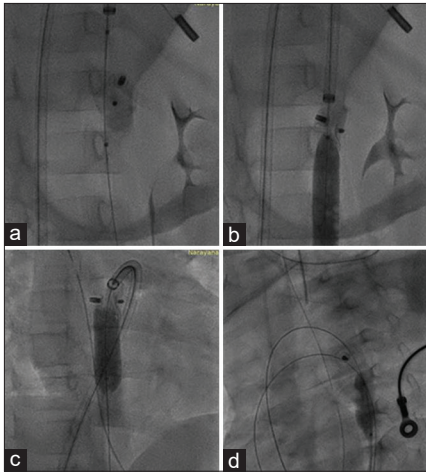


Figure 3: Successful hybrid retrieval: (a) 10 mm × 30 mm TyShak II Balloon passed from the inferior vena cava end through the 7F Sheath (Antegrade), (b) TyShak balloon (antegrade) passed distal to the device and inflated, (c) Sheath–TyShak balloon ensemble with the device held in-between pulled up to the thoracic aorta, (d) Lateral view–TyShak balloon through the right femoral artery (retrograde), partially inflated to stabilize the device in thoracic aorta at the level of ductus, with distal blood flow monitoring

includes vascular trauma (femoral vessels), compartment syndrome, and tricuspid valve injury (related to repeated retrieval attempts). All of these lead to increased morbidity and mortality, necessitating urgent device retrieval.

When device is embolized into PA and the percutaneous retrieval fails, usually requires median sternotomy PDA ligation and device retrieval with or without cardio pulmonary bypass (CPB).^[5] However, failure of percutaneous retrieval in aortic embolization of the device necessitates sternotomy with CPB and deep hypothermic circulatory arrest (DHCA)^[5] for arch embolization, aortotomy and retrieval^[6] for DTA embolization and abdominal exploration^[7] for infradiaphragmatic aorta or its branch embolization.

When the percutaneous retrieval fails, by mobilizing the device to the DTA (from anywhere in the aorta or its branches), it is possible to retrieve the device with simultaneous ligation of the PDA through the standard thoracotomy (hybrid approach). This will prevent additional incisions (sternotomy/laparotomy) and avoids the need of CPB or DHCA and its complications.

Comments

In the cases of aortic embolization of duct occlusion device, when percutaneous retrieval fails, then hybrid

approach will allow the device retrieval and PDA ligation through thoracotomy incision, thus decreasing the complications.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Kang SL, Jivanji S, Mehta C, Tometzki AJ, Derrick G, Yates R, *et al.* Outcome after transcatheter occlusion of patent ductus arteriosus in infants less than 6 kg: A national study from United Kingdom and Ireland. *Catheter Cardiovasc Interv* 2017;90:1135-44.
2. Faella HJ, Hijazi ZM. Closure of the patent ductus arteriosus with the amplatzer PDA device: Immediate results of the international clinical trial. *Catheter Cardiovasc Interv* 2000;51:50-4.
3. Pass RH, Hijazi Z, Hsu DT, Lewis V, Hellenbrand WE. Multicenter USA amplatzer patent ductus arteriosus occlusion device trial: Initial and one-year results. *J Am Coll Cardiol* 2004;44:513-9.
4. Jang GY, Son CS, Lee JW, Lee JY, Kim SJ. Complications after transcatheter closure of patent ductus arteriosus. *J Korean Med Sci* 2007;22:484-90.
5. Gokaslan G, Ustunsoy H, Deniz H, Ozcaliskan O, Yasim A, Baspinar O, *et al.* Urgent surgical management for embolized occluder devices in childhood: Single center experience. *J Cardiothorac Surg* 2012;7:127.
6. Amanullah MM, Siddiqui MT, Khan MZ, Atiq MA. Surgical rescue of embolized amplatzer devices. *J Card Surg* 2011;26:254-8.
7. Şişli E, Epeçan S. An attempt to retrieve an embolized ductal closure device leading to iliac artery dissection in an 11-month-old child: A case report. *Turk Gogus Kalp Damar Cerrahi Derg* 2019;27:111-3.