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Retrograde wiring and antegrade closure of patent ductus arteriosus by Cocoon Duct Occluder in 6-month-old infant

Wprowadzenie cewnika techniką *retrograde* i zamknięcie przetrwałego przewodu tętniczego techniką *antegrade* za pomocą urządzenia Coccoon Duct Occluder u 6-miesięcznego dziecka

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Abstract

Patent ductus arteriosus (PDA) accounts for up to 10% of all congenital heart disease. Transcatheter closure of PDAs has now become a treatment of choice replacing surgery. It is simple, consisting of placement of device or vascular occlusion coils either antegradely from femoral vein or retrogradely from femoral artery. Here we report a patient with PDA and with vascular anatomy too difficult to be antegradely approached and thus it was closed by a retrograde wiring and antegrade snaring using a customised snare. Then the device was deployed by usual antegrade approach over snared wire. This retrograde wire-assisted technique and antegrade snaring could be utilised to overcome PDA of difficult vascular anatomy, which could not be easily fulfilled by conventional antegrade venous approach alone.

Key words: antegrade snare, patent ductus arteriosus, retrograde snare, retrograde wiring, transcatheter closure

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Introduction

Patent ductus arteriosus (PDA) is a persistent communication between the aorta and the pulmonary artery. After birth, the ductus closes by contraction of the medial smooth muscle, leading to constriction, shortening and functional closure, followed by permanent sealing of the lumen to form ligamentum arteriosus by 3 weeks. Failure of constriction of ductus leads to patency of ductus. The process of closure is incomplete in 1/2000 live births [1]. It can be isolated or may be present in association with all forms of congenital heart disease. Unoperated patients may present with heart murmur or symptoms caused by a large left-to-right shunt, including shortness of breath and easy fatigability. If PDA is large and nonrestrictive, the patient may present with Eisenmenger physiology, including differential cyanosis and clubbing. Such patients are at an increased risk of developing endarteritis, heart failure, and pulmonary vascular disease. The shape of the PDA varies, but most often the aortic end is wide and narrows towards the pulmonary end. The procedure is indicated only in patients with continuous murmur suggestive of PDA with echo-Doppler confirmation or the presence of an auscultable murmur.

Case report

A 6-month-old infant presented with heart failure and continuous murmur. His vitals and routine biochemistry were normal. Echocardiography with colour Doppler in the parasternal short-axis view confirmed large PDA (8 mm)

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with left to right shunt. The chest X-ray revealed cardiomegaly, pulmonary plethora, enlarged left atrium and left ventricle. Devise closure was planned after proper consent. Femoral artery and vein were punctured by 21 G needle and 0.021" guide wires (Avanti transradial kit; Cordis Corp, USA) were inserted. 5F and 6F sheath were put in artery and vein respectively. Administered heparin dose was 400 U. 5F Pigtail catheter was put into femoral artery by placing its distal end into distal aortic arch. The angiogram was done to delineate the anatomy and size the PDA. 5F multipurpose catheter (MPA) was then tried to advance from the venous side into the PDA, but it failed due to difficult anatomy. Retrograde wiring was then planned by exchanging Pigtail catheter to MPA. 0.035" 110 cm Terumo wire was negotiated to pulmonary artery to right ventricle, finally reaching right atrium (RA) through PDA from aortic side and MPA was advanced to RA. MPA 1 was advanced over the wire reaching to RA. This wire was exchanged with long length super stiff Terumo wire (260 cm, 0.035") (Figure 1). A customised snare was constructed using 0.014" 230 cm Hi-torque BMW Guidewire (Abott Vascular, USA) and 6F JR4 Pro-Flo™ catheter (Medtronic, USA) (Figure 2). Distal end of the Terumo wire was then snared and exteriorised via femoral vein. MPA catheter was then removed from femoral artery keeping wire *in situ,* thus making a rail road (Figure 3). 5F MPA catheter was then advanced over Terumo wire from *venous side* antegrade to descending aorta and this wire was finally exchanged with 260 cm 0.035" super stiff Amplatz wire (COOK, USA). 12F Cocoon delivery sheath (Vasc Concept, UK) was tracked over the guide wire and the dilator was removed, leaving the sheath in the descending aorta (Figure 4). Cocoon Duct Occluder-12/10 mm (Vasc. Concept, UK) was mounted over the delivery cable by screwing it clockwise and by passing through the loader, an assembly was created-loader/cable/ /device. The assembly was connected to delivery sheath through loader by keeping device just short of tip of loader and was advanced into the descending aorta. The sheath

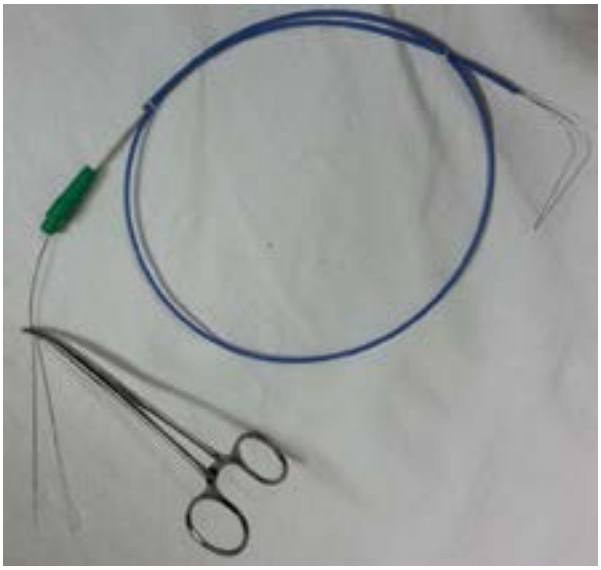

Figure 2. Customised snare prepared by exchange length BMW wire by passing through Judkin's Right diagnostic catheter and proximal end caught by arterial forceps

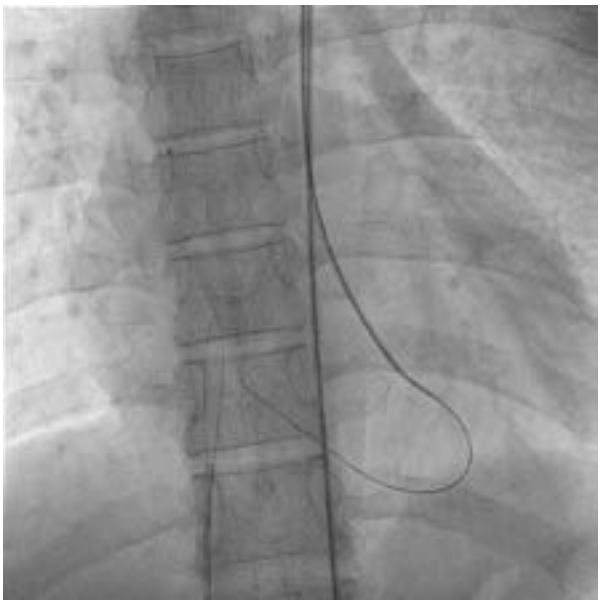

Figure 1. Soft tip of Terumo wire through retrograde route being caught by customised snare through antegrade route in right atrium

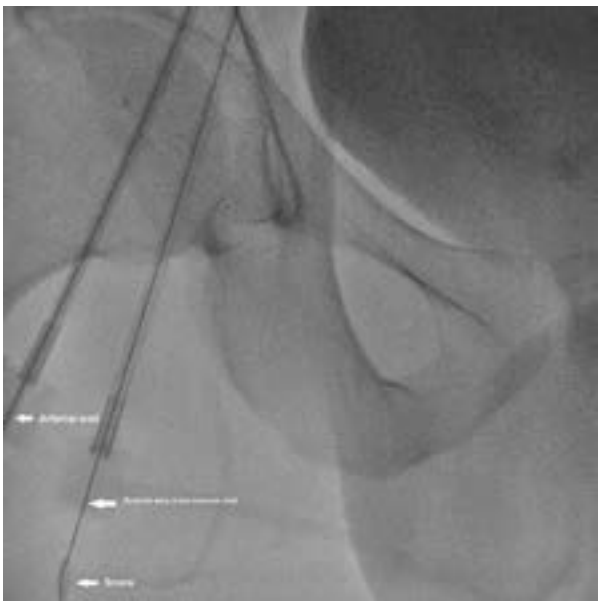

Figure 3. Distal end of the Terumo wire being snared and exteriorised via femoral vein

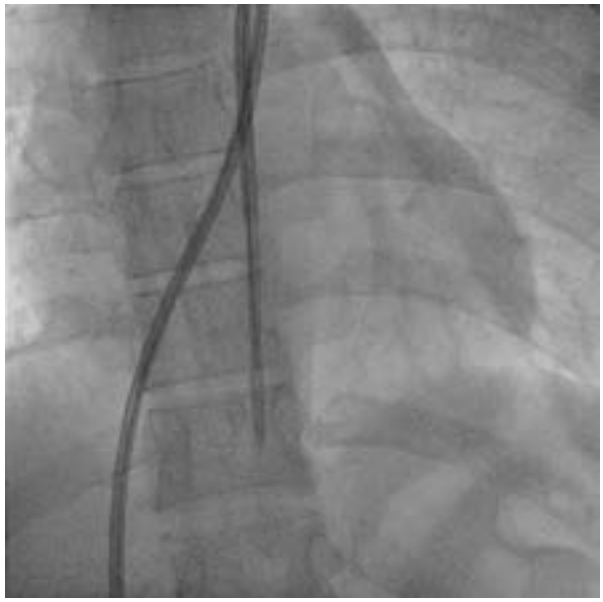

Figure 4. 12F delivery sheath in the descending aorta

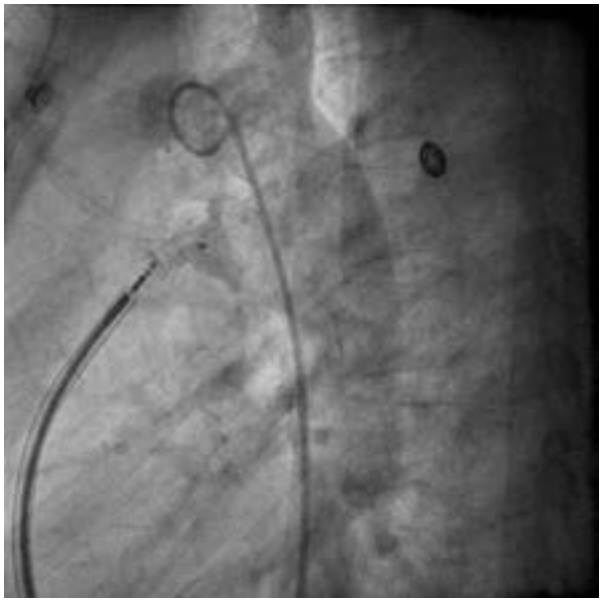

Figure 5. Fully opened patent ductus arteriosus device attached with delivery cable in left lateral view

was little retracted until the aortic side of disc was opened. The sheath with opened aortic end of the disc was pulled back as one unit until aortic side of disk was snugly fitted against the aortic end of the ampulla. The sheath was further pulled to release the pulmonary end of the device. Device position was checked in lateral view by doing an aortogram (Figure 5). After 10-min delay descending aortogram was again performed to rule out any residual leak and to ensure proper device position. The device was then released by turning the cable counterclockwise using the pin vise (Figure 6). Chest X-ray in the posteroanterior and lateral views were obtained to assess device position and trans-thoracic echo-Doppler was done to rule out any obstruction of the left pulmonary artery, descending aorta and residual leak. The patient was discharged next day in stable condition and has regular follow-ups since then.

Discussion

Anatomy of the PDA in the adult is remarkable for the presence of calcification and general tissue friability in the area of the aortic isthmus and pulmonary artery, which makes surgical manipulation in the adult more hazardous than in the child [2–4]. When a PDA occurs in isolation, device closure is usually feasible. The venous route has several advantages, including confirmation of PDA position before device release as the arterial catheter can be used for injection of contrast, avoidance of a large sheath in the femoral artery and the potential application of this technique to the very young infant who has PDA [5]. Sometimes when antegrade approach is difficult, it can be facilitated with the help of snare through retrograde

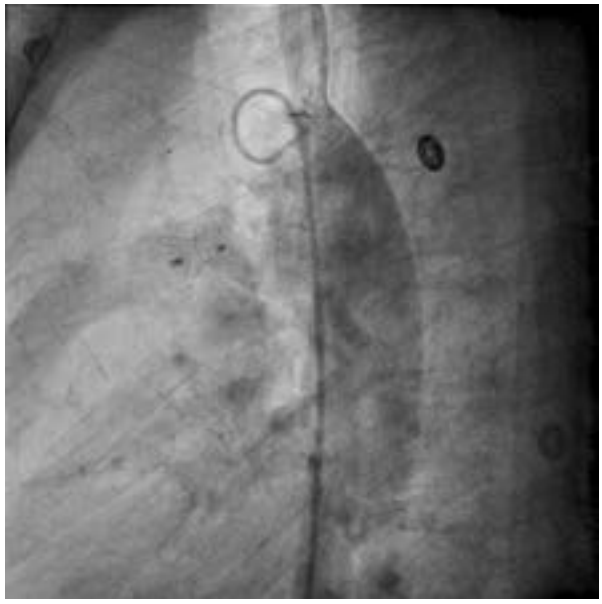

Figure 6. Well deployed Cocoon Duct Occluder with no residual shunt

route. The wire will serve as a guide to track the delivery system to cross the ductus from the venous side smoothly. Our case is unique in the sense that wiring was initially retrograde and snaring was antegrade, but finally very large device was smoothly deployed in usual antegrade fashion. Larger devices of this much size might find difficult for deployment. In the absence of conventional snare, it can then always be customised as we did. This retrograde wire-assisted technique could be utilised to overcome the PDA of difficult vascular anatomy, which could not be easily

fulfilled by conventional antegrade venous approach. The Cocoon Duct Occluder is made from nitinol wires coated with platinum using nano fusion technology. Nano platinum coating provides superior bio-compatible properties compared to bare nitinol. Platinum provides better radio opacity, which enables easy positioning of the device in the defect. It also prevents corrosion of nitinol wire frame in long term implants.

Conflict of interest(s)

None.

Streszczenie

Przetrwały przewód tętniczy (PDA) stanowi nawet 10% wszystkich wrodzonych wad serca. Przezcewnikowe zamknięcie PDA jest obecnie metodą z wyboru, która zastąpiła leczenie chirurgiczne. Zabieg przezcewnikowy jest prosty do przeprowadzenia i polega na umieszczeniu w przewodzie tętniczym specjalnych implantów lub sprężynek wprowadzanych z dostępu przez żyłę udową (technika zstępująca, *antegrade*) lub przez tętnicę udową (technika wsteczna, *retrograde*). W niniejszej pracy opisano przypadek pacjenta z PDA, u którego budowa anatomiczna naczyń uniemożliwiała zastosowanie techniki zstępującej, dlatego zabieg wykonano, wsuwając prowadnik przez tętnicę udową (*retrograde*) i wprowadzając przez żyłę udową (*antegrade*) pętlę wykonaną specjalnie na potrzeby zabiegu przez operatorów. Następnie implantowane urządzenie umieszczono na miejscu standardową techniką zstępującą (*antegrade*), wsuwając je po prowadniku za pomocą pętli. Tę technikę z użyciem prowadnika i pętli można wykorzystać do zamykania PDA u chorych z trudnymi warunkami anatomicznymi uniemożliwiającymi wykonanie zabiegu konwencjonalną metodą — wyłącznie z dostępu przez żyłę udową.

Słowa kluczowe: pętla wprowadzona techniką *antegrade*, przetrwały przewód tętniczy, pętla wprowadzona techniką *retrograde*, prowadnik wprowadzony techniką *retrograde* przezcewnikowe zamknięcie

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