Transcatheter closure of patent ductus arteriosus and interruption of inferior vena cava with azygous continuation using an Amplatzer duct occluder II

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ABSTRACT

We report a case of transcatheter closure of patent ductus arteriosus using the new Amplatzer duct occluder II in an adult patient with interrupted inferior vena cava with azygous continuation via the femoral artery approach.

Keywords: Patent ductus arteriosus, interruption of inferior vena cava, Amplatzer duct occluder II

DOI: 10.4103/0974-2069.58320

INTRODUCTION

Percutaneous transcatheter closure is the mainstay and considered to be a safe alternative to surgical ligation in the treatment of patent ductus arteriosus (PDA). Currently the most widely used device is the Amplatzer duct occluder for moderate to large PDAs and it has been proven to be safe and efficacious.[1] However, closure of a PDA in an adult patient with inferior vena cava (IVC) interruption can be both technically demanding and challenging. Technical problems have been encountered often because of the failure of advancing the sheath and kinking at the acute angle of azygous and superior vena cava junction and the right ventricular outflow tract toward the pulmonary artery. The symmetrical design of the new Amplatzer duct occluder II (ADO II) has alleviated this technical hurdle with a retrograde approach via the femoral artery. We describe a successful transcatheter occlusion of a patent ductus arteriosus in an adult patient with interrupted IVC using an ADO II.

CASE REPORT

A 37 year old female was diagnosed with interrupted IVC with PDA 7 years earlier after an incidental finding of a heart murmur. Percutaneous closure of the PDA was attempted twice but was unsuccessful. She was subsequently referred for a surgical PDA ligation 3 years ago but defaulted on follow up. Her case was brought to our attention by an obstetrician for her history of congenital heart disease during her pregnancy. She was asymptomatic and well after the delivery of her first baby. A clinical examination revealed a normal first and second heart sound with a continuous murmur noted in the left infraclavicular region. A chest X-ray and ECG showed no significant findings. A two dimensional transthoracic echocardiogram (TTE) demonstrated a small PDA with no evidence of elevated pulmonary pressure or chambers dilatation.

We proceeded with a percutaneous closure of PDA using an ADO II through a retrograde approach under general anesthesia. A 6F sheath was placed in the right femoral vein and a 5F sheath was placed in the right femoral artery. A contrast injection in the IVC showed an interrupted IVC with well-developed azygous continuation draining to the superior vena cava [Figure 1a and b]. A descending aortogram done with a 5 F pigtail catheter (Cook, Bloomington, USA) showed a Krichenko Type A PDA[2] measuring 3.5 mm in diameter and 11 mm in length [Figure 2]. Hemodynamic data showed a Qp/Qs of 1.5 and the patient's pulmonary pressure was 34/22 mmHg (mean 28 mmHg). The PDA was crossed with a Judkins right catheter (Cordis, Minneapolis, MN, USA) and a 0.035" Terumo wire (Terumo, Tokyo, Japan). The wire was exchanged with a standard 0.035" exchange wire and followed by the removal of the catheter and femoral sheath. A 5 F TorqVue low profile delivery catheter (AGA Medical, Golden Valley, MN) was advanced over the wire from the descending aorta into the pulmonary artery. The PDA was occluded with the new ADO II 6 mm × 6 mm (waist 6 mm, length 6 mm) device screwed onto the delivery cable and pushed through the delivery catheter. A post device deployment angiogram showed

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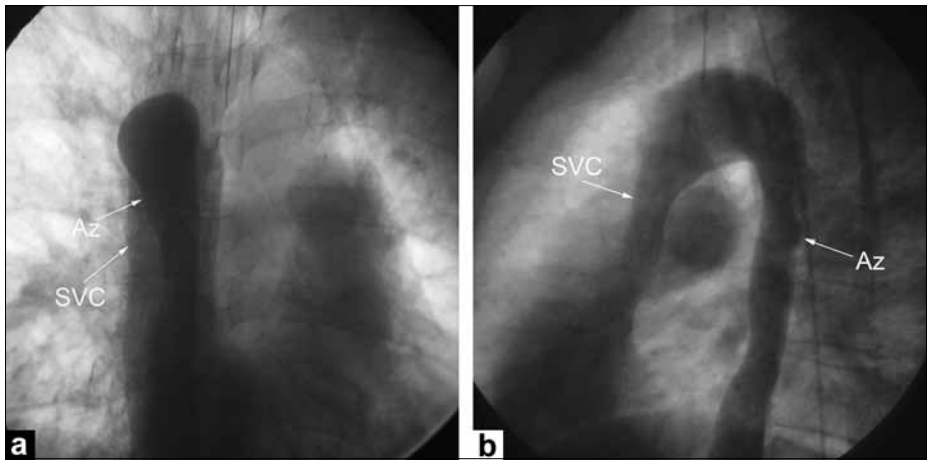

Figure 1: Contrast injection in the inferior vena cava showing azygous continuation from an interrupted inferior vena cava; (a) Anteroposterior projection demonstrating a well-developed azygous vein; (b) Lateral projection showing a reverse "U" loop at the level of the azygous vein draining into the superior vena cava. AZ: Azygous vein; SVC: Superior vena cava

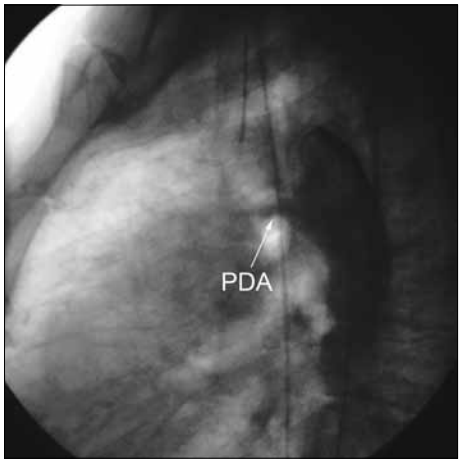

Figure 2: Descending aortogram demonstrating Krichenko type A patent ductus arteriosus

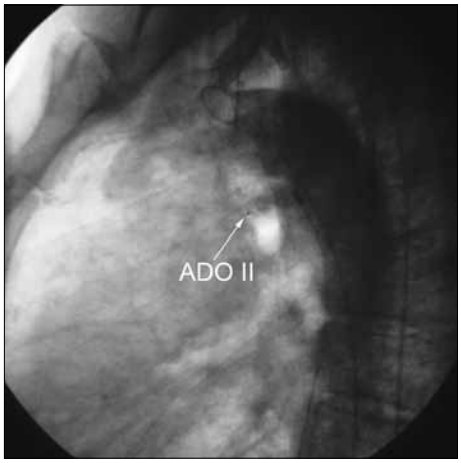

Figure 3: Post deployment descending aortogram showing no residual shunt across the ductus arteriosus

no residual PDA [Figure 3] with the device in a stable position. A repeat TTE the next day showed no residual shunt across the duct or flow acceleration in either the left pulmonary artery or the descending aorta.

DISCUSSION

Congenital anomalies of the inferior vena cava are uncommon in a normal heart. They are more commonly associated with complex cyanotic heart especially with left isomerism. The prevalence of interruption or congenital stenosis of IVC was found to be 0.15% in one large, adult population study based on routine abdominal computed tomography (CT) examinations.[3] This rare variation can be physiologically normal if there is well-developed azygous or hemiazygous continuation. However, interruption of IVC poses a significant difficulty in the closure of PDA using the traditional antegrade approach. Although it remains a considerable challenge, PDA can be occluded with an Amplazter duct occluder with the technique of forming an arteriovenous guidewire loop or a flexible transductal "rail" for the advancement of the sheath.[4]

With the new ADO II device, closure of PDA via an arterial approach in this patient was done without difficulty. The ADO II device consists of a self expanding multi-layer nitinol wire braid with symmetric retention disks and an articulating connecting center waist. Both discs are 6 mm larger than the diameter of the connecting waist. The device contains no sewn-in polyester fabric, which decreases the profile. The symmetrical design of the device and the low profile delivery allowed the retrograde approach via the femoral artery in this patient. The connecting waist diameter of the device ranges from 3 to 6 mm and its length is available in 4 and 6 mm. The initial experience in children using ADO II for small and moderate to large PDAs is promising as reported by Thanopoulos.[5] The device is also highly effective in occluding morphologically varied PDAs.[6]

In adult patients, PDA can be associated with calcification,

tortuosity, and an eccentric ductal lumen.[7] These can add technical complexities to the aforementioned interrupted IVC in an adult patient.

Without resorting to complex implantation techniques, the Amplatzer vascular plug is a device that can be considered in this patient via a retrograde approach. However, this device is not specifically designed for PDA closure and in the absence of polyester patches, might result in significant residual PDA. The ADO II design provides six levels of occlusion[8] resulting in optimal closure of PDA even without sewn-in polyester. One could also consider the multicoil technique[9] using Gianturco coils via the femoral artery approach if the size of the PDA is smaller but with the risk of embolisation. Overall, without the advent of the new device, the options for this patient are limited and technically difficult with the exception of surgical ligation.

We conclude that the new ADO II with its innovative low profile and symmetrical design allows transcatheter closure of PDA via a retrograde approach from the femoral artery in patients with interrupted IVC without difficulty.

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Source of Support: Nil, **Conflict of Interest:** None declared