Annals of Clinical and Medical Case Reports

Case Report ISSN 2639-8109 | Volume 10

Pulmonary Arterial Embolization of an Amplatzer™ Vascular Plug after Patent Ductus Arteriosus Closure in a 12-Year-Old Patient

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Received: 10 Apr 2023
Accepted: 08 May 2023
Published: 15 May 2023
J Short Name: ACMCR

Citation:

Arous S, Pulmonary Arterial Embolization of an Amplatzer™ Vascular Plug after PatentDuctus Arteriosus Closure in a 12-Year-Old Patient. Ann Clin Med Case Rep. 2023; V10(20): 1-3

Keywords:

Patent ductus arteriosus; Congenital heart disease

Abbreviations:

PDA: Patent Ductus Arteriosus; AVP: Amplatzer vascular plug; PA: Pulmonary Artery; IV: Intravenous; Qp: Pulmonary blood flow; Qs Systemic blood flow

1. Abstract

Currently, the primary approach for treating patent ductus arteriosus (PDA) is an alternative non-surgical strategy. Various devices are used for transcatheter closure of PDA. However, the embolization of these percutaneous devices is a rare yet severe complication. In this case, a 12-year-old girl underwent a successful attempt to close her PDA using an Amplatzer device. At the next morning echocardiography control, the device was found to be dislodged and migrated to the right pulmonary artery.

2. Introduction

The use of an alternative non-surgical strategy for closing patent ductus arteriosus (PDA) has been well-established through various studies [1-5]. This approach involves the placement of an intra-ductal plug or occlusion device, which has shown reasonable success in achieving long-term outcomes. However, the major drawbacks of this approach include longer procedure times, the introduction of intravascular foreign bodies, and potential misplacement and embolization. Currently, several devices are being used for transcatheter closure of PDA [5]. In this case, we present an emergency situation in which the PDA device became dislodged and migrated to the right pulmonary artery.

3. Case Report

An autistic 12-year-old Moroccan girl, with past medical history of pulmonary embolism under anticoagulant treatment 4 months prior, was incidentally diagnosed with patent ductus arteriosus (PDA). The clinical examination revealed a continuous left sternal border murmur and bounding pulses. The echocardiography showed a 5mm PDA with a peak systolic gradient of 51 mm Hg and left-to-right shunt on color Doppler. The left ventricle was dilated at 50mm, and moderate pulmonary artery systolic pressure was observed through trivial tricuspid regurgitation. No dilatation or dysfunction of the straight cavities or any other shunt was visualized.

The patient was admitted for transcatheter closure using a 5-mm Amplatzer™ vascular occlusion device under intravenous (IV) sedation. The angiography of the aorta revealed a continuous conical ductus of 5 mm, and the device was deployed with satisfactory results. However, the next morning, a routine follow-up echocardiography revealed that the device had migrated, following self-inflicted punches by the patient. The clinical examination was normal, including arterial oxygen saturation, except for a palpable thrill.

The patient was immediately brought back to the catheterization laboratory, where the fluoroscopy showed the exact situation of device embolization, located in the right pulmonary artery (PA) (Figure 1). Multiple attempts of embolized device closure retrieval were made but were unsuccessful. It was then decided to clinically monitor the patient and keep her under anticoagulant treatment, which resulted in good clinical evolution after several months.

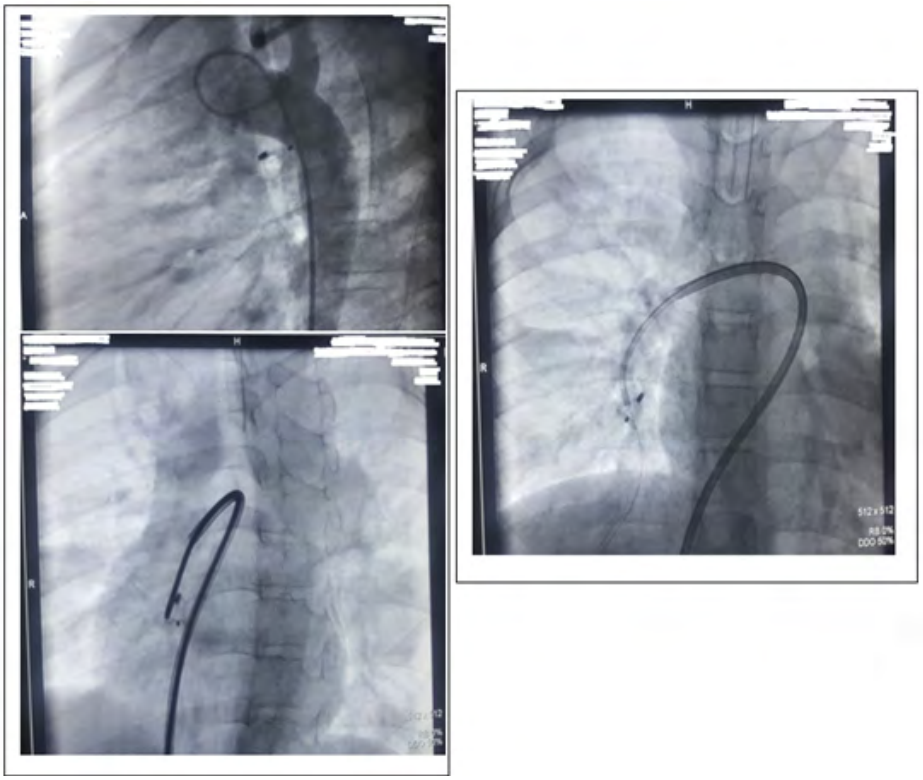

Figure 1: Invasive coronary angiography view shows the migrated Amplatzer™ vascular plug into the right pulmonary artery.

4. Discussion

Patent ductus arteriosus (PDA) is a rare congenital heart disease, occurring in approximately 1 per 2000 full-term live births, excluding silent PDA [1]. The female-to-male ratio is 2:1 [2]. Functional closure of PDA occurs 12 to 18 hours after birth, while anatomical closure happens in two to three weeks [2]. PDA is considered persistent if it remains patent after 72 hours, and is classified based on its diameter, length, and hemodynamic effect [3]. The Krichenko classification is based on the shape and orientation of the PDA [4].

The management of PDA depends on the size of PDA, pulmonary artery pressure, and the patient's general condition. According to the latest European Society of Cardiology guidelines, PDA closure is recommended in the presence of left ventricular volume overload, with no pulmonary artery hypertension (pulmonary vascular resistance < 3 WU) or significant left-to-right shunt (Qp/Qs > 1.5) and PVR between 3 and 5 WU [5].

Percutaneous closure is the most favorable treatment option for PDA, due to its high success rate, shorter recovery time, and lower complications. Closure can be achieved through the use of coils (for PDAs with a diameter of ≤3 mm) or by utilizing an occlusion device [6].

A recent study by Delaney and Fletcher reported no complications in 42 patients with various PDA morphological types who underwent PDA closure using the Amplatzer™ Vascular Plug (AVP) [7]. Similarly, Tuite et al. investigated 23 patients and reported no complications [8]. These findings were also confirmed in a six-month retrospective study conducted by Cho et al. [9].

In a series of 50 patients reported by Schwartz et al. who were treated with vascular occlusion procedure with AVP (20 patients had PDA), two cases with complications occurred after successful device deployment for PDA. The first patient required a blood transfusion due to major bleeding from the venous site puncture, while the other developed a femoral arteriovenous fistula [10].

Other cases have been described involving migration to lung arteries [11, 13, 14, 15, and 16].

An 8-month-old girl admitted to the Department of Paediatric Cardiac Surgery at the Pomeranian Centre of Traumatology in Gdansk presented with migration of an Amplatzer™ Duct Occluder II device (AGA Med. Corp., USA) to the left pulmonary artery after interventional PDA closure. Successful retrieval was achieved using a hybrid strategy, involving classical surgical closure of the PDA and simultaneous intraoperative minimally invasive catheter removal of the displaced implant from the left pulmonary artery using a muscle bioptome (Cook, EU). No further complications were reported.

Although percutaneous procedures for PDA closure in small children are safe and effective, they may be associated with a risk of complications, especially in patients with inconvenient anatomy [16].

Since the device is self-expanding, migration is very rare [8]. However, there is one case report of AVP migration into the abdominal aorta after deployment in the proximal left subclavian artery [11].

Hill et al. studied 89 AVP procedures from 11 centers and reported one AVP implanted in a large type PDA that required surgical

removal after five weeks due to significant residual flow through the device [12].

In our case, we implemented close clinical and echocardiographic follow-up after the device embolization, as the patient was asymptomatic. Surgical removal was discussed by the heart team but rejected to avoid further iatrogenic complications. This therapeutic option was retained in case of a complicated course during follow-up.

5. Conclusion

Percutaneous closure of PDA can be successfully performed in most patients, even symptomatic infants. Device closure should be preferred over surgical treatment when technically feasible, due to its high success rate and faster recovery time. However, it is important to be aware of potential complications such as Coils and plug migration following PDA closure. To minimize these risks, it is crucial to carefully select the appropriate device size based on multi-modal imaging, considering the ductal morphology, its narrowest diameter, the size of the descending aorta, and the patient's clinical characteristics. Additionally, careful clinical evaluation and follow-up are necessary in these patients.

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