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AMPLATZER™ Duct Occluder II AS embolization to left pulmonary artery related to thrombolytic therapy: Surgical rescue without cardiopulmonary bypass

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ABSTRACT

We report a case of a 7-month-old girl (5.2 kg), submitted to transcatheter closure of patent *ductus arteriosus* with AMPLATZER™ Duct Occluder II AS device. Six hours after the procedure the patient developed right inferior limb coldness with absent pedal and tibial pulse. Unfractionated heparin was immediately started. Doppler ultrasound confirmed the absence of flow in the right femoral artery, and thrombolysis with Alteplase infusion began, with positive results in the inferior limb ischemia.

The next morning echocardiogram showed a newly-patent *ductus arteriosus*. CT-angiography revealed an embolized device into the inferior lobar left pulmonary artery. Thus, to prevent late effects of a foreign object in the pulmonary artery, the patient was referred to surgery for device retrieval. Surgery outcome was positive without cardiopulmonary bypass. There was no sign of thrombus formation in the device mesh. Recovery was uneventful, and the patient was discharged five days after the operation.

To our knowledge, this is the first patient in whom surgery rescue of this specific device was successfully performed without the need of cardiopulmonary bypass.

1. Introduction

Recently, less invasive methods for closure of patent *ductus arteriosus* have gained popularity, such as thoracoscopic or extrapleural clipping, ligation with mini-thoracotomy and interventional catheter techniques. After being initially introduced by Portsman et al., alternative strategies of a non-surgical closure of patent *ductus arteriosus* have been the object of increasing attention after the report by Gianturco et al. Since that, several devices have been used with varying success rates. Although results of occlusion with these devices are reported to be satisfactory, some adverse events have been described. The complications of interventional treatment include lack of closure, embolization, left pulmonary artery stenosis, femoral puncture site problems and hemolysis.

2. Case Report

A seven month old female infant (5.2 kg, ex-preterm 32 weeks) with a history of recurrent lower respiratory tract infections was referred to our hospital because of a clinically significant patent *ductus arteriosus*. Echocardiogram evaluation showed *ductus arteriosus* with continuous left-to-right flow, smallest diameter > 3 mm, left atrium-to-aorta ratio > 1.8, left ventricle end diastolic diameter *Z*-score 2.8, without pulmonary hypertension. We decided to do a percutaneous closure of the *ductus arteriousus*. The catheterization was performed *via* the right femoral vein and left femoral artery (firstly we have unsuccessfully tried to cannulate the right femoral artery), with a 5 and 4 French introducers respectively. Hemodynamic data were obtained, allowing the calculation of shunt, systemic and pulmonary vascular resistances. Qp/Qs ratio was 4.3. A pre-implant lateral aortogram showed a tubular *ductus arterious* (type C), with 3 and 3.5 mm diameters in the pulmonary and aortic ends, length of 7.4 mm. We implanted transvenously an AMPLATZER™ Duct Occluder II AS 5 × 6 mm. Stability testing with gentle alternating pushing and retraction of the delivery cable was performed, and the cable was unscrewed and the device released. Post-implant angiography confirmed proper device positioning [Fig. 1].

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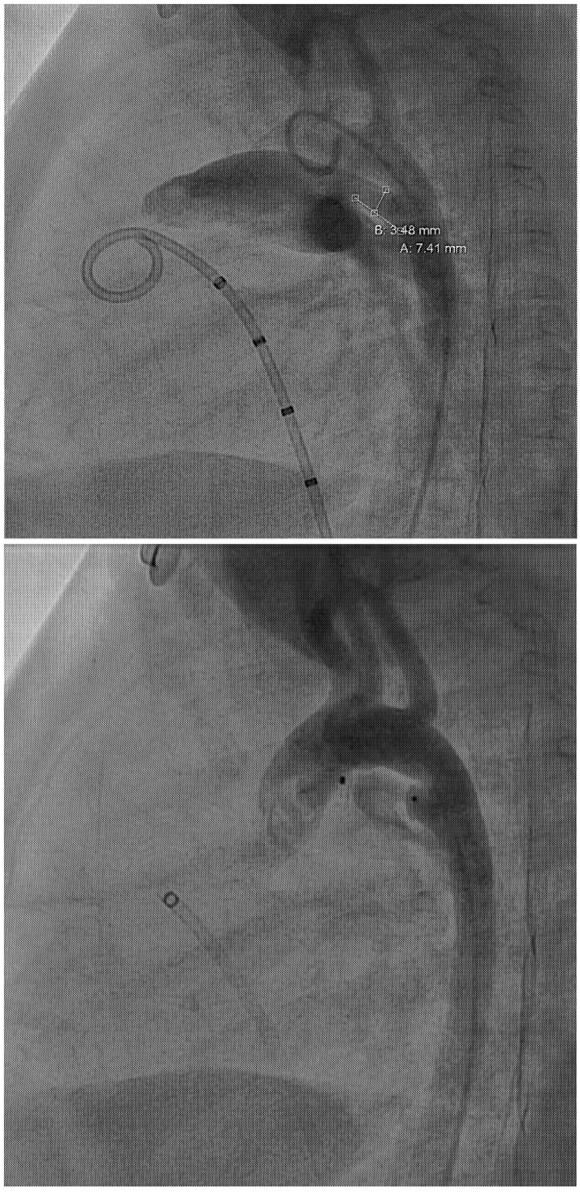

Fig. 1. Post-implant angiography.

During the recovery period, absent tibial and pedal pulse in the cannulated extremity was noted. She also had differential blood pressure between the right and left lower limbs. Therefore, we commenced unfractionated heparin according to our institutional protocol. Twelve hours later she was re-evaluated by vascular surgery, and a Doppler ultrasound showed the absence of flow in the right femoral artery. Hence, alteplase was initiated. The next morning, physical examination documented continuous murmur. Consequently, control echocardiogram revealed *de novo ductus arteriosus* with a continuous left-to-right flow [Fig. 2]. CT angiography showed embolization of the device into a left inferior lobar pulmonary branch [Fig. 3]. Alteplase was discontinued after the demonstration of thrombus resolution. Left thoracotomy was performed, and dissection was carried out around the left pulmonary artery, which was cross-clamped. Arteriotomy over the handled device facilitated its removal [Fig. 4]. The left pulmonary artery was primarily repaired using 6-0 prolene sutures without the need of any plasty. After the pulmonary artery repair, there were no signs of any constriction around it and no signs of thrombus formation in the device mesh. The *ductus arterious* was ligated and the entire procedure was conducted without cardiopulmonary bypass.

After six days of hospitalization, the infant was discharged asymptomatic. Follow-up assessment at 30 days' post-surgery with full echocardiogram evaluation showed no residual shunt, and no additional adverse events were reported.

3. Discussion

Percutaneous *ductus arteriosus* closure was first reported by Portsman in 1971 [1] and is now widely applied, with conventional surgery reserved for selected patients. Currently, for this purpose, there are different types of coils and Amplatzer devices that are most commonly used. The AMPLATZER™ Duct Occluder II AS is a particular device which allows safe and efficient implantation in neonates and small infants. Hence, reports of this device's embolization are rare [2].

Excluding the routine heparinization accompanying the arterial catheterization, anticoagulation is not required after device placement. The AMPLATZERTM Duct Occluder II AS device is devoid of any internal membrane, and its occluding capacity relies just on the central waist between 2 discs that provides six planes of double-layer nitinol. Furthermore, a tightly woven and single-layer mesh improves its occlusive properties. After a combination of mass effect causing gross occlusion plus successful thrombosis, the device becomes endothelized [3]. Diffuse residual flows after closure with the AMPLATZER Duct Occluder is well described. This flow usually declines and disappears over a period of few months [4]. The use of thrombolytic therapy dissolved clots already formed, leading to incomplete fibrosis of the *ductus arteriosus*, predisposing device embolization. Thus, we admit that the flow through the device mesh was the leading cause for this event. Percutaneous recapture of the device wasn't attempted due to its size (the biggest dimension), and the risk of re-embolization while redeploying it. Additionally, the other devices available were too big, and it could protrude into descending aorta with the risk of flow obstruction.

Immediate surgical intervention to remove the migrated device is indicated in hemodynamically unstable patients. Even in hemodynamically stable patients, surgical retrieval is preferred before inflammatory reaction of the vessel walls starts [5]. Most of the surgical attempts to remove these devices were conducted with the aid of cardiopulmonary bypass [5,6]. Aydin and Ozisik reported removal of the migrated coil from left lower pulmonary artery with the help of Fogarty without cardiopulmonary bypass [7].

Firstly, the rationale for this approach without extracorporeal circulation was due to the distal location of the device, being more favourable to perform by thoracotomy than by sternotomy. Secondly, it was under direct vision, which made it easier to palpate and thus remove the device. Finally, in the worst scenario, it could be necessary to perform a pulmonary artery plasty. Thereby, in the cases where the device migrates into pulmonary circulation, we believe that there is no advantage in using extracorporeal circulation for its resolution.

4. Conclusion

This case highlights the risks of early thrombolytic therapy after percutaneous occlusion of patent *ductus arteriosus*. Although the AMPLATZER™ Duct Occluder II AS placement results in virtually a 100% occlusion rate, the embolization may be directly related to the impairment of clot formation into device mesh. Notwithstanding its remarkable efficacy and safety profile, a few patients remain in whom surgical retrieval of the device and ligation is needed. Indeed, in cases of migration into pulmonary circulation, the procedure may be more safely performed without extracorporeal circulation, avoiding the endeavour and risks related to it.

Declaration of Interest

Authors declare there is no conflict of interest.

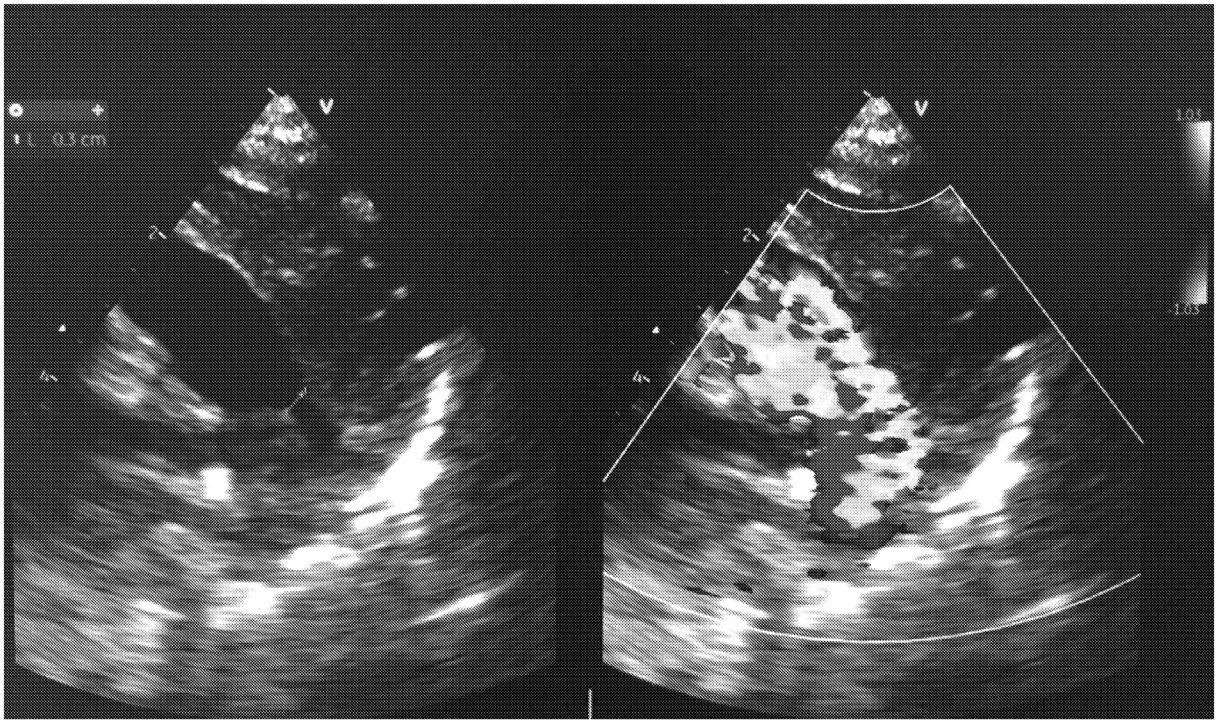

Fig. 2. *De novo ductus arteriosus* with a continuous left-to-right flow.

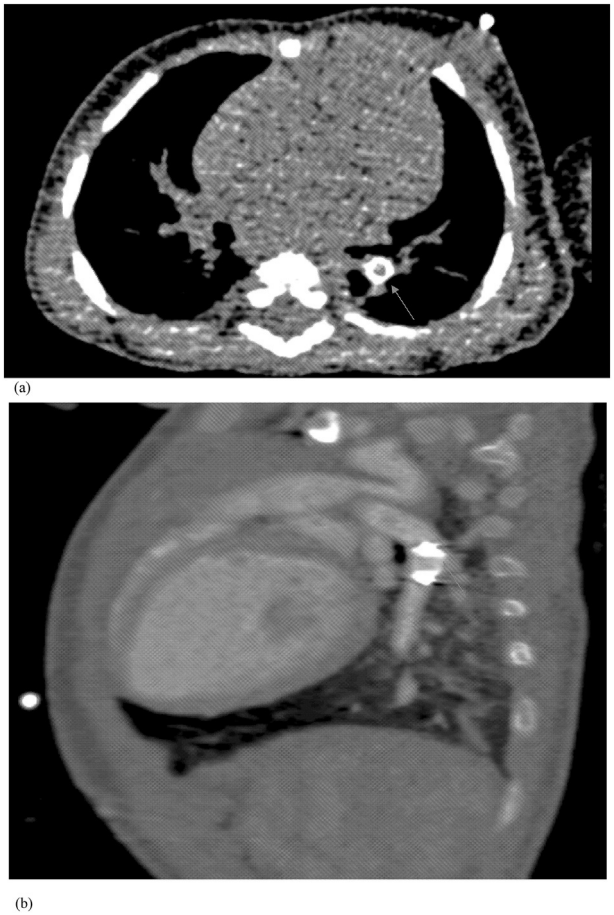

Fig. 3. CT angiography - embolization of the device into a left inferior lobar pulmonary branch.

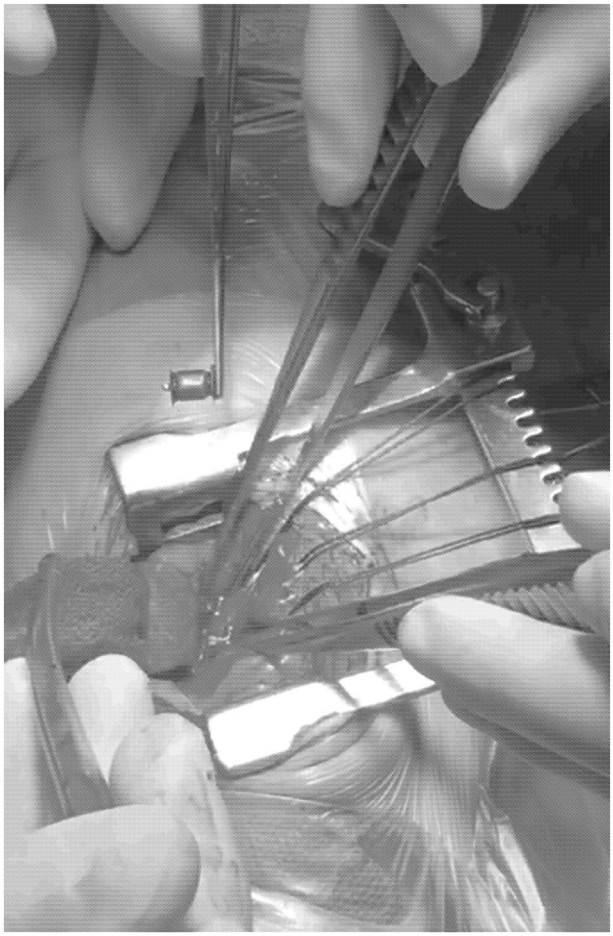

Fig. 4. Arteriotomy and device removal.

Compliance with Ethical Standards

- This study has no financial aid (no funding was received).
- This article does not contain any studies with human participants performed by any of the authors.
- Informed consent was obtained from all individual participants included in the study.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ppedcard.2018.10.001.

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