Delayed retrieval of embolized ductal stent: A surgical challenge

Biswa Ranjan Panda[1], **Jayashree Mishra**[2]
[1]Department of Cardiac Surgery, Bai Jerbai Wadia Hospital for Children, Mumbai, Maharashtra, India, [2]Department of Pediatric Cardiology, Bai Jerbai Wadia Hospital for Children, Mumbai, Maharashtra, India

ABSTRACT

Retrieval of embolized ductal stents from the pulmonary or systemic circulation can be challenging. Most children benefit from surgical shunts in such scenarios. Although early retrieval is advised, stents lodged in the peripheral pulmonary tree can be inaccessible, making the removal complicated. In such patients, stents can be "parked" in the segmental pulmonary arterial branches for retrieval later. In the low-pressure single ventricle pulmonary circulation, partially expanded embolized stents, if left *in situ*, can precipitate pulmonary arterial thrombosis. This subset of patients may benefit from meticulous anticoagulation and antiplatelet agents. In our case report, we describe the successful extraction of an embolized ductal stent without damage to the right lower lobe pulmonary artery (PA). In the follow-up evaluation, the growth of the right PA is good.

Keywords: Cavopulmonary shunt, ductal stent, migration, stent embolization

INTRODUCTION

Neonatal ductal stenting is a commonly performed palliative procedure for patients with congenital cyanotic heart disease and reduced pulmonary blood flow. This procedure is usually performed in selected patients whose pulmonary artery (PA) anatomy allows safe deployment of the stent without significant impingement on the branch pulmonary arteries. Infrequently, a ductal stenting procedure can have serious complications, such as stent thrombosis, ductal tear, stent migration, or embolization into one of the branch pulmonary arteries. We report a case of an embolized ductal stent in the lower lobar branch of the right PA, which was detected 5 months later during evaluation for second-stage palliation. The stent was retrieved during bidirectional cavopulmonary shunt surgery.

CASE REPORT

A 6-month-old infant presented to us with a diagnosis of pulmonary atresia, hypoplastic right ventricle, and restrictive ventricular septal defect. He had undergone a ductal stenting procedure at 1 month of age in another hospital and was lost to follow-up in the interstage period. The child had central cyanosis and a continuous 2/6 murmur on the left upper sternal border. The chest roentgenogram showed the *in situ* ductal stent and another stent in the hilar right PA [Figure 1a]. Echocardiography confirmed flow through the *in situ* ductal stent, which had partially migrated to impinge on the origin of the left PA orifice. The embolized stent was in the hilar right PA, with blood flowing around it [Figure 2a and b]. A computed tomographic pulmonary angiogram demonstrated the embolized stent in the right lower lobar branch with protrusion into the hilar right PA [Figure 1b]. The stent patency and preservation of right lower lobe vascularity were confirmed.

Under normothermic cardiopulmonary bypass, the stented ductus was clipped. The right PA was opened at

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Address for correspondence: Dr. Biswa Ranjan Panda, Cardiac Office, 2nd Floor, Bai Jerbai Wadia Hospital for Children, Parel, Mumbai - 400 012, Maharashtra, India.
E-mail: drbiswapanda@gmail.com

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the site of the proposed superior vena cava anastomosis. The expanded coronary stent (11 mm × 3.5 mm) was found embedded in the right lower lobar branch protruding into the right PA [Figure 3a]. With gentle manipulation, the embedded stent was extracted without causing any obvious endothelial damage [Figure 3b]. A bidirectional cavopulmonary anastomosis was completed. The protruding part of the *in situ* ductal stent was excised through a small incision in the PA confluence. The incision on the PA confluence was repaired. Postoperative anticoagulation was maintained by heparin infusion, which was switched over to oral aspirin and clopidogrel before discharge. At 6-month follow-up, the bidirectional cavopulmonary shunt is functioning well, and echocardiography demonstrated patency of the right lower lobe PA [Figure 2b]. Antiplatelet therapy is planned for 1 year.

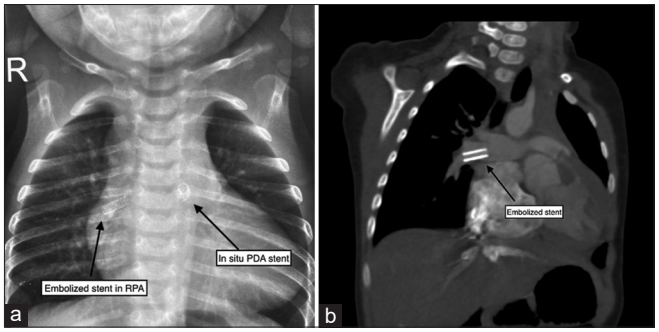

Figure 1: (a) Chest roentgenogram showing the embolized stent in the right branch pulmonary artery, (b) Preoperative computed tomographic scan showing the stent

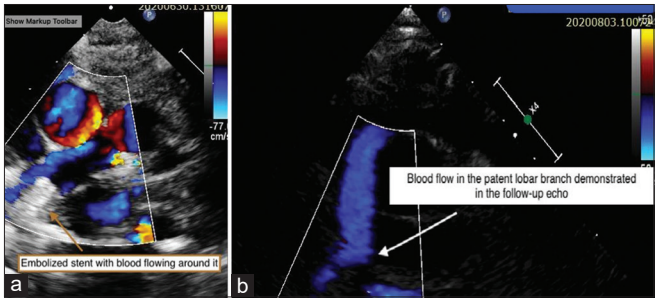

Figure 2: (a) Preoperative echocardiography showing embolized stent and blood flowing around it, (b) Postoperative echocardiography showing patent branch pulmonary arteries with good flow

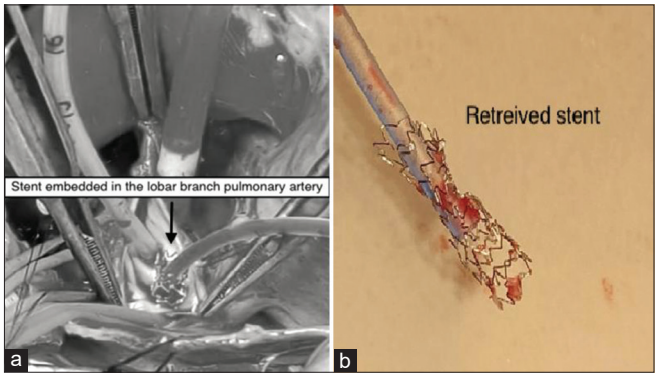

Figure 3: (a) Intraoperative view of the stent being retrieved from the branch pulmonary artery, (b) Retrieved stent

DISCUSSION

Patent ductus arteriosus (PDA) stent dislodgement and migration is an uncommon complication. The incidence is approximately 0.9%–2.4% and is commonly seen in children with a PDA diameter of more than 2.5 mm.[1] Newly deployed stents can easily migrate distally in the direction of blood flow, or proximally following guide wire retrieval. A stent that has migrated, can obstruct the PA branch, mimicking acute pulmonary embolism. Few cases have been reported in the literature with individual experiences of dealing with displaced stents. Michel-Behnke *et al.*, in their series, have described techniques of either transcatheter removal or permanent "parking" of the embolized stent in one of the lobar branch pulmonary arteries. These children were resuscitated successfully with systemic to pulmonary shunts.[2] Pavithran and Sivakumar have successfully performed transcatheter retrieval of embolized ductal stent from pulmonary circulation and redeployment in the PDA, the only case described in English literature.[3] Ductal stents can also embolize the systemic arterial circulation and lodge distally requiring peripheral vascular exploration for retrieval as demonstrated by Alwi *et al.*[1] Children experiencing the complication of ductal stent embolization generally need emergency surgery as a salvage procedure.[4,5]

Children with elastic ducts who are receiving prostaglandin while undergoing the procedure have a higher incidence of embolization. A higher stent-to-duct diameter ratio is recommended in such patients to avoid stent mobility.[1,2] If percutaneous retrieval of migrated stents fails, surgical removal with cardiopulmonary bypass and pulmonary arteriotomy adds to the complexity of the systemic pulmonary shunt. Acute embolization can lead to severe hemodynamic compromise, which may require resuscitation and extracorporeal life support, as well as emergency systemic to PA shunt.[6,7]

Leaving the embolized stent in the pulmonary circulation, though it reduces the complexity of the procedure, carries the risk of stent-related thrombosis, and distortion and growth restriction of the PA. In our patient, the detailed history of embolization and distal parking with peripheral stent deployment could not be traced. However, the presence of the stent at the site of cavopulmonary anastomosis and future Fontan extracardiac conduit anastomosis, and the higher risk of thrombosis in a low-pressure, single ventricle circulation demanded removal.

The migration of shunts can be total (to the hilar left or right PA embedding in the segmental branches) or partial (projecting from the roof of PA confluence or protruding in the orifice of the left or right PA. The long-standing presence of the stent leads to endothelial growth of the embedded part of the stent, which makes the extraction challenging.

The principle of stent retrieval involves either complete enucleation or maximum removal of the foreign body with minimal damage to the endothelium and the establishment of an unobstructed path for blood flow. Stents protruding from the PDA orifice are debrided with an incision in the PA confluence. If the metallic grid is fused with the left or right pulmonary orifice, careful trimming minimizes endothelial avulsion and predisposition for PA origin stenosis in the future.[4] In case of major damage to the PA segment, a pericardial patch augmentation protects from scar contracture and PA narrowing. Piecemeal removal of the stent is advised on patients where intact stent cannot be retrieved in total. Vladimiro *et al*. in their study reported that during elective surgical repair, PDA stents were completely retrieved in only 23% of patients. In 77% of patients, the dense fusion of the stent to the vascular wall necessitated partial excision. Nearly half (53%) of children in their series required surgical PA plasty. In patients with complete fusion of the stent, segmental resection of the PA was needed to achieve complete stent retrieval.[4]

In patients where the shunt is densely embedded into the lobar branch PA, a debridement attempt leads to significant distortion of the segment and risk of cutoff from the branch PA in the future. Leaving a small piece of stent *in situ* at surgery, and periodic balloon dilation in the catheterization laboratory can be considered to maintain the integrity of the pulmonary vascular tree. An unretrieved stent in the low-pressure cavopulmonary or Fontan circulation carries an indefinite risk of thrombosis and failure of cavopulmonary and Fontan circulation physiology. However, leaving the stent in inaccessible areas is advisable to avoid permanent damage to the peripheral pulmonary tree.

CONCLUSIONS

Managing an embolized stent is a challenge for the interventional cardiologist as well as the surgeon. Removal of the embolized stent and establishment of pulmonary blood flow requires surgical intervention in most of the patients. Maintaining a good branch of PA anatomy is essential as many of these patients subsequently undergo univentricular palliation. The risk–benefit assessment of removal versus leaving *in situ* is customized as per the patient's condition.

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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.

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Conflicts of interest

There are no conflicts of interest.

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