

EMBOLIZATION OF THE SYSTEMIC ARTERIAL SUPPLY IN A CHILD

Edmundo Pereira de Souza Neto ^{1,2}, Delphine Gamondes ³, François Sassolas ⁴

¹ Hospices Civils de Lyon, Groupement Hospitalier Est, Hôpital Neurologique Pierre Wertheimer, Service d'Anesthésie Réanimation, 59 boulevard Pinel, 69677, Bron, Cedex, France.

² Laboratoire de Physique, CNRS UMR 5672, École Normale Supérieure de Lyon, 46, allée d'Italie, 69364 Lyon Cedex 07, France.

³ Hospices Civils de Lyon, Groupement Hospitalier Est, Hôpital Louis Pradel, Service de Radiologie, 28, avenue Doyen Lépine, 69677, Bron, Cedex, France.

⁴ Hospices Civils de Lyon, Groupement Hospitalier Est, Hôpital Louis Pradel, Service de Cardiologie C, 28, avenue Doyen Lépine, 69677, Bron, Cedex, France.

PJR July - September 2008; 18(3): 92-95

Introduction

Normal pulmonary venous circulation carries oxygenated blood from the alveolar capillaries to the left side of the heart for systemic distribution. Systemic-to-pulmonary artery collaterals can develop and may be an important source of blood supply to the lungs.^{1,2} They usually arise from the aorta or its branches and communicate with the pulmonary arteries at various levels. The diagnosis is made by transthoracic or transesophageal echocardiography, angiography, and more recently by computed tomographic angiography or magnetic resonance angiography.

If the amount of blood flowing to the inferior vena cava from the anomalous pulmonary veins is small, no therapy is required. Surgical correction should be considered in the presence of significant left to right shunting ($Q_p/Q_s = 2:1$) and pulmonary hypertension.^{1,3} Aortopulmonary collateral arteries can be closed either in the cardiac catheterization by placement of occluding coils or other devices, or surgically.²

We report the case of a child who benefits from closure of persistent Ductus Arteriosus canal by Amplatzer™ vascular occlusion device and embolization of the abnormal of systemic arterial collaterals by coils.

Case Report

A sixteen-month-old female, weight 10 kg and height 86 cm, with a body mass index of 14 kg.m^{-2} presented with dextrocardia and interventricular septal defect diagnosed in utero by echocardiography, with evidence

of a patent ductus arteriosus. She has been hospitalised several times for pulmonary infections. She has a normal growth without any neurological symptom. On physical examination, the heart sounds were only right sided. The electrocardiogram showed right axis deviation and right ventricular hypertrophy. The echocardiography showed a right-sided heart, an increased pulmonary pressure and a large persisting arterial canal with a left-to-right shunt.



Figure 1: Computed tomography angiogram shows a right large inferior pulmonary vein.

Cardiac catheterization demonstrated an increased pulmonary pressure (pulmonary artery pressure 63/31 mmHg, systemic pressure 73/38 mmHg). The pulmonary hypertension was not changed by nitric oxide or by arterial canal occlusion. There was a

Correspondence : Edmundo Pereira de Souza Neto
Service d'Anesthésie Réanimation,
Hôpital Neurologique Pierre Wertheimer,
Groupement Hospitalier Est,
59 boulevard Pinel, 69677, Bron, Cedex, France.
E-mail: edmundo.pereira-de-souza-neto@chu-lyon.fr

moderate left-to-right shunt (pulmonary/systemic flow ratio: 1.3) a hypoplasia of the right lung and the right pulmonary artery and an abnormal systemic artery, originating from the abdominal aorta below the origin of the Celiac trunk supplying blood to the right inferior lobe. The pulmonary venous return was normal. There was a normal variant with a large right inferior pulmonary vein draining in the left inferior pulmonary vein and then in the left atrium. Computed tomography confirmed these findings (Fig. 1).

Medical team decided to close the persistent arterial canal by Amplatzer™ (Fig. 2) and the abnormal of systemic artery by coils (Fig. 3).

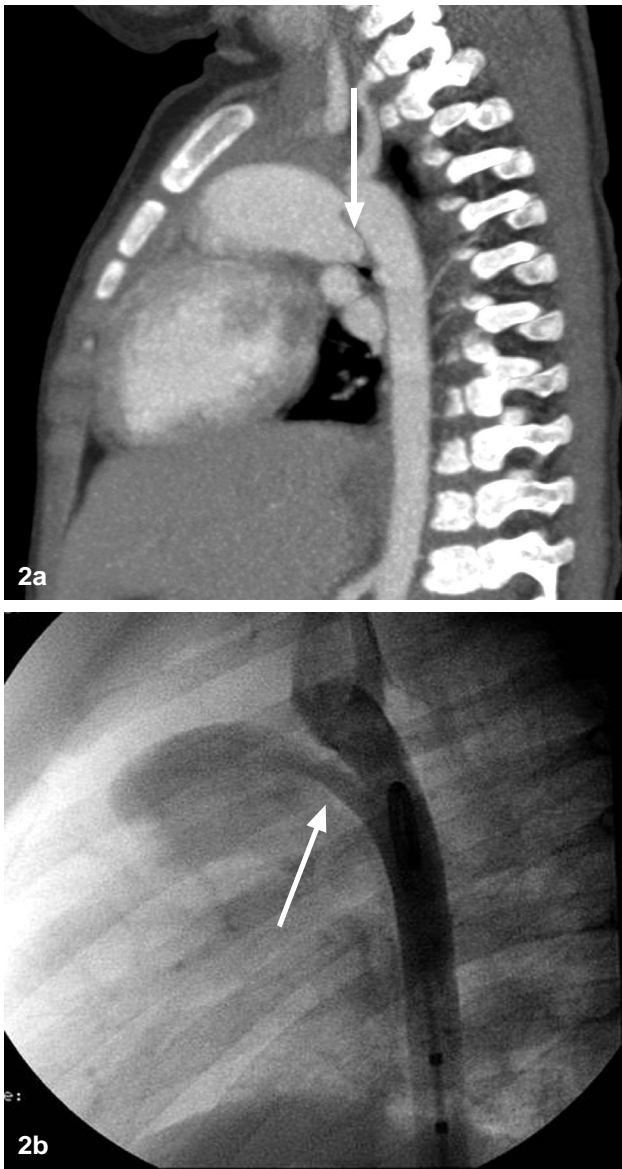


Figure 2 : Persistent arterial canal.
2a: Computed tomography angiogram.
2b: Digital subtraction angiography.

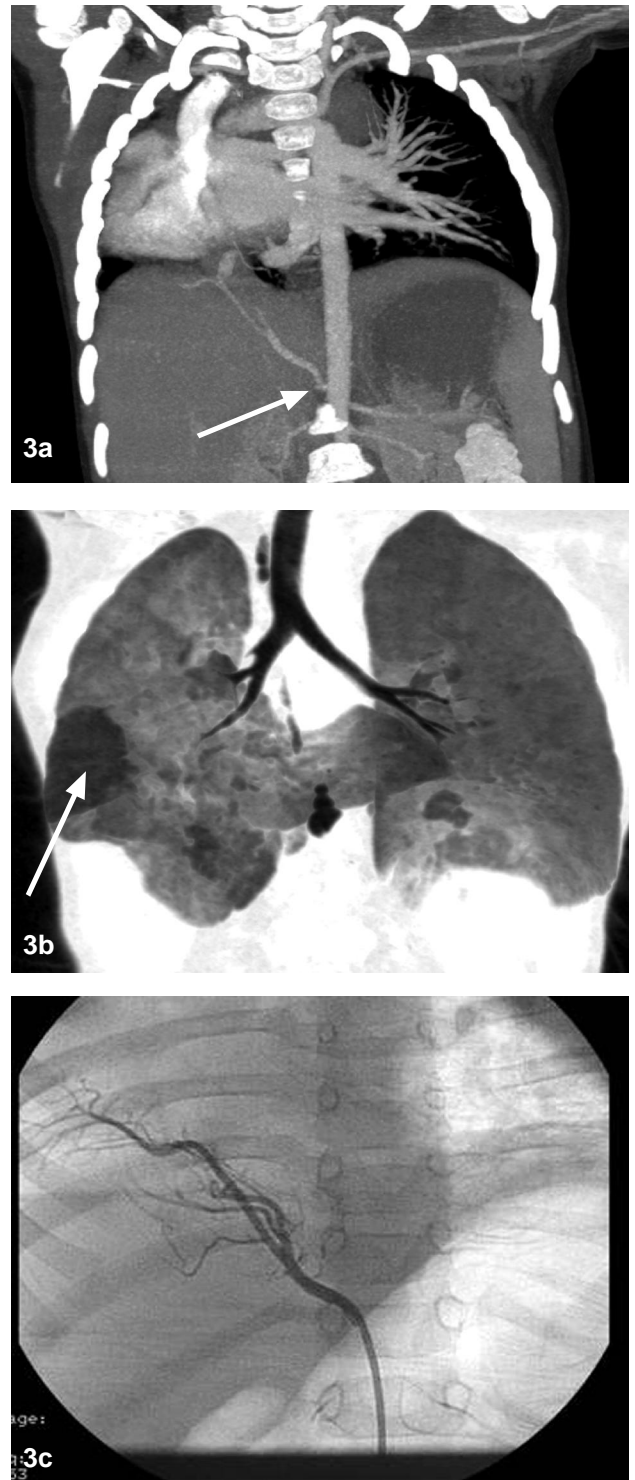


Figure 3: The systemic artery originating in abdominal aortic below the beginning of Celiac trunk.

3a: Computed tomography angiogram with a Maximum Intensity Projection (MIP) reconstructions shows the systemic artery.

3b: Computed tomography with Minimum Intensity Projection MinIP) reconstructions show the hyperclarity of the sequestered lung, with a transmediastinal lung hernia.

3c: Digital subtraction angiography.

The procedure was performed under general anaesthesia (sevoflurane and sufentanil). After anaesthesia induction the trachea was intubated and mechanical ventilation was started. The catheterisation was performed through the right femoral artery and left femoral vein.

First of all, the systemic artery was catheterized with a 5 French vertebral catheter; the injection confirmed the computed tomography data. Four detachable coils (Jackson 35-4-3; William Cook Europe, Bjaeverskov, Denmark) were delivered successfully. The systemic artery was completely occluded in ten minutes (Fig. 4).

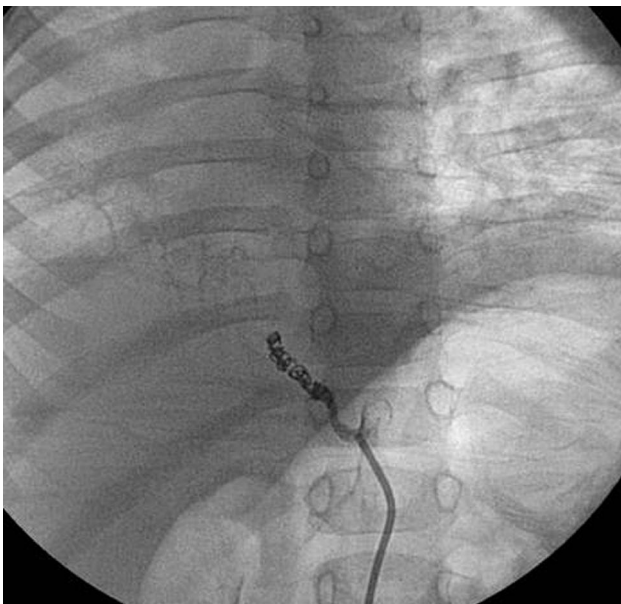


Figure 4: Digital subtraction angiography shows the occlusion of the systemic artery with coils

Secondly, a 6 French right coronary artery catheter has been introduced in the pulmonary artery and the persistent arterial canal was catheterized with a 0.035" guidewire. This was replaced with a rigid guidewire, allowing the placement of the Amplatzer - sheaf.TM The AmplatzerTM device was delivered in the persistent arterial canal which were also occluded rapidly (Fig. 5).

No passage of contrast was seen beyond the coils and by the persistent arterial canal after the procedure. No significant pressure differences were detected in the pulmonary artery.

The hospital stay was uneventful and the child was discharged 2 days after the procedure.

Although a repeat cardiac catheterization a year later demonstrated that pulmonary pressure was still high

(pulmonary artery pressure 62/23 mmHg, systemic pressure 80/43 mmHg) the patient was asymptomatic and had not had any chest infection in the year since the procedure.

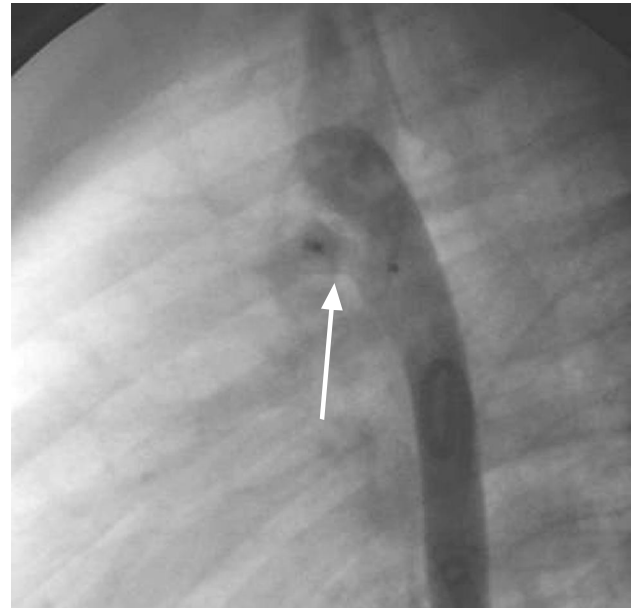


Figure 5: Digital subtraction angiography shows the occlusion of the arterial canal with an Amplatzer.TM

Discussion

Pulmonary sequestration is defined as a segment of lung parenchyma separated from the tracheobronchial tree and receiving its blood supply from a systemic artery rather than a pulmonary arterial branch.^{2,3} This systemic artery usually arises from aorta or its branches and anastomoses with the pulmonary arteries at various levels.^{2,3} An arterial supply to the right lung from the descending aorta may function as a large arteriovenous fistula and normally, the size of the shunt through these vessels determines the presence and severity of symptoms.^{1,4}

Therapeutic obliteration of selected arteries by embolization through a catheter has been used recently in a variety of situations and this technique proves to be an effective palliative measure.^{4,5} Transcatheter embolization is a safe and effective method to achieve vascular occlusion. It has been reported as an alternative to surgical ligation in symptomatic infants or to control infection in patients with pulmonary sequestration.³ In patients with congenital heart disease, embolization of systemic to pulmonary collateral vessels avoids lungs overperfusion and

surgical floods by the pulmonary venous return while the systemic vascular bed is underperfused.

Many embolic materials are available for therapeutic occlusion of vessels. The angiographic and embolic materials used should be tailored to the specific clinical situation.² Mechanical devices for the most part produce proximal occlusion of medium to larger vessels.⁵ Particulates occlude the terminal arterioles and liquid and sclerosing agents reach capillary vascular bed resulting in tissue infarction.⁵

In our report case, detachable coils were used because they allow safer, more accurate, and more distal embolization. Detachable coil systems permit controlled deployment of an embolization coil or simple retrieval of the device if it has been suboptimally positioned.⁶ The safety afforded by a retrievable system is of particular value when embolizing high-flow arterio-venous communications. The stainless steel coil is perhaps the most frequently used embolization agent by paediatric cardiologists.^{5,7} However few complications during deployment of a Jackson detachable coil have been reported.⁸

In our case, closure of the persistent arterial canal by Amplatzer™ and embolization of the abnormal of systemic artery by coils were safe, efficient, and fast. Although pulmonary pressure one year after embolization was persistently high the patient did not have any respiratory infection.

References

1. Bryan AC, Bentivoglio LG, Beerel F, Macleish H, Zidulka A, Bates DV. Factors affecting regional distribution of ventilation and perfusion in the lung. *J Appl Physiol* 1964; **19**:395-402.
2. Lois JF, Gomes AS, Smith DC, Laks H. Systemic-to-pulmonary collaterals vessels and shunts: treatment with embolization. *Radiology* 1988; **169**:671-6.
3. Felker RE, Tonkin IL. Imaging of pulmonary sequestration. *Am J Roentgenol* 1990; **154**:241-9.
4. Dickinson DF, Galloway RW, Massey R, Sankey R, Arnold R. Scimitar syndrome in infancy. Role of embolisation of systemic arterial supply to right lung. *Br Heart J* 1982; **47**:468-72.
5. Sim JY, Alejos JC, Moore JW. Techniques and applications of transcatheter embolization procedures in pediatric cardiology. *J Interv Cardiol* 2003; **16**:425-48.
6. Coley SC, Jackson JE. Endovascular occlusion with a new mechanical detachable coil. *AJR* 1998; **171**:1075-9.
7. Moore JW, Berdjis F. Coil occlusion of congenital vascular malformation and surgical shunts. *Prog Pediatr Cardiol* 1996; **6**:149-59.
8. Paul N, Robertson I, Kessel D. Fibre entanglement whilst using the Jackson detachable coil system a: potential pitfall. *J Interv Radiol* 1996; **11**:153-5.