Case Report

Surgical Treatment of Coil Embolization to the Pulmonary Artery After an Attempt at Percutaneous Closure of Patent Ductus Arteriosus

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The embolization of one of the 3 Gianturco coils used for closure of a large ductus arteriosus in a child aged 5 years and 6 months, located in the left pulmonary artery, required surgical intervention after 6 months, due to a decrease in perfusion to that lung. Section and suture of the ductus arteriosus were performed, and, with the patient under deep hypothermia and through left pulmonary arteriotomy, the obstructive coil was removed. That coil was located in the inferior lobar artery, adhered to the arterial wall, and covered with endothelium. Because no thrombus existed in the place, pulmonary arterial patency was totally reestablished.

The effectiveness, low complication rate, and adequate evolution of intervention with cardiac catheterization in several congenital cardiac defects have drawn the attention of the current therapeutic management to that method [1]. For percutaneous closure of ductus arteriosus, several devices have been used. However, Gianturco coils have become the most indicated device for small-diameter defects (up to 3 mm) due to their low cost [2], good efficacy, and low complication rate. The major complication is embolization [3] of the device, with an incidence ranging from 3.8% [4] to 20% [3], especially in ductus arteriosus greater than 4 mm and those with tubular morphology. The risk is attenuated due to the possibility of coil retrieval during the interventional catheterization itself [5], or due to the use of other more appropriate devices, such as the Amplatzer prosthesis [6]. The need for surgical removal of the embolus rarely occurs, which motivated this case report, in which embolization had occurred 6 months earlier, leading to impairment of perfusion to the left lung.

Case report

The patient was a male child aged 5 years and 6 months, admitted to the outpatient care clinics of the Instituto do Coração of the Faculdade de Medicina of the University of São Paulo with a history of fatigue on physical exertion and repetitive respiratory infections. On physical examination, the patient was in good general condition, active, afebrile, acyanotic, eupneic, and his pulses were wide in his 4 limbs. His weight was 22 kg and his height 116 cm. His heart rate was 90 bpm, and his blood pressure was 100/50 mmHg. His precordial area showed no deformities, and the cardiac apex was palpated on the fifth left intercostal space in the midclavicular line. The second cardiac sound on the pulmonary focus had increased intensity. A continuous murmur of great intensity was heard in the high left sternal margin, accompanied by a thrill of equal intensity. The pulmonary auscultation was normal, and no visceromegaly was evidenced.

The electrocardiogram showed sinus rhythm with a heart rate of 120 bpm, signs of left ventricular overload and diffuse alterations in ventricular repolarization. A simple chest X-ray showed a mildly enlarged cardiac area, bulging of the middle arch, and accentuation of the pulmonary vasculature, mainly in the hilar region.

Doppler 2-dimensional echocardiography confirmed the clinical suspicion of persistent ductus arteriosus with increased pulmonary blood flow and a diameter of 4.5 mm. It was characterized as having moderate hemodynamic repercussion.

The percutaneous treatment was chosen to close the ductus arteriosus. Because of the great dimension of the ductus arteriosus, 3 Gianturco coils (William Cook, Europe) were chosen and stacked. The procedure was not successful due to an accident in occluding the ductus arteriosus, with migration of the coils to the left pulmonary tree. In the same procedure, retrieval of 2 coils was possible; the last one became embedded in one branch of the left pulmonary artery, and could not be retrieved (fig. 1).

The patient underwent a complementary investigation to locate the precise site of coil embolization and to determine its repercussion on pulmonary perfusion. Pulmonary perfusion scintigraphy showed a decreased flow to the left lung (34%) as compared with that to the right lung (61%). In addition, chest computed tomography identified the presence of hypoattenuation of metallic density in the projection of the left descending interlobular artery.

Because of the impairment of pulmonary perfusion to the left caused by coil embolization, surgical treatment was performed in a programmed and elective manner approximately 6 months after interventional catheterization. Under balanced general anesthesia, the following steps were taken: median sternotomy, longitudinal pericardiotomy, and installation of extracorporeal circulation through the ascending aorta and bicaval cannulation. Section and suture of the ductus arteriosus was performed during the cooling

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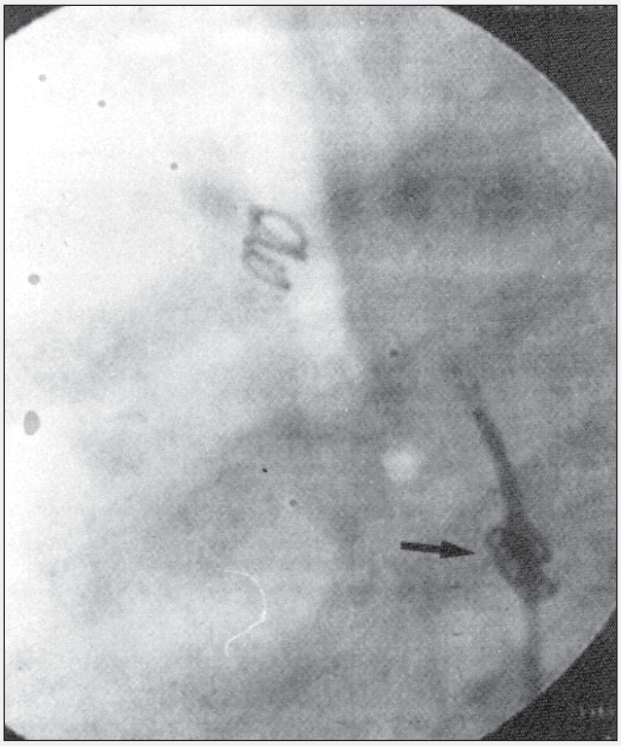

Fig. 1 - Image obtained on interventional catheterization, during which a coil detached from the site of the ductus arteriosus and become embedded in the left pulmonary artery (arrow).

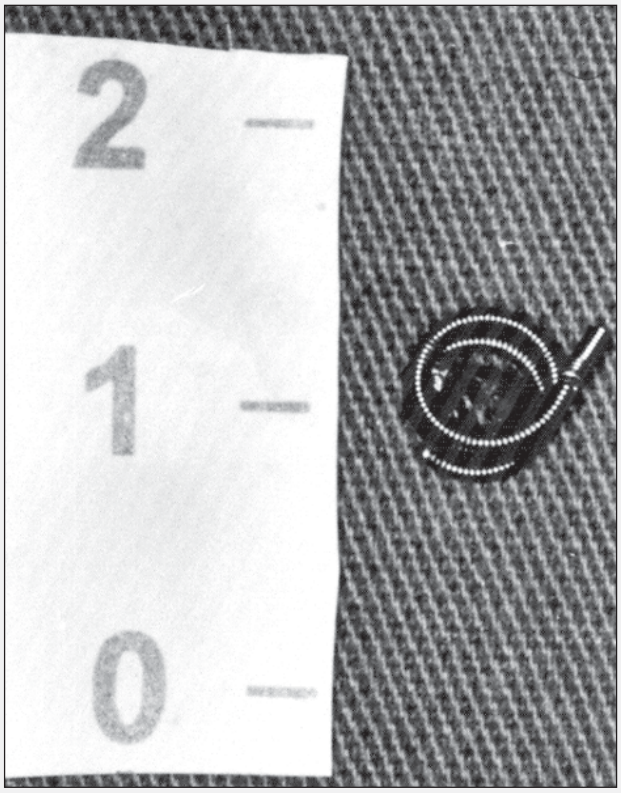

Fig. 2 - Pictures of the device (coil) for closure of the ductus arteriosus after its surgical removal from the left inferior lobar pulmonary artery.

period. With the patient under deep hypothermia at 20º Celsius and total circulatory arrest for 10 minutes, left pulmonary arteriotomy was performed, and the presence of a metallic material was identified in the left inferior lobar artery. The coil was well adhered to the arterial wall and covered with vascular endothelium, occluding blood flow to the corresponding pulmonary segment. No localized thrombosis was evident. The coil was completely removed (fig. 2) through right access, without the aid of endoscopy, because it was located in the lobar branch, leaving a slight denudement of arterial endothelium. As such, pulmonary arterial patency was reestablished.

The postoperative evolution was considered good and uneventful. The continuous murmur disappeared, the peripheral pulses normalized, and the patient was discharged from the hospital on the fourth day after surgical intervention.

Discussion

The treatment of persistent ductus arteriosus is traditionally surgical [7]. Recently, other less invasive techniques have gained emphasis, such as thoracoscopy [8], minithoracotomy with extrapleural access [9], and interventional catheterization [10]. The latter has gained increasing attention since the initial report by Gianturco et al [11] in 1975. Since then, some devices with varying efficacy and complex and expensive deployment systems have been investigated.

Technological progress led to the first percutaneous closure of ductus arteriosus using coils in 1992 [12], being established as the treatment of choice for patent ductus arteriosus with diameters smaller than 4 mm in many institutions worldwide. This fact is justified by its high degree of efficacy (88% [3] to 95% [4]), low index of complications, and costs similar to those of surgery in select groups of patients [13].

The complications of interventional treatment include the lack of closure of ductus arteriosus, embolization of the device, left pulmonary artery stenosis, lesion or occlusion of the femoral artery, and hemolysis. Embolization (3.8% of the cases [4]) may occur during the procedure or later, being more frequent in individuals with large-diameter defects, in which more than one device is used, as in the case here reported. Embolization occurs more commonly to the pulmonary circulation than to the systemic circulation, due to the pressure gradient existing between them. In most cases, the treatment of this complication consists of retrieving the device during the interventional procedure itself.

The report of cases requiring surgical relief of the emboli significantly obstructing a point in the pulmonary artery is rare, and some authors [4] even recommend the expectant management in these cases. In our opinion, the treatment of any embolization of foreign material to the pulmonary artery, which had not been rescued on interventional catheterization, should be surgical. Usually, the surgery is performed right after cardiac catheterization, which may facilitate the removal of the embolus, because no inflammatory reaction exists yet. In the present case, the removal was performed approximately 6 months after catheterization, which increased the technical difficulty, due to adherence of the coil to the arterial wall and its endothelialization. The procedure was beneficial, enabling arterial clearing and greater pulmonary perfusion, despite the need for extracorporeal circulation and total circulatory arrest. In addition, the endothelialization of the coil would have made its removal with new attempts on interventional catheterization impossible.

We believe that, in similar cases, surgical management should

be adopted, aiming at a better clinical and hemodynamic perspective, and at avoiding the possibility of endothelitis at the site of obstruction. Over time, in addition to the impaired pulmonary perfusion due to the increasing stenosis of the lobar artery, other complications could appear, such as the possible overload of volume and hypertension in other pulmonary territories. Infectious endothelitis in the site of arterial obstruction or close to it resulting from other deformities was the most expected and feared complication in this evolution. These elements reinforce the surgical management adopted, making it even obligatory in similar cases.

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