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Brief Report

Complete transcatheter closure of a patent arterial duct with subsequent haemolysis

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Abstract We report a development of severe haemolysis after complete transcatheter closure of patent arterial duct. Aortography and echocardiography revealed no signs of residual shunt. Haemolysis occurred a day after the implantation. Aortography was performed and the extrusion of coil in aorta was evident. The extruded part of the coil was surgically removed. No signs of haemolysis remained.

Keywords: Patent arterial duct; coil; complication; percutaneous occlusion

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In infants with a patent arterial duct, transcatheter closure by an occluder represents an alternative to surgical treatment, whereas in children it is a method of choice.[1,2] The availability of a variety of devices and the improvement of techniques enable the closure of the majority of patent arterial duct with catheter-based techniques.[3] The selection of a method of patent arterial duct closure largely depends on its minimal diameter, and to some extent, on its shape.[1,4,5] Small patent ducts usually require coils, whereas an Amplatzer duct occluder (AGA Medical Corporation, Golden Valley, Minnesota, United States of America) is frequently used for closure of moderate-to-large patent arterial ducts.

Serious complications of transcatheter closure of the patent duct are rare.[1]

We report here uncommon development of haemolytic anaemia that followed complete transcatheter closure of patent arterial duct. To our knowledge, there are no published data regarding such a complication in completely closed patent arterial ducts.

Case report

A 4-year-old girl was admitted to our hospital for the pre-arranged transcatheter closure of a patent arterial duct that was, together with pulmonary valve stenosis and atrial septal defect, diagnosed at birth. Later, cardiac anomaly had closed spontaneously, whereas patent arterial duct and pulmonic stenosis remained unchanged. Previous history data revealed heavy sweating with no exercise intolerance. On admission, physical examination revealed a holosystolic, three out of six, and quiet continuous murmur. Laboratory results were within referent limits, and the electrocardiogram and the chest radiograph were normal.

Echocardiography showed patent arterial duct, 2–3 millimetres in width, with accelerated flow through the pulmonary trunk, with the peak gradient of 40 millimetres of mercury. Cardiac catheterisation with aortography revealed a conical duct with a minimal diameter of 2 millimetres. The length of the aortic diverticulum was 4 millimetres and its maximal diameter was 5 millimetres (Fig 1). Using a multi-purpose angiographic catheter, a Flipper detachable coil (Bloomington, Indiana, United States of America), 5/5 millimetres in size, has been delivered to a patent arterial duct in a retrograde fashion through the right femoral artery. Aortography performed 10 minutes after the procedure revealed complete closure of the patent arterial duct with the extrusion of the coil in the aorta (Fig 2). Diagnostic cardiac catheterisation of the right-sided cardiac structures revealed mild pulmonary valve stenosis with an estimated pressure gradient of 23 millimetres of mercury.

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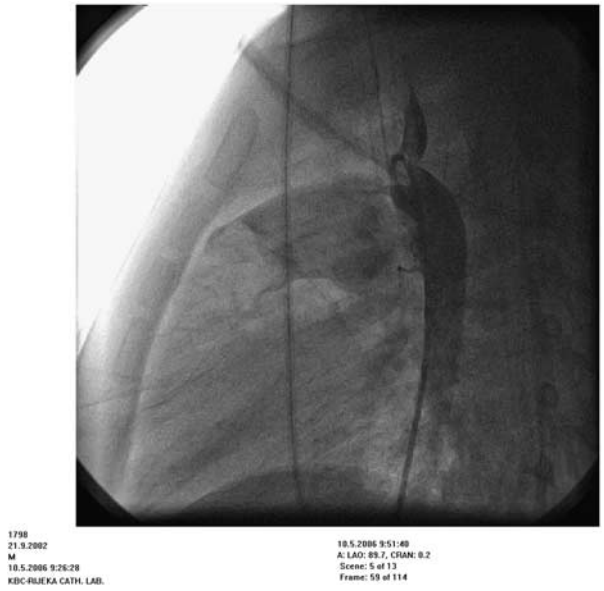

Figure 1.
Conical duct shown on aortography.

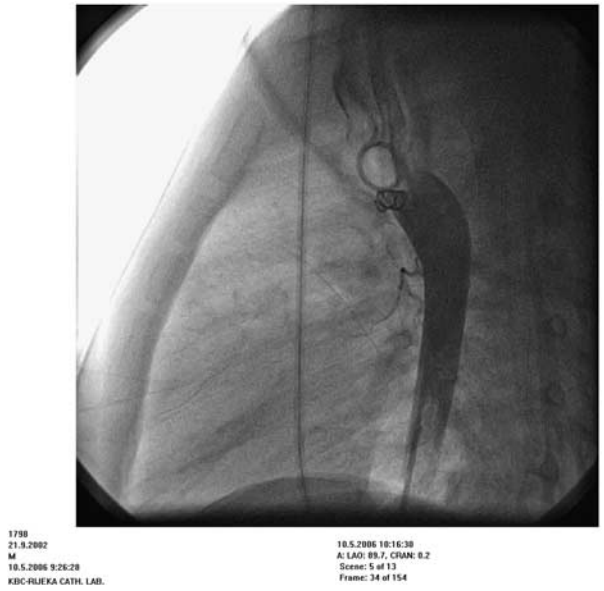

Figure 2.
Complete closure of the patent arterial duct 10 minutes after the procedure.

Control echocardiography evaluation showed adequate position of the coil and no signs of residual shunt. However, the extrusion of the coil in the aorta was evident with mild flow turbulence.

On the second post-implantation day, the patient was discharged from our hospital. On Haemoglobinuria and jaundice were developed on the same day and the girl was admitted to the hospital in her native town. Repeated laboratory findings revealed decreased haemoglobin levels, decreased number

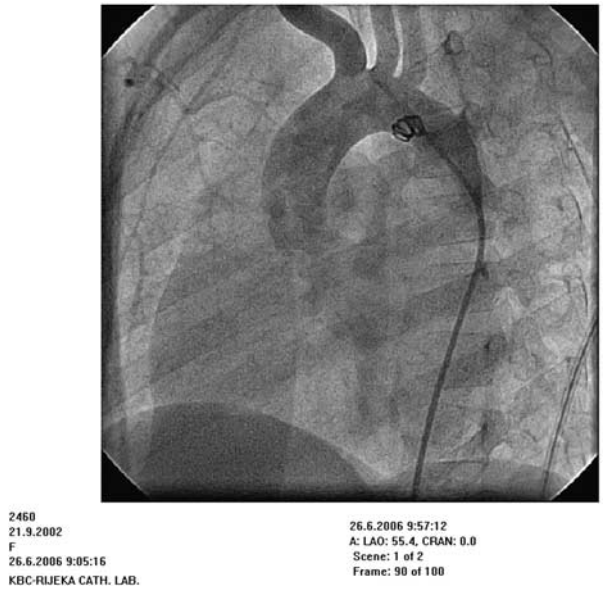

Figure 3.
Extrusion of coil loop in aorta with no opacification in the pulmonary artery.

of red blood cells with the presence of fragmented cells on the blood film, reticulocytosis, decreased haptoglobin, and the presence of the indirect hyperbilirubinaemia. Incubated osmotic fragility test of red blood cells and haemoglobin electrophoresis were normal. Both direct and indirect Coombs tests were negative.

Ultrasound examination of the abdominal organs, chest radiograph, and electrocardiogram were normal. Management of rising anaemia was conducted through repeated blood transfusions and folate supplementation. Spontaneous resolution of the haemolysis was expected. However, due to the persistence of the haemolysis, the child was transferred to our hospital on the 47th post-implantational day.

Repeated cardiac catheterisation and aortogram revealed the extrusion of approximately one-half of the complete loop in the aorta, without opacification in the pulmonary artery (Fig 3). Extrusion of the device that was detected presumably caused haemolysis.

The child was directed to the Department of Cardiac Surgery. The extruded part of the coil was removed from the aorta and double ligation of the patent arterial duct was performed (Fig 4).

The post-operative course was uneventful. Clinical evaluation and laboratory findings showed no signs of haemolysis. The patient was discharged from the hospital on the 9th post-operative day.

At follow-up, 1 year after surgery, the child is asymptomatic. Laboratory tests are within referent

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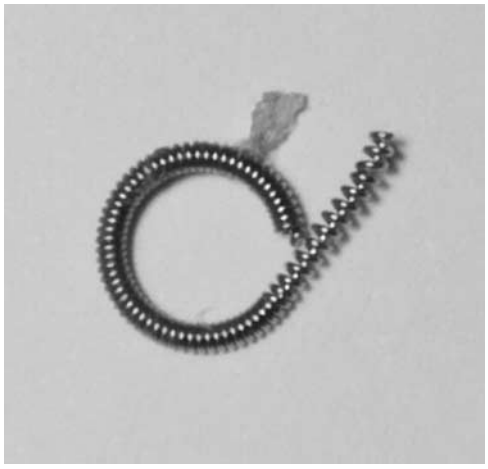

Figure 4.
Part of the coil removed from the aorta.

values, repeated echocardiography evaluations show no signs of residual patency of the duct.

Discussion

Beyond early infancy, transcatheter coil occlusion of the patent arterial duct is the preferred technique for the closure of the patent arterial duct with a diameter of less than 2 millimetres.[1,3] The dimensions of the duct determine the selection of the upper limits of coil loop diameter and the number of coil loops. Loop diameter must be at least twice the minimum duct angiographic diameter and should be less than or equal to the maximum dimension of the aortic diverticulum. A minimum of two coil loops should be placed in the aortic diverticulum distal to the narrowest part of the patent arterial duct in order to facilitate complete occlusion.[3,6]

The effectiveness of an occluding device is evaluated by angiography performed 10 minutes following its placement. Evaluation by echocardioghraphy studies during follow-up is undertaken to determine the eventual residual patency of the duct.[1,3,7] Major complications of the transcatheter coil occlusion of the patent arterial duct are misplacement, dislodgement, left pulmonary artery obstruction, thoracic aorta obstruction, and embolisation of the device. Other potentially important complications are flow disturbance due to the protruding device, thrombosis of femoral vessels related to vascular access, and infection.[1]

Furthermore, there have been reports of severe intravascular haemolysis after coil implantation in patent arterial duct related to the degree of residual shunting. In such cases, haemolysis results from high-velocity residual jet and its contact with the metallic surface of the occluding coil.[8]

In our case, repeated echocardiography evaluations performed after coil implantation showed the adequate position of the coil and no signs of residual shunt.

However, the extrusion of the half of the coil in the aorta was evident with mild flow turbulence. We reported the development of haemolytic anaemia as a consequence of such extrusion. Blood contact with the extruded part of the coil led to red blood cell mechanical injury. Extensive diagnostic procedures showed no other possible causes of haemolytic anaemia.

Elimination of the extruded device was not undertaken in the transcatheter manner due to the time elapsed since its implantation. Instead, surgical removal of the extruded part of the coil is performed. After the surgical removal of the extruded part of the coil, there were no clinical or laboratory signs of haemolysis.

This case emphasises the importance of the proper analysis of the patent arterial duct measurements and its morphology in order to choose the appropriate type and the size of the occluding device.

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