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Brief Report

Surgical ligation of a residually patent arterial duct following failed occlusion using transcatheter coils

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Abstract Transcatheter techniques for occlusion of the persistently patent arterial duct using coils have become standard therapy at many centers for pediatric cardiology, and in selected patients have demonstrated comparable efficacy to surgical ligation. Surgical ligation may still be required in many cases, including premature infants or those born with low weight, those with ducts of large diameter, those with associated structural heart disease, and in circumstances of unsuccessful occlusion subsequent to attempted closure using coils. We report on the successful surgical ligation of an arterial duct of moderate size that exhibited residual patency despite two separate attempts at occlusion using coils.

Keywords: Ductus arteriosus; congenital heart disease; cardiac catheterization

TRANSCATHETER TECHNIQUES FOR OCCLUDING the persistently patent arterial duct with coils have become standard therapy at many centers for pediatric cardiology, and in selected patients have demonstrated comparable efficacy to surgical ligation.[1–4] In particular, occlusion using coils introduced through catheters is widely reported to be safe and relatively simple, especially when used to close the arterial ducts of small diameter.[3,4] Although several investigators have demonstrated success when attempting to occlude vessels with a larger diameter, these procedures often require deployment of multiple coils, and carry a higher risk of migration of the coils, hemolysis, residual ductal flow, and possibly endarteritis.[4–8] Surgical ligation is still required in many cases, including premature infants or those born with low weight, those with ducts of large diameter, those with associated structural heart disease, and in circumstances of unsuccessful interventional closure. We report on the successful surgical ligation of a duct of moderate size that remained patent despite two separate attempts at occlusion using coils, which had been left in position.

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Case report

A 25-month-old male weighing 12.7 kg with an asymptomatic patent arterial duct of moderate size, diagnosed clinically and echocardiographically at the age of 12 months, presented to the cardiac catheterization laboratory for elective transcatheter closure. The arterial duct was short and conical, having its narrowest portion at the aortic end, falling into the "Type B" of the Toronto classification.[9] It measured 4.5 mm at its narrowest dimension as seen in a lateral descending aortic angiogram. The calculated ratio of pulmonary to systemic flow of blood was 2.2. Two Gianturco stainless steel coils, 0.038 by 10 mm by 10 cm, and 0.038 by 5 mm by 8 cm, respectively, were successfully deployed. Despite their good position, a small amount of residual flow was seen on angiography. The patient was discharged home with the expectation of complete occlusion by delayed thrombosis. He developed transient hemolysis after 24 h, which spontaneously resolved, but he continued to have residual ductal patency. At 33 months of age, weighing 14.8 kg, he was brought back for occlusion of

the residual shunt, the ratio of pulmonary to systemic flows then being 1.3. The small residual patency was documented angiographically, and an additional coil measuring 0.038 by 5 mm by 5 cm was deployed within the previously placed coils. Follow-up angiograms demonstrated continued flow. Rather than attempt to deploy additional coils, the patient was taken to the operating suite for surgical ligation of the residual shunt, with all the coils left in place.

In the operating suite, the patient was placed in the right lateral decubitus position. The arterial duct was exposed through a small left lateral thoracotomy. The stainless steel coils were easily palpated within the lumen, and the area was carefully dissected to provide adequate exposure. Three heavy ties of 2.0 silk were passed around the arterial duct, with the coils remaining in place, and were gently secured. No attempt was made at resection of the coil embedded ductal tissue. Intraoperative Doppler echocardiography and auscultation confirmed the absence of residual flow. The child had an uneventful postoperative course, and was discharged home the following day. Follow-up echocardiograms at 24 h and at 6 months of age revealed no residual ductal flow, and no evidence of turbulence in either the left pulmonary artery or the descending aorta.

Discussion

We report the surgical management of residual ductal flow following failed occlusion of a patent arterial duct subsequent to insertion of coils through a catheter. Although there is one previous report of surgical ligation of a residual patent arterial duct following failed occlusion with a Rashkind umbrella device,[10] as far as we are aware, there has been no discussion of the most appropriate surgical technique, such as ligation versus division, particularly when stainless steel coils are endothelialized into the ductal tissue. Although more aggressive attempts, with delivery of additional coils, has been shown to be effective, we were uncomfortable with the increased risk of migration of the coils, hemolysis, and the possibility of residual ductal flow after two attempts at therapeutic cardiac catheterization. We believe that the optimal management of residual ductal flow following transcatheter occlusion using coils depends upon several factors, including the amount of residual flow, a history of hemolysis or endarteritis, the experience of the operator, and the choice of the family for definitive closure. Transcatheter techniques are rapidly becoming the preferred method for ductal closure in selected patients, but may not always be successful, especially when attempted in patients with ducts of larger diameter. We describe the option of surgical ligation over coils that are left in position. This approach appears to be safe and effective, and may become necessary with increasing frequency in this new era of transcatheter therapy for children with congenital cardiac malformations.

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