The Advantage of the DuctOcclud Coil for the Occlusion of Aorto-Pulmonary Shunts

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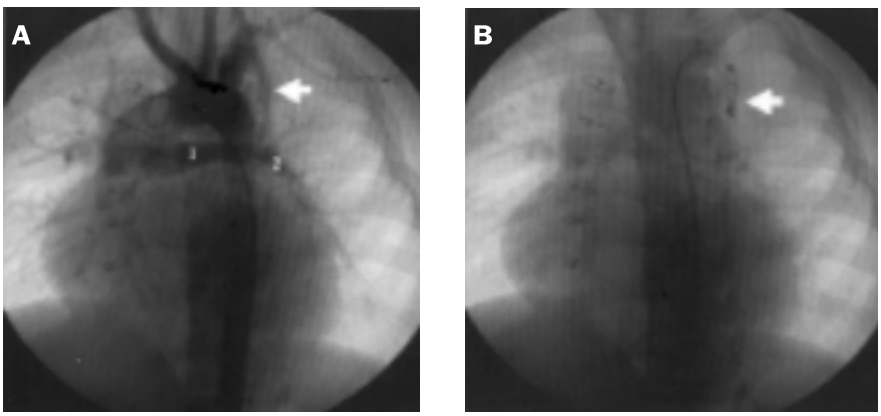
Systemic to pulmonary shunts are indicated in newborns or infants with a single ventricle and diminished pulmonary blood flow. Aorto-pulmonary shunts are installed for palliative stabilization of pulmonary blood flow as an elective or urgent surgical intervention. A modified Blalock-Taussig shunt was introduced into our patient, who had tricuspid valve atresia and a rudimentary right ventricle in the early neonatal period [1]. Additional interventions have been performed to complete the total cavo-pulmonary connection.

The ease of coil embolization of an aorto-pulmonary shunt is described with the use of a DuctOcclud coil (Produkte fur die Medizin AG, Cologne, Germany) [2]. This procedure is a substitute for the surgical closure of the shunt, which is intended to decrease surgical complications involved in a previously operated area [3,4] This may include nerve damage, which may in turn lead to Horner's syndrome and paralysis of the homolateral phrenic nerve. Damage to the lymphatic duct during dissection and isolation of the shunt, in a previously operated area, may lead to impaired lymphatic drainage resulting in chylothorax.

Patient Description

This 5 year old girl was born with a hypoplastic right ventricle, tricuspid valve atresia and a patent foramen ovale. There was mild global left ventricular dysfunction and a slight left ventricular enlargement. The patient was dependent on the aorto-pulmonary flow across the patent ductus arteriosus. Patency of the ductus arteriosus was maintained by intravenous infusion of prostaglandin E_1. Left ventricular function recovered following the intravenous infusion of a modest dose (8 g/kg/min) of dopamine. A left modified Blalock-Taussig aorto-pulmonary shunt was installed on the third day of life, by means of a 4 mm diameter Gore-Tex tube (W.L. Gore & Associates GmbH, Putzbrunn, Germany.) A 'generous' balloon atrial septostomy (the Rashkind procedure) was performed when she was 7 days old, based on the estimation that the patent foramen ovale was not adequate to support infantile and early childhood circulation. A bi-directional Glenn procedure was performed at 2 years of age. Surgery to complete total cavo-pulmonary connections was planned for when the patient reached the age of 5 years.

Percutaneous trans-catheter coil occlusion of the left modified Blalock-Taussig aorto-pulmonary shunt was suggested to avoid potential neurologic and lymphatic complications during surgery in a rather poor exposure of a previously operated area. The patient was catheterized shortly before surgical intervention for the completion of the total caval pulmonary connection and, in addition to a hemodynamic evaluation, a DuctOcclud coil 4 x 5 mm was released in the modified left Blalock-Taussig shunt. The procedure is illustrated in Figures A and B. The position of the coil could be controlled and modified to perfection. The coil was held in site for a brief period to allow stabilization and initial clotting, before it was released from the delivery system. We believe that the use of that coil with a fully controlled delivery and release optimized the accuracy and the safety of the procedure in a univentricular heart patient. Following coil implantation there was a reduction of oxygen saturation in room air, from 88% to 79%, as a result of shunt closure and reduction in pulmonary blood flow. Seven days following this procedure the patient underwent surgery for the completion of an extra-cardiac approach for total cavo-pul-



Aortography in the left anterior oblique projection demonstrating: **[A]** Left modified Blalock-Taussig shunt (arrow) filling the confluence of the pulmonary arteries as well as the right (1) and left (2) branches. **[B]** DuctOcclud 5/4 mm coil immediately following release in the aorto-pulmonary shunt. The coil (arrow) is a few millimeters distant from the distal end of the delivery catheter which bears a marker at its tip.

monary connections, with only minor postoperative pleural and pericardial effusions that resolved rapidly.

Comment

The use of percutaneous trans-catheter coil occlusion of the left modified Blalock-Taussig shunt was suggested to avoid a potential surgical complication in a previously operated area [1]. Potential surgical complications include neurologic damage to the phrenic nerve, which may result in diaphragmatic paralysis and may complicate the postoperative course [3]; Horner syndrome, which is usually temporary; injury to the recurrent laryngeal nerve and vocal cords dysfunction [5]; and possible damage to the lymphatic duct followed by chylothorax, which requires thoracocentesis and dietary changes for lengthy periods. On rare occasions re-operation and ligation of the thoracic duct were necessary [4]. Some surgeons meticulously try to avoid such complications by encircling the shunt with a loose marking suture material, which is left underneath the sternum to facilitate shunt isolation at the time of the shunt takedown. Our patient had had a left lateral thoracotomy for the left modified Blalock-Taussig shunt, while both the bi-directional Glenn procedure and the total cavo-pulmonary connection were performed through a midsternotomy. The surgeon claimed that the distant location of the Blalock-Taussig shunt from the midline with the lack of any markers left during surgery made the procedure of shunt takedown an increasingly risky one for neurologic and lymphatic complications.

The use of DuctOcclud coils makes it a safe procedure. It allows for controlled coil implantation and controlled release. The size of the coil can be chosen to match the dimensions of the surgical shunt. In order to achieve a stable positioning of the coil, the coil diameter should exceed the diameter of the Gore-Tex shunt by 1–2 mm. The branch pulmonary artery growth and flow should not be adversely influenced by the fixed connection to the homolateral left subclavian artery, but this should be periodically investigated on a follow-up basis. Since surgical takedown of aorto-pulmonary shunts is a frequent and common practice in centers specializing in congenital heart anomalies, the indication for trans-catheter coil occlusion of aorto-pulmonary shunts should be discussed between the cardiology and surgery teams and be applied only in cases when surgical shunt takedown is deemed to be risky. DuctOcclud, being a control-release device, is safer than non-control release systems. It offers a safe, low risk and time-efficient procedure using a 5 French or 4 French size introducer and catheter, thus making the procedure less traumatic for the femoral artery with fewer local and systemic complications. This procedure may be indicated for patients who need only surgical shunt takedown for the completion of their interventional treatment, such as those with pulmonary atresia and intact ventricular septum, who previously underwent surgery for aorto-pulmonary shunt and pulmonary valvotomy. Trans-cathether coil occlusion of the shunt may obviate the need for another surgical intervention.

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Capsule

HIV and hepatitis C virus co-infection

Rockstroh et al. addressed the issue of HIV and HCV co-infection. Since the decline in HIV-related morbidity and mortality after introduction of highly active antiretroviral therapy (HAART) in 1996, liver disease caused by chronic infection with HCV has become an increasingly important cause of morbidity and mortality among HIV-infected patients infected parenterally with HCV in more developed countries. A third of HIV-infected individuals in Europe and the USA have HCV co-infection. HIV accelerates HCV liver disease especially when HIV-associated immunodeficiency progresses. With the introduction of pegylated interferon in combination with ribavirin, greatly improved treatment options for patients with HIV and HCV co-infection have become available and have led to sustained virologic response rates of up to 40%. Furthermore, recent cohort analyses have shown that immune reconstitution induced by HAART can improve the course of hepatitis C, leading to a decline in liver-related mortality. However, patients with HCV co-infection are at increased risk of hepatotoxicity from HAART. Owing to the high rates of HIV and HCV co-infection worldwide, new improved treatment strategies and guidelines for the management of co-infection remain a major future goal.

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