Coil Occlusion of Patent Ductus Arteriosus

Impact of 0.052-Inch Gianturco Coil Without Amplatzer Duct Occluder

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Background Coils are the only devices available for transcatheter occlusion of patent ductus arteriosus (PDA) in Japan. Since April 1999, we have introduced a 0.052-inch Gianturco coil (0.052-inch coil) to close PDA ≥2.5 mm. Methods and Results A retrospective survey of the outcome of coil occlusions for PDA ≥2.5 mm before and after the 0.052-inch coil became available found that (1) the frequency of PDA ≥2.5 mm among all candidates for coil occlusion significantly increased after the availability of a 0.052-inch coil (p<0.01); (2) deployment complicated by migration (p<0.01), and prolonged procedure time (p<0.05) were significantly decreased after the introduction of the 0.052-inch coil. In a multivariate logistic regression model for uneventful deployment adjusted for age, pulmonary to systemic flow ratio, and use of a 0.052-inch coil, use of the 0.052-inch coil significantly decreased eventful deployment (p<0.05); and (3) successful deployment of a coil for PDA ≥2 mm significantly increased with the 0.052-inch coil (p<0.01). Complete occlusion was achieved once deployment was successful. Conclusion Introduction of the 0.052-inch coil decreased complicated coil occlusion deployment for PDA ≥2.5 mm, and contributed to a better likelihood of coil occlusion for PDA ≥4 mm. (Circ J 2006; 70: 28–30)

Key Words: Coil occlusion; Flipper coil; 0.052-inch Gianturco coil; Patent ductus arteriosus

Oclusion of a patent ductus arteriosus (PDA) with a coil has become the common treatment strategy in Japan since the detachable PDA coil (Flipper coil®, Cook Inc, Bloomington, IN, USA) was released. Although, the Amplatzer duct occluder, which can effectively close medium- to large-sized PDAs, is currently available in many countries, it is not yet approved in Japan. The Porstmann method has been reported as useful in adults but has been almost abandoned for children because of the large applicator required to insert the Ivalon plug from a femoral artery. Other devices for transcatheter closure of PDA, such as the Rashkind PDA occluder or the Grifka bag, are also not approved. Consequently, in Japan, the coil is the only device currently available for transcatheter closure of PDA in children.

Grifka et al first reported using a 0.052-inch Gianturco coil (0.052-inch coil, Cook Inc) with controlled delivery using a biotome. As our current policy is to use a 0.052-inch coil for PDA ≥2.5 mm, we retrospectively analyzed the impact of using this coil in the setting of it being the only device available for transcatheter closure of PDA.

Methods

From March 1995 to December 2004, a single operator (HT) performed 160 transcatheter occlusions in 145 patients with PDA at the Sapporo Medical University Hospital and National Cardiovascular Center. Of these, outcomes and complications were retrospectively analyzed from the medical records of 61 coil occlusions in 59 patients with a native PDA ≥2.5 mm. The angiographic appearance of the PDA was classified according to Krichenko et al and the minimum diameter of the PDA was measured on the lateral projection of the aortogram. All patients had follow-up intervals longer than 6 months. Cases of coil occlusions for residual shunt following surgery or a previous transcatheter occlusion were excluded.

From March 1995 to March 1999, we used the 0.038-inch Gianturco coil (Cook Inc) or Flipper coil deployed either retrogradely or progradely. A snare catheter was occasionally used with the Gianturco coil for control of delivery as reported by Sommer et al. Since April 1999, we have used the 0.052-inch Gianturco coil for PDA ≥2.5 mm, the procedure for which is reported elsewhere. Briefly, 3F “cup” biopsy forceps are advanced through a 4F sheath. The round-tipped leading end of the 0.052-inch coil is extruded beyond its metal housing and pulled slightly by mosquito forceps. The extended tip is then carefully grasped with the biopsy forceps and after tightening the forceps, the coil is gently retracted into the sheath. We routinely use a 6F Brit tip guiding catheter (Johnson and Johnson) as the delivery catheter, which is passed across the PDA either progradely or retrogradely. The 4F sheath, loaded with the coil-biotome, is inserted into the hemostasis valve of the Brit tip, and the coil-biotome is advanced slowly through the Brit tip.
Initially, we delivered the 0.052-inch coil retrogradely, but currently we use a prograde approach, as controlling the number of loops in the pulmonary artery is easier with a prograde rather than a retrograde approach. Two or 3 coils are deployed simultaneously for a PDA ≥3.5–4.0 mm.

We do not have data on fluoroscopic times; however, we analyzed the total procedure time needed to complete deployment of coils.

Statistical analysis was done by chi-square test or multiple logistic regression and a p-value <0.05 was regarded as statistically significant.

Results

Frequency of Coil Occlusion for PDA ≥2.5 mm

Before the availability of the 0.052-inch coil (pre 0.052-inch coil), 54 procedures were performed in 49 patients, whereas after the introduction of the 0.052-inch coil (post 0.052-inch coil), there were 106 procedures in 96 patients. Pre 0.052-inch coil, 12 procedures in 11 patients were for a PDA ≥2.5 mm, whereas post 0.052-inch coil, there were 49 procedures in 48 patients. The frequency of PDA ≥2.5 mm among all candidates significantly increased post 0.052-inch coil (Fig 1, p<0.01).

Underlying Patient Characteristics

Age and body weight post 0.052-inch coil were greater than pre 0.052-inch coil, because there were 4 adult patients post 0.052-inch coil. However, there were no significant differences between the 2 time periods in the minimum diameter of PDA, distribution of angiographic morphology. Pulmonary to systemic flow ratio (Qp/Qs) was slightly larger in pre 0.052-inch coil than in post 0.052-inch coil (Table 1).

Outcome of Coil Occlusions Pre and Post 0.052-Inch Coil for PDA ≥2.5 mm

There were no significant differences between the 2 periods in the ratio of successful deployment and complete occlusion, or in the number of coils deployed. “Eventful” deployments complicated by migration (p<0.01), or long procedure time (p<0.05) were significantly decreased post 0.052-inch coil (Table 1). Multivariate analysis using a regression model of successful deployment adjusted for age, Qp/Qs, and use of the 0.052-inch coil showed no significant contribution of use of the 0.052-inch coil to successful deployment (Table 2).

However, the multivariate analysis of uneventful deployment showed a significant contribution of use of the 0.052-inch coil to successful deployment (Table 3).

Coil Occlusion for PDA ≥4.0 mm

The maximum PDA diameter for which there was suc-
cessful deployment in each period was 3.8 mm and 5.6 mm, respectively, and successful deployment of the coil for PDA ≥4 mm significantly increased post 0.052-inch coil (p<0.01). Complete occlusion was achieved once deployment was successful (Table 4).

Discussion
Transcatheter occlusion with Gianturco coils is a safe and effective method of occluding a PDA, but there have been reports of complications including migration of the coil, hemolysis, and recanalization, particularly when the minimum diameter of the ductus exceeds approximately 3.0 mm. The modified Grifka method using the 0.052-inch coil offers better positioning during implantation, and successful deployment in each period was 3.8 mm and 5.6 mm, respectively, and successful deployment of the coil for PDA ≥4 mm significantly increased post 0.052-inch coil. However, a 0.052-inch coil should be used for occlusion of PDA ≥2.5 mm, and PDA up to 6 mm may be closed with multiple 0.052-inch coils as long as the ampulla is of sufficient size. However, surgery is indicated for PDA ≥6 mm or with a small ampulla until the Amplatzer duct occluder is approved in Japan.

In conclusion, introduction of the Gianturco 0.052-inch coil decreased eventful deployment during coil occlusion for PDA ≥2.5 mm, and contributed to better outcomes of coil occlusion for PDA ≥4 mm. For safe deployment, a 0.052-inch coil should be used for occlusion of PDA ≥2.5 mm, and PDA up to 6 mm may be closed with multiple 0.052-inch coils as long as the ampulla is of sufficient size. However, surgery is indicated for PDA ≥6 mm or with a small ampulla until the Amplatzer duct occluder is approved in Japan.

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References