EDITORIAL
http://dx.doi.org/10.4070/kcj.2011.41.11.639

Print ISSN 1738-5520 / On-line ISSN 1738-5555

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Do We Have to Close Residual Patent Ductus Arteriosus After Surgery or Transcatheter Intervention?

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Introduction

Patent ductus arteriosus (PDA), defined as an arterial connection between the pulmonary artery and the aorta, is a common congenital cardiac defect. The connection can be closed surgically or by transcatheter methods. The overall incidence of PDA in infants born prematurely is about 16 times higher than that in full term infants. Preterm infants with symptomatic heart failure secondary to persistent PDA can be treated by surgical ligation or by conservative treatment involving indomethacin or ibuprofen. The latter, more conservative approach, is usually the treatment of choice due to the risks involved with surgical ligation in premature babies.[1)2)]

Transcatheter techniques for PDA closure have been evolving for over 40 years, and most PDAs can be safely closed in the laboratory setting using currently available coils and devices. Transcatheter closure of the ductus has been effective, with shorter hospital stay and lower cost compared to surgical closure.[2)3)]

Surgical Versus Transcatheter Closure: Clinical Outcome and Complications

The first successful surgical closure of PDA was described in 1939.[4)] For several decades it remained as the only practical procedure of closing the patent arterial duct.[5)] The next important modification in the surgical approach occurred in 1991, when duct closure was achieved by video assisted thoracoscopic (VAT) surgery.[6)7)] VAT ligation is a minimally invasive method that can be safely performed in children.[6)7)] After surgery, residual shunts occur in approximately 0.6-5% of cases.[8)] Closure of the relatively large, hemodynamically significant, PDA may be established as the standard of care, and can be performed safely and effectively using either surgical or transcatheter intervention. The appropriate management of the very small, hemodynamically insignificant PDA is less clear.[8)9)] In asymptomatic patients with a small duct, the only argument in favor of closure is avoiding the risk of developing endarteritis and endocarditis. This risk has been estimated at 0.45% per patient year. However, this figure may be high, given the recent report no instances of endarteritis in a patient population.[8)] Routine closure of such defects has been advocated to eliminate or reduce the risk of infective endocarditis. However, the risk of endocarditis or endarteritis in patients with a small PDA appears to be extremely low, and these infections are treatable. Although closure of the small duct is generally safe and technically successful, it is unknown whether this treatment truly improves the risk versus benefit balance compared with careful observation. Closure of a residual PDA to prevent infectious arteritis is strongly recommended despite of silent ductus.[9)]

Identification and location of the residual duct with complex anatomy remains as a challenge. Surgical ligation of PDA can cause the residual duct to adopt a long, distorted tubular shape. Real-time, three-dimensional echocardiogram can be successful as a means of guidance in the identification of complex residual ducts.[10)]

In one reported case,[11)] several transcatheter approaches and coils were utilized for successful transcatheter closure of

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• The author has no financial conflicts of interest.

residual post-surgical PDA. Antegrade (trans-pulmonary) or retrograde (trans-aortic) approaches using a snare technique were tried so that catheters with coils such as Nit-Occlud (Pfm, Cologne, Germany) were introduced to residual ductus with tortuous anatomy after ligation. Also, an antegrade (trans-aortic) approach for the Gianturco coil and Cook Detachable coil (Cook Cardiology, Bloomington, IN, USA) was used for transcatheter closure.[2)11-15)]

Catheter-derived therapies had already begun as an alternative therapy of the surgical approach after 1971. These surgical or catheter-derived techniques became complementary for PDA closure at that time.[2)3)15)] The percutaneous embolization of coils has been used for smaller ducts, with larger ducts addressed by open thoracotomy or, occasionally, video assisted ligation at that time.

The potential causes of morbidity after transcatheter coil-mediated closure of PDA include device embolization, obstruction of the pulmonary arteries or the thoracic aorta, persistence of the residual shunt and hemolysis. Immediate residual shunt is very common during transcatheter coil-mediated closure of PDA, with an incidence ranging from 32-42%.[2)8)14)] Although the majority of patients with residual shunts spontaneous closure of the PDAs occurs within 36 months, a few patients with residual PDA will require a second procedure to close the shunt due to hemolysis. The reported incidence of hemolysis ranged from 1.0-3.6%.[2)8)14)] Several types of coils, such as Gianturco embolization coils, detachable coils (Cook Cardiology), and the Duct-Occlud (Pfm) have proven to be both safe and effective in the closure of small-to-moderate sized PDAs. The incidence of hemolysis for ductus >3 mm in diameter, occurring due to incomplete closure, can be up to 18.8%. Hemolysis is typically noted within 24 hours after the procedure, and can sometimes persist from weeks to months after the intervention. Once hemolysis has occurred, severe anemia or renal failure may follow.[2)8)14)] In one study,[15)] patients with a continuous high velocity residual shunt required treatment with a second device after a mean duration of 2 years.

Transcatheter PDA occlusion remains as a challenge, particularly in tubular ductus or in infants with large PDA. Even though an amplatzer duct occlude (ADO) can be successfully implanted, protrusion of the retention disk into the aorta can be problematic in infants. To alleviate this problem, modifications of the ADO device have been developed. These include an angled ADO device (for infants) or ADO II device (for tubular type). The Amplatzer Vascular Plug (AVP) II device can be used for closure of ductus in small infants. Both the ADO II and AVP II devices have a central plug portion sandwiched by two outer disks.[3)]

In the current era, transcatheter closure is the therapy of choice for PDA. The remaining indications for surgical intervention are in premature babies, sometimes for closure of huge, aneurysmal, infected or complicated ducts that are unsuitable to accommodate devices, and after complications arising during a trial of intervention.[16)]

REFERENCES

1) Schneider DJ, Moore JW. *Patent ductus arteriosus. Circulation 2006; 114:1873-82.*
2) Jung JW. *Recent strategies and outcomes of transcatheter closure for patent ductus arteriosus. Korean Circ J 2010;40:216-8.*
3) Ng B, Schneider DJ, Hokanson JS. *Closure of tubular patent ductus arteriosus in infants and small children with the Amplatzer Vascular Plug II. Congenit Heart Dis 2011;6:64-9.*
4) Gross RE, Hubbard JP. *Surgical ligation of a patent ductus arteriosus: report of first successful case. JAMA 1939;112:729-31.*
5) Mavroudis C, Backer CL, Gevitz M. *Forty-six years of patent ductus arteriosus division at Children's Memorial Hospital of Chicago: standards for comparison. Ann Surg 1994;220:402-9.*
6) Laborde F, Noirhomme P, Karam J, Batisse A, Bourel P, Saint Maurice O. *A new video-assisted thoracoscopic surgical technique for interruption of patient ductus arteriosus in infants and children. J Thorac Cardiovasc Surg 1993;105:278-80.*
7) Burke RP, Jacobs JP, Cheng W, Trento A, Fontana GP. *Video-assisted thoracoscopic surgery for patent ductus arteriosus in low birth weight neonates and infants. Pediatrics 1999;104(2 Pt 1):227-30.*
8) Galal MO, Hussain A, Arfi AM. *Do we still need the surgeon to close the persistently patent arterial duct? Cardiol Young 2006;16:522-36.*
9) Fortescue EB, Lock JE, Galvin T, McElhinney DB. *To close or not to close: the very small patent ductus arteriosus. Congenit Heart Dis 2010; 5:354-65.*
10) Chuang YC, Yin WH, Hsiung MC, et al. *Successful transcatheter closure of a residual patent ductus arteriosus with complex anatomy after surgical ligation using an Amplatzer ductal occluder guided by live three-dimensional transesophageal echocardiography. Echocardiography 2011;28:E101-3.*
11) Baspinar O, Kilinc M, Kervancioglu M, Irdem A. *Transcatheter closure of residual patent ductus arteriosus after surgical ligation in children. Korean Circ J 2011;41:654-7.*
12) Wierny L, Plass R, Porstmann W. *Transluminal closure of patent ductus arteriosus: long-term results of 208 cases treated without thoracotomy. Cardiovasc Intervent Radiol 1986;9:279-85.*
13) Rashkind WJ, Mullins CE, Hellenbrand WE, Tait MA. *Nonsurgical closure of patent ductus arteriosus: clinical application of the Rashkind PDA Occluder System. Circulation 1987;75:583-92.*
14) Brunetti MA, Ringel R, Owada C, et al. *Percutaneous closure of patent ductus arteriosus: a multiinstitutional registry comparing multiple devices. Catheter Cardiovasc Interv 2010;76:696-702.*
15) Magee AG, Huggon IC, Seed PT, Qureshi SA, Tynan M; Association for European Cardiology. *Transcatheter coil occlusion of the arterial duct; results of the European Registry. Eur Heart J 2001;22:1817-21.*
16) Abadir S, Boudjemline Y, Rey C, et al. *Significant persistent ductus arteriosus in infants less or equal to 6 kg: percutaneous closure or surgery? Arch Cardiovasc Dis 2009;102:533-40.*