## SHORT REPORT

Walter Knirsch · Nikolaus A. Haas Martin A. G. Lewin · Ingo Dähnert · Deniz Kececioglu Felix Berger · Frank Uhlemann

## Percutanous closure of patent ductus arteriosus in small infants of less than 8 kg body weight using different devices

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Therapeutic closure of patent ductus arteriosus (PDA) may become necessary in small infants with congestive heart failure refractory to medical management, regardless of the age or weight of the patients. Percutanous closure of PDA offers an alternative to surgical treatment [3,4]. The aim of this retrospective, multicentre observational trial was to evaluate the immediate results and mid-term clinical and echocardiographic follow-up of percutanous closure of PDA in young infants weighing less than 8 kg. Four centres were involved.

Percutanous PDA closure was performed in 25 patients (16 female, 9 male) with a body weight of less than 8 kg (mean age 9.2 months, mean body weight 6.3 kg). The mean dimensions of the PDA were 5.9 mm at the aortic end and 2.7 mm at the pulmonary end with a mean of 2.2 mm at the narrowest part. Mean pulmonary artery pressure was 22.6 mm Hg, Qp:Qs = 2.2 to 1 and Rp:Rs = 0.13 to 1. Two patients had an additional atrial septal defect and one patient had an aorto-pulmonary collateral, which were closed during the same cardiac catheterisation (Table 1). Mean fluoroscopy time was 15.0 min. For a tubular shaped PDA, the preferred device was the pfm Ductocclud coil (pfm-AG, Cologne, Germany) or Cook detachable coils (Cook

W. Knirsch (⋈) · F. Berger

Department of Paediatric Cardiology,

University Children's Hospital, Steinwiesstrasse 75,

8032 Zürich, Switzerland

E-mail: walter.knirsch@kispi.unizh.ch

Tel.: +41-1-2667617 Fax: +41-1-2667981

N. A. Haas · M. A. G. Lewin · F. Uhlemann Department of Paediatric Cardiology and Paediatric Intensive Care, Olgahospital, Stuttgart, Germany

D. Kececioglu Department of Paediatric Cardiology, University Children's Hospital, Freiburg, Germany

I. Dähnert Department of Paediatric Cardiology, Heart Centrer, University of Leipzig, Leipzig, Germany Inc., Bloomington, IN, USA). For a fenestrated PDA, the Amplatzer Duct Occluder (AGA Medical Corp., Golden Valley, MN, USA) was used. The PDA was closed according to standardised procedures [5].

The Amplatzer Duct Occluder (ADO) was used in 17 patients, Cook detachable coils in six patients, and the pfm Ductocclud coil in two patients (Table 1). In two patients (one with a body weight of 3.3 kg), percutanous PDA closure failed due to protrusion of the device into the aorta or left pulmonary artery; these infants successfully underwent surgical PDA closure (Table 1). Complete closure was achieved in all patients: immediate occlusion in 13 patients, the following day in four patients, and after mid-term follow-up (6 months) in six patients. In one patient, the Cook detachable coil migrated to the right pulmonary artery 1 day after the intervention; the coil was retrieved and the PDA was closed with an ADO (Fig. 1). In all patients, symptoms of heart failure resolved and medical treatment could be terminated. At mid-term follow-up (mean 18.8 months) Doppler echocardiography revealed mild flow velocity acceleration in the left pulmonary artery in two patients and in the descending aorta in one patient. Special attention was given to monitoring femoral vessel patency after catheterisation. There were no other complications (haematoma, femoral artery thrombosis, haemolysis, infection, haemorrhage or recanalisation).

The rate of percutanous closure of PDA was comparable to other studies in small children of less than 10 kg body weight described by Aydogan et al. [1] (94%) or by Dalvi et al. [2] (90%), although we used other device types, depending on the morphology of the PDA.

We conclude that percutanous closure of PDA is a feasible, safe and effective method in infants of between 4 and 8 kg body weight.

## References

 Aydogan Ü (2002) Arterial duct closure with detachable coils: application in the small child. Asian Cardiovasc Thorac Ann 10: 124–128

Table 1 Overview of the 25 patients with a body weight of less than 8 kg with percutanous PDA closure using different devices

sq s	Patient	Sex	Age (years)	Body weight (kg)	Venous	Arterial sheath	Devices	X-ray time (mins)	Occlusion	Special aspects
Ff         0.19         4.20         5         4         Amplatzer Duct Occluder oil         14.3         Immediately months and the formouths of the formouths of the formouths oil         Immediately mediately for 0.24         4         Amplatzer Duct Occluder oil oil oil mediately	_	Ľι	1.43	7.83	5	4	Amplatzer Duct Occluder	29.8	During 48 h	Aorto-pulmonary collateral closure during
March   10.8   Amplatzer   10.	2	王;	0.19	4.20	S	4	Amplatzer Duct Occluder	14.3	Immediately	
Fig. 164   7.90   5   5   Cook detackable coil   77.5   Immediately   Fig. 10.6   8.00   5   5   Cook detackable coil   77.5   Immediately   Fig. 10.6   7.30   5   4   Amplatzer Duct Occluder   11.8   Immediately   Immediate	m ·	Σ	0.91	6.74	5	4	Pfm Ductocclud coil	10.8	After 6 months	
Main	4 '	Ξï	1.43	7.90	v, v	ν.	Cook detachable coil	17.5	Immediately	
M 0.14 4.70 5 4 Amplaizer Duct Occluder 11.8 Immediately Minor Cocluder 12.9 Immediately Pfin Ductocclud coil 14.9 Immediately Minor Cocluder 12.9 17.20 6 4 Amplaizer Duct Occluder 14.0 Not possible Pfin Ductocclud coil 18.6 Immediately Minor Cocluder 19.1 17.20 6 4 Amplaizer Duct Occluder 17.5 After 6 months Ffin Cock 6 5.80 6 4 Amplaizer Duct Occluder 17.5 After 6 months Pfin Ductocclud coil 19.1 After 6 months Pfin Cock detachable coil 19.1 After 6 months Pfin Cock detachable coil 19.1 After 6 months Pfin Cock detachable coil 19.1 After 6 months Pfin Cock 6 19.3 Amplaizer Duct Occluder 19.3 Immediately Pfin Cock 6 19.3 Amplaizer Duct Occluder 19.3 Immediately Pfin Cock 6 19.0 6 4 Amplaizer Duct Occluder 19.3 Immediately Pfin Cock 6 19.0 6 4 Amplaizer Duct Occluder 19.4 Immediately 19.3 After 6 months Pfin Cock 6 19.0 6 4 Amplaizer Duct Occluder 19.4 Immediately 19.4 Amplaizer Duct Occluder 19.4 Immediately 19.4 Amplaizer Duct Occluder 19.4 Immediately 19.5 Amplaizer Duct Occluder 19.4 Immediately 19.5 Amplaizer Duct Occluder 19.5 Immediately 19.5 Amplaizer Duct Occluder 19.5 Immediately 19.5 Amplaizer Duct Occluder 19.5 Immediately 19.5 After 6 months 19.5 After 6 months 19.5 After 6 months 19.5 Amplaizer Duct Occluder 19.3 After 6 months 19.5 Amplaizer Duct Occluder 19.5 Amplaize	5	Ξ	1.06	8.00	9	4	Amplatzer Duct Occluder	13.0	Immediately	
M         0.76         7.50         5         4         Amplatzer Duct Occluder         14.9         Immediately	9	$\boxtimes$	0.14	4.70	2	4	Amplatzer Duct Occluder	11.8	Immediately	
F         0.45         6.90         4         4         Pfm Ductocclud coil         18.6         Immediately more class           M         0.28         3.33         6         3         Amplatzer Duct Occluder         10.4         Not possible pm Ductocclud coil         14.0         During 48 h           F         0.56         5.80         6         4         Amplatzer Duct Occluder         7.5         After 6 months           F         0.56         5.80         6         4         Amplatzer Duct Occluder         20.2         During 48 h           F         0.56         5.80         6         4         Amplatzer Duct Occluder         20.2         During 48 h           F         0.57         5.55         6         4         Amplatzer Duct Occluder         13.1         After 6 months           F         1.13         8.00         6         4         Amplatzer Duct Occluder         20.3         Immediately           F         1.13         8.00         6         4         Amplatzer Duct Occluder         20.3         Immediately           F         0.58         5.30         6         4         Amplatzer Duct Occluder         32.3         Immediately           F         0.56	7	Σ	92.0	7.50	2	4	Amplatzer Duct Occluder	14.9	Immediately	
M         0.28         3.33         6         3         Amplatzer Duct Occluder; 10.4         Not possible prossible pin Ductocelud coil           F         1.91         7.20         6         4         Amplatzer Duct Occluder 7.5         After 6 months After 6 months Amplatzer Duct Occluder 7.5         After 6 months After 6 months Amplatzer Duct Occluder 7.5         After 6 months After 6 months Amplatzer Duct Occluder 7.5         After 6 months After 6 months Amplatzer Duct Occluder 7.5         After 6 months After 6 months Amplatzer Duct Occluder 7.5         Amplatzer Duct Occluder 7.5         Amplatzer Duct Occluder 7.5         Immediately 7.5           F         0.56         6         4         Amplatzer Duct Occluder 7.5         1.0.3         Immediately 7.5           F         0.56         6         4         Amplatzer Duct Occluder 7.5         9.4         Immediately 7.5           F         0.56         6.30         6         4         Amplatzer Duct Occluder 7.8         1.0.3         Immediately 7.8           F         0.76         6.90         6         4         Amplatzer Duct Occluder 7.8         1.4         After 6 months 7.8	~	Ц	0.45	06.9	4	4	Pfm Ductocclud coil	18.6	Immediately	
F         1.91         7.20         6         4         Amplatzer Duct Occluder 7.5         7.5         After 6 months After 6 months Amplatzer Duct Occluder 7.5         After 6 months After 6 months Amplatzer Duct Occluder 7.5         After 6 months After 6 months Amplatzer Duct Occluder 7.5         After 6 months After 6 months After 6 months Amplatzer Duct Occluder 7.5         After 6 months Amplatzer Duct Occluder 7.0         Amplatzer Duct Occluder 7.0         Amplatzer Duct Occluder 7.0         After 6 months After 6 months Amplatzer Duct Occluder 7.0         After 6 months 7.0         Amplatzer Duct Occluder 7.0         After 6 months 7.0         Amplatzer Duct Occluder 7.0         After 6 months 7.0         Amplatzer Duct Occluder 7.0         Amplatzer Duct Occluder 7.0         Amplatze	6	Σ	0.28	3.33	9	8	Amplatzer Duct Occluder;	10.4	Not possible	
F         0.69         7.60         6         4         Amplatzer Duct Occluder         7.5         After 6 months           F         0.56         5.80         6         4         Amplatzer Duct Occluder         7.5         After 6 months           F         0.57         5.55         6         4         Amplatzer Duct Occluder         13.1         After 6 months           F         1.65         8.00         -         4         Cook detachable coil         4.9         After 6 months           F         1.13         8.00         -         4         Amplatzer Duct Occluder         20.3         Immediately           F         0.88         5.30         6         4         Amplatzer Duct Occluder         20.3         Immediately           F         0.88         5.30         6         4         Amplatzer Duct Occluder         9.2         Immediately           F         0.57         7.60         6         4         Amplatzer Duct Occluder         9.2         Immediately           F         0.56         6.30         6         4         Amplatzer Duct Occluder         20.5         Immediately           F         0.76         6.90         6         4         Amplatzer	10	Щ	1.91	7.20	9	4	Amplatzer Duct Occluder	14.0	During 48 h	
F         0.56         5.80         6         4         Amplatzer Duct Occluder         20.2         During 48 h           F         0.57         5.55         6         4         Amplatzer Duct Occluder         13.1         After 6 months           F         1.65         8.00         -         4         Cook detachable coil         4.9         After 6 months           F         1.13         8.00         6         4         Amplatzer Duct Occluder         20.3         Immediately           F         0.88         5.30         6         4         Amplatzer Duct Occluder         9.2         Immediately           F         0.56         7.10         6         4         Amplatzer Duct Occluder         9.4         Immediately           F         0.56         7.10         6         4         Amplatzer Duct Occluder         9.4         Immediately           F         0.61         6.80         6         4         Amplatzer Duct Occluder         20.5         Immediately           F         0.76         6.90         6         4         Amplatzer Duct Occluder         20.5         Immediately           M         0.27         4,00         6         4         Amplatzer Duct	11	Ц	69.0	7.60	9	4	Amplatzer Duct Occluder	7.5	After 6 months	
F         0.57         5.55         6         4         Amplatzer Duct Occluder         13.1         After 6 months           M         0.36         3.50         6         4         Cook detachable coil         4.9         After 6 months           F         1.65         8.00         -         4         Cook detachable coil         4.9         After 6 months           F         1.13         8.00         6         4         Amplatzer Duct Occluder         20.3         Immediately           F         0.58         7.10         6         4         Amplatzer Duct Occluder         9.2         Immediately           F         0.56         7.10         6         4         Amplatzer Duct Occluder         9.4         Immediately           F         0.61         6.80         6         4         Amplatzer Duct Occluder         20.5         Immediately           F         0.76         6.90         6         4         Amplatzer Duct Occluder         20.5         Immediately           M         0.27         4.00         6         4         Amplatzer Duct Occluder         20.5         Immediately           M         0.24         4         Amplatzer Duct Occluder         20.5	12	Ц	0.56	5.80	9	4	Amplatzer Duct Occluder	20.2	During 48 h	Left pulmonary artery flow
M         0.36         3.50         6         4         Cook detachable coil         4.9         After 6 months           F         1.65         8.00         -         4         Cook detachable coil         4.9         After 6 months           F         1.13         8.00         -         4         Amplatzer Duct Occluder         20.3         Immediately           F         0.88         5.30         6         4         Amplatzer Duct Occluder         9.2         Immediately           F         0.56         7.10         6         4         Amplatzer Duct Occluder         9.4         Immediately           F         0.61         6.80         6         4         Amplatzer Duct Occluder         9.4         Immediately           F         0.61         6.80         6         4         Amplatzer Duct Occluder         20.5         Immediately           M         1.43         6.40         6         4         Amplatzer Duct Occluder         20.5         Immediately           M         0.27         4.00         6         4         Amplatzer Duct Occluder         21.4         After 6 months           F         0.54         6.00         4         Amplatzer Duct Occluder	13	ഥ	0.57	5.55	9	4	Amplatzer Duct Occluder	13.1	After 6 months	velocity < 2 m/s Left pulmonary artery flow velocity < 2 m/s
F         1.65         8.00         -         4         Cook detachable coil         4.9         After 6 months           F         1.13         8.00         -         4         Amplatzer Duct Occluder         20.3         Immediately           F         0.88         5.30         6         4         Amplatzer Duct Occluder         9.2         Immediately           M         0.57         7.60         6         4         Amplatzer Duct Occluder         9.4         Immediately           F         0.56         7.10         6         4         Amplatzer Duct Occluder         9.4         Immediately           F         0.61         6.80         6         4         Amplatzer Duct Occluder         20.5         Immediately           M         1.43         6.40         6         4         Amplatzer Duct Occluder         7.8         Immediately           M         0.27         4.00         6         4         Amplatzer Duct Occluder         7.8         Immediately           M         0.27         4.00         6         4         Amplatzer Duct Occluder         7.8         Immediately           F         0.54         6.20         6         4         Amplatzer Duct Occlud	14	×	0.36	3.50	9	4	Cook detachable coil	10.1	During 48 h	
F         1.13         8.00         6         4         Amplatzer Duct Occluder         20.3         Immediately           F         0.58         5.30         6         4         Amplatzer Duct Occluder         9.2         Immediately           M         0.57         7.60         6         4         Amplatzer Duct Occluder         9.2         Immediately           F         0.56         7.10         6         4         Amplatzer Duct Occluder         9.4         Immediately           F         0.61         6.80         6         4         Amplatzer Duct Occluder         20.5         Immediately           F         0.76         6.90         6         4         Amplatzer Duct Occluder         7.8         Immediately           M         1.43         6.40         6         4         Amplatzer Duct Occluder         7.8         Immediately           M         0.27         4.00         6         4         Amplatzer Duct Occluder         7.8         Immediately           M         0.21         4         Amplatzer Duct Occluder         7.8         Immediately           F         0.54         6.20         6         4         Amplatzer Duct Occluder         7.8	15	Щ	1.65	8.00		4	Cook detachable coil	4.9	After 6 months	
F         0.88         5.30         6         4         Amplatzer Duct Occluder	16	Ц	1.13	8.00	9	4	Amplatzer Duct Occluder	20.3	Immediately	Atrial septal defect closure
M         0.57         7.60         6         4         Amplatzer Duct Occluder Occluder O.3.         9.2 Immediately Immediately Immediately Immediately Immediately Immediately Immediately           F         0.61         6.80         6         4         Amplatzer Duct Occluder Occlude	17	Г	0.88	5.30	9	4	Amplatzer Duct Occluder	13.2	Immediately	Reduced arterial perfusion for 72 h
F         0.56         7.10         6         4         Amplatzer Duct Occluder Coil;         9.4         Immediately Immediately Immediately           F         0.61         6.80         6         4         Cook detachable coil;         32         Immediately Immediately           Amplatzer Duct Occluder         20.5         Immediately           M         1.43         6.40         6         4         Amplatzer Duct Occluder         7.8         Immediately           M         0.27         4.00         6         -         Cook detachable coil         21.4         After 6 months           M         0.11         4.10         4         -         Cook detachable coil         19.3         After 6 months           F         0.54         6.20         6         4         Amplatzer Duct Occluder         11.3         Not possible	18	Σ	0.57	7.60	9	4	Amplatzer Duct Occluder	9.2	Immediately	
F         0.61         6.80         6         4         Cook detachable coil;         32         Immediately           Amplatzer Duct Occluder         Amplatzer Duct Occluder         20.5         Immediately           M         1.43         6.40         6         4         Amplatzer Duct Occluder         7.8         Immediately           M         0.27         4.00         6         -         Cook detachable coil         21.4         After 6 months           M         0.11         4.10         4         -         Cook detachable coil         19.3         After 6 months           F         0.54         6.20         6         4         Amplatzer Duct Occluder         11.3         Not possible	19	Ч	0.56	7.10	9	4	Amplatzer Duct Occluder	9.4	Immediately	
F         0.76         6.90         6         4         Amplatzer Duct Occluder         20.5         Immediately           M         1.43         6.40         6         4         Amplatzer Duct Occluder         7.8         Immediately           M         0.27         4.00         6         -         Cook detachable coil         21.4         After 6 months           M         0.11         4.10         4         -         Cook detachable coil         19.3         After 6 months           F         0.54         6.20         6         4         Amplatzer Duct Occluder         11.3         Not possible	20	щ	0.61	08.9	9	4	Cook detachable coil; Amplatzer Duct Occluder	32	Immediately	Embolisation
M         1.43         6.40         6         4         Amplatzer Duct Occluder Colder         7.8 Immediately           M         0.27         4.00         6         -         Cook detachable coil         21.4 After 6 months           M         0.11         4.10         4         -         Cook detachable coil         19.3 After 6 months           F         0.54         6.20         6         4         Amplatzer Duct Occluder         11.3 Not possible	21	ĹΉ	0.76	06.90	9	4	Ampiatzer Duct Occluder	20.5	Immediately	Descending aorta flow velocity acceleration 2 5 m/s
M         0.27         4.00         6         -         Cook detachable coil         21.4         After 6 months           M         0.11         4.10         4         -         Cook detachable coil         19.3         After 6 months           F         0.54         6.20         6         4         Amplatzer Duct Occluder         11.3         Not possible	22	M	1.43	6.40	9	4	Amplatzer Duct Occluder	7.8	Immediately	
M 0.11 4.10 4 – Cook detachable coil 19.3 After 6 months F 0.54 6.20 6 4 Amplatzer Duct Occluder 11.3 Not possible	23	Σ	0.27	4.00	9	ı	Cook detachable coil	21.4	After 6 months	Atrial septal defect closure
F 0.54 6.20 6 4 Amplatzer Duct Occluder 11.3 Not possible	24	M	0.11	4.10	4	I	Cook detachable coil	19.3	After 6 months	Right-sided PDA
	25	Ľ	0.54	6.20	9	4	Amplatzer Duct Occluder	11.3	Not possible	

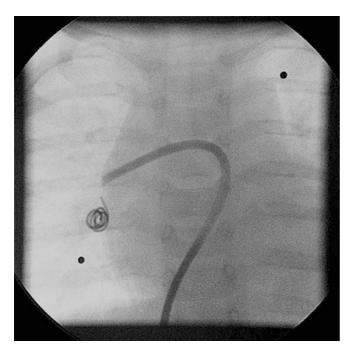


Fig. 1 Posterior-anterior chest X-ray film showing the embolised Cook detachable coil in the right pulmonary artery. A 6 F long sheath was introduced into the right pulmonary artery and the Cook detachable coil was retrieved into the sheath using a snare catheter. Afterwards the sheath was used to implant the ADO

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