Evaluation of Transcatheter Amplatzer Occlusion Of the Persistent Arterial Duct with Echocardiographic Guidance

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Abstract

Background- This study was performed to report on the data of transcatheter Amplatzer occlusion of the persistent arterial duct under echocardiographic guidance.

Methods- This prospective study was conducted on 39 Iranians, who underwent 39 transcatheter Amplatzer occlusions of arterial ducts. Echocardiography was performed in all of the patients versus aortography in 5 patients for the evaluation of residual shunts across the duct immediately and after 10 minutes of Amplatzer implantation.

Conclusion- The results showed the advantages of echocardiography over aortography; consequently, the former is a useful, non-invasive tool for patients having their PDAs closed ***(Iranian Heart Journal 2004; 5(3): 37-41).***

Key words: Persistent arterial duct ■ transcatheter Amplatzer occlusion

In 1967, Postman et al. were the first to employ successfully an Ivalon plug for transcatheter closure of persistent arterial ducts (PDA).[1]

Since then, several devices have been used, including the Rashkind PDA occluder (not being used now), the Gianturco coil, the detachable coil (for small PDA), the CardioSEAL and other umbrella devices and the Amplatzer PDA occluder.[2]

Transcatheter closure of the persistently patent arterial duct beyond the neonatal period has now become an established practice, with a high success rate and a low incidence of complications. The rationale for duct closure in this population is to reduce the risk of endarteritis and possibly heart failure in later life.[3] Many researchers, in agreement over the safety and effectiveness of the procedure,[1,4-15] have reported successful implantation of various devices, especially coils and Amplatzer occluders inside the PDA, which has been done in adults as well as children.[16-18]

Caution must be exercised after the procedure so that there is no residual shunt across the device. Previous attempts consisted of visualization, so that correct position was confirmed by a hand injection of contrast medium through the aortic catheter into the descending aorta, and recording the aortogram.[1,14,19]

Aortography requires the insertion of an intra-arterial catheter via the intra-arterial line, which is invasive to the arterial vessel. We, therefore, attempted to record echocardiographic data immediately after the implantation of the device, looking for any residual shunts or iatrogenic coarctations. By performing echocardiography during the procedure, we can release the arterial vessel so as to prevent injury. This study sought to compare echocardiography with aortography in order to evaluate the

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success of device implantation for the occlusion of the PDA.

Methods

Prospective data were collected from 39 Iranian children, referred to our center over a one-year period. A standard data collection sheet was completed, with the information required shown in Table I.

Table I. Data collected for each procedure

Date of birth
Weight
Cardiac diagnosis
Date of procedure
Pulmonary artery pressure
Minimum duct diameter
Duct shape
Presence of echocardiographic leak after occlusion
Presence of echocardiographic coarctation of aorta
Presence of echocardiographic stenosis of LPA
Latest date at which Doppler leak demonstrated
Earliest date at which complete occlusion demonstrated
Maximum Doppler velocity in descending aorta

LPA = Left Pulmonary Artery

Implantation procedure

All the procedures were performed by end-hole catheters, long guide wires, delivery system and the device (Fig. 1).

Statistical analysis

Immediate and long-term results after device implantation are expressed as mean values ± 1 SD, median values and range.

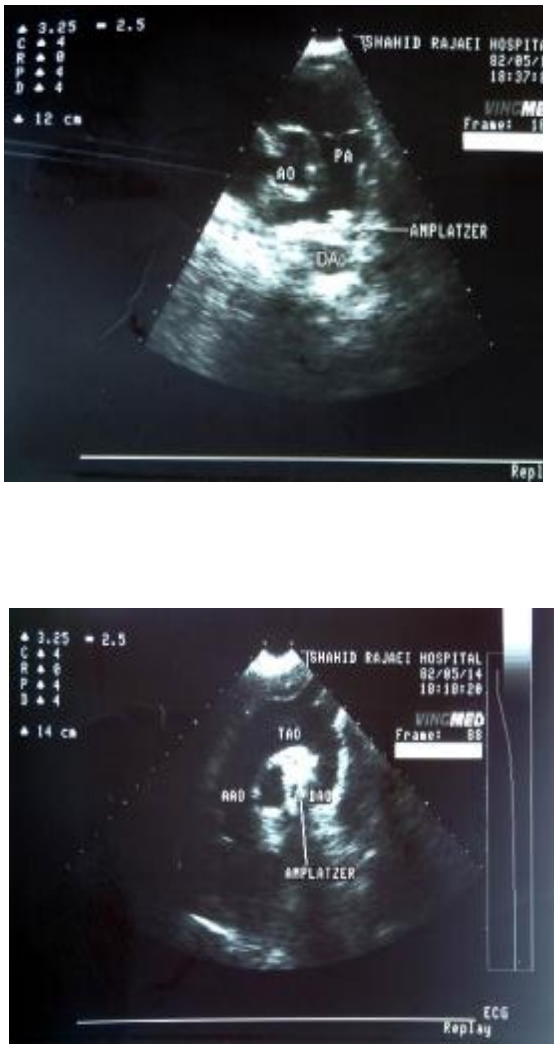

Fig. 1. Echocardiograms depicting Amplatzer device implantation inside PDA.

Results

A total of 39 attempted transcatheter Amplatzer occlusions of arterial ducts were performed in 39 patients (Table II). There were 26 females and 13 males. The mean age at the time of the procedure was 5.3 ± 4.8 years (ranging from 6 months to 17 years) with a median of 3.5 years. The mean weight was 17 ± 10.9 kg (ranging from 5 to 46 kg) with a median of 13.5 kg.

The vast majority had an isolated arterial duct (n=36), but a number had miscellaneous other cardiac diagnoses (n=3), the commonest being a restrictive VSD (n=2). The mean PDA minimal (pulmonary end) diameter (determined by aortography reaching the pulmonary artery via PDA) was 5.2 ± 2.0mm (ranging from 2 to 10 mm).

Table II. Patient characteristics and outcome after Amplatzer implantation.

N	Age (y/m)	W (Kg)	Cardiac Diagnosis	PAP (mm Hg)	PDA diameter (mm)	PDA type (C/ T/ W)	Device size	Result					
								Imm	1day	1m	3m	5m	1y
1	14/00	40	PDA	30	6	C	8/6	CC	CC	CC	CC	CC	CC
2	00/07	6.7	PDA+ VSD	19	6	C	8/6	CC	CC	CC	CC	CC	CC
3	01/00	8	PDA	40	6	C	8/6	CC	CC	CC	CC	CC	CC
4	00/08	7.3	PDA	30	4	C	6/4	CC	CC	CC	CC	CC	CC
5	06/00	18	PDA	45	8	C	10/8	CC	CC	CC	CC	CC	CC
6	01/02	7.5	PDA	25	10	T	12/10	CC	CC	CC	CC	CC	CC
7	17/00	45	PDA	30	5	W	6/4	CC	CC	CC	CC	CC	CC
8	00/10	6.5	PDA	30	4	C	6/4	TL	CC	CC	CC	CC	CC
9	07/00	22	PDA	30	5	C	8/6	CC	CC	CC	CC	CC	CC
10	08/00	16	PDA-AS-MS	50	9	T	12/10	CC	CC	CC	CC	CC	CC
11	14/05	38	PDA-VSD	30	3	T	5/4	CC	CC	CC	CC	CC	CC
12	02/00	13.5	PDA	30	3	C	6/4	CC	CC	CC	CC	CC	-
13	00/11	5.8	PDA	48	4	C	8/6	MoC	MiC	MiC	MiC	MiC	-
14	01/00	10	PDA	25	3	C	6/4	CC	CC	CC	CC	CC	-
15	02/06	12	PDA	40	6	C	10/8	CC	CC	CC	CC	CC	-
16	01/02	9	PDA	30	3	C	6/4	CC	CC	CC	CC	CC	-
17	09/00	25	PDA	30	3	C	6/4	CC	CC	CC	CC	CC	-
18	05/06	19	PDA	30	3	C	6/4	CC	CC	CC	CC	-	-
19	02/06	15	PDA	25	6	C	8/6	CC	CC	CC	CC	-	-
20	00/06	7.5	PDA	63	6.5	C	10/8	CC	CC	CC	CC	-	-
21	00/10	8	PDA	20	3	C	6/4	CC	CC	CC	CC	-	-
22	12/00	24	PDA	25	5	C	8/6	CC	CC	CC	CC	-	-
23	09/00	28	PDA	25	4	C	8/6	CC	CC	CC	CC	-	-
24	01/00	8.9	PDA	20	2	C	6/4	CC	CC	CC	CC	-	-
25	00/06	5	PDA	35	4	C	6/4	CC	CC	CC	CC	-	-
26	00/08	8	PDA	35	5.5	C	8/6	CC	CC	CC	CC	-	-
27	01/02	8	PDA	60	7	C	10/8	CC	CC	CC	CC	-	-
28	10/00	23	PDA	25	3	C	6/4	CC	CC	CC	CC	-	-
29	10/00	22	PDA	45	6	C	8/6	CC	CC	CC	CC	-	-
30	06/00	18	PDA	25	5	C	8/6	TL	CC	CC	-	-	-
31	08/00	21	PDA	30	10	C	14/12	CC	CC	CC	-	-	-
32	07/00	15	PDA	52	6	C	8/6	CC	CC	CC	-	-	-
33	03/00	13.5	PDA	30	3	C	6/4	CC	CC	CC	-	-	-
34	03/06	11	PDA	35	6	C	8/6	CC	CC	CC	-	-	-
35	04/00	12	PDA	40	7	C	10/8	CC	CC	CC	-	-	-
36	14/00	46	PDA	25	4	C	8/6	CC	CC	CC	-	-	-
37	11/06	30	PDA	27	6	C	10/8	CC	CC	CC	-	-	-
38	02/00	10	PDA	25	8	C	10/8	CC	CC	CC	-	-	-
39	08/00	20	PDA	25	8	C	10/8	CC	CC	CC	-	-	-

PDA = Persistent Arterial Duct, **VSD** = Ventricular Septal Detect, **AS** = Aortic Stenosis, **MS** = Mitral Stenosis, **CC**= Completely Closed, **MiC** = Mild Coarctation of aorta, **MoC** = Moderate Coarctation of aorta, **TL** = Trivial Leak, **C** = Conical, **W** = Window shape, **T** = Tubular.

There was left-to-right shunting across the PDAs in all the patients, both by oximetry and angiography. Pulmonary artery pressures were from 25mmHg to systemic. Systemic pulmonary artery pressure was reported in one patient, who had an isolated duct. The shape of the PDA was conical in 35 patients (89.7%), tubular in 3 (7.7%) and window-shaped in 1 patient (2.6%).

The catheter approach was venous in 34 (87.1%) and combined venous and arterial in 5 (12.8%) patients. Implantation was attempted using the Amplatzer duct occluder (ADO) in all the patients.

Having performed device implantation, we studied 5 patients both by aortography and echocardiography during the procedure (patients 1-5). There was no residual flow across the PDAs, no coarctation and no left pulmonary artery obstruction by aortographic and echocardiographic evaluations. As a result, we continued our evaluation with echocardiography alone during the procedure without an arterial approach (and aortography) for the other patients.

We had two small residual shunts in two patients (pts. no. 8 and 31). However, after 24hr of implantation, there was no shunt flow across the PDA.

One patient (pt. no.13) had coarctation of the aorta with 60mmHg pressure gradient (by echocardiography) caused by the Amplatzer after its implantation, although both leg pulses were easily palpable. The pressure gradient in the descending aorta dropped to 30mmHg by echocardiography about 3 months after the procedure. No left pulmonary artery obstruction or stenosis was caused, and we had no other problem in our evaluations.

Discussion

Amplatzer occlusion is an effective and safe procedure to stop shunting across the PDA. Evaluation of residual flow across the PDA was an angiographic and aortographic method until recently.

Echocardiographic assessments of early and mid-term results of transcatheter closure of persistent arterial ducts in children has been done in other centers of the world from about 24-48 hours after the procedure up to years after it.[20,21] Although echocardiographic guidance for transcatheter coil occlusion of patent ducts arteriosus in the catheterization laboratory concludes that immediate Doppler echocardiography is useful in assessing the status of residual PDA just after coil implantation,[22] performing echocardiography immediately after Amplatzer implantation is a very good suggestion since it does not require invasive methods of evaluation, such as having an intra-arterial line and catheter and doing aortography. Therefore, applying interventional methods instead of surgical procedures for PDA occlusion and echocardiographic evaluation instead of aortographic evaluation of residual shunting across the PDA can achieve the best trend towards a minimally invasive procedure.

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