


RESEARCH LETTER

Complete Left Bundle-Branch Block After Transcatheter Closure of Perimembranous Ventricular Septal Defect Using Amplatzer Duct Occluder II

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Amplatzer duct occluder II (ADO-II) is claimed to be safe and effective for transcatheter closure of perimembranous ventricular septal defect (PmVSD) with low incidence of postprocedure arrhythmias, particularly complete atrioventricular block and complete left bundle-branch block (CLBBB).¹ However, a recent study has reported 2 cases of complete atrioventricular block following transcatheter closure of PmVSD using ADO-II.² Data on CLBBB after device closure of PmVSD with ADO-II were lacking. The incidence, risk factors, and follow-up outcomes of CLBBB after device closure of PmVSD using ADO-II might be completely different from that we have previously reported for symmetrical double-disk device³ because ADO-II is only suitable for small size of PmVSD. Therefore, the present study was performed to address these issues in children.

The data that support the findings of this study are available from the corresponding author on reasonable request. This study was approved by the University Ethics Committee on Human Subjects at Sichuan University (No.2015[010]), and the written informed consent was provided by all patients'

guardians. A total of 276 children undergoing successful transcatheter closure of PmVSD using ADO-II (Abbott Medical, MN) between January 2016 and April 2020 in our center were retrospectively reviewed. The PmVSDs were closed because of increased left ventricular size (defined as left ventricular end-diastolic diameter [LVEDD] Z-score>2; n=51), recurrent lower respiratory tract infection (n=28), pulmonary arterial hypertension (n=12), growth retardation (n=13), cardiac dysfunction (n=4), and patient preference or social pressures (n=136). The mean, 25th, 75th, and 95th percentiles of LVEDD Z-score were 0.31, -0.76, 1.92, and 2.95, respectively. Z-score of LVEDD>3 was observed in 10 children. The process of transcatheter closure procedure was similar as previous study.³ With a follow-up duration of 1 to 48 months, 32 patients were excluded because of incomplete follow-up data, with a follow-up rate of 88.4% (244/276). Of the 244 children included, 87 (35.66%) developed post-procedure arrhythmias, including CLBBB in 8 (3.28%), incomplete right bundle-branch block in 27 (11.07%), complete right bundle-branch block in 8 (3.28%), left anterior hemiblock in 5 (2.05%), left anterior hemiblock

Key Words: Amplatzer duct occluder II device ■ complete left bundle-branch block ■ perimembranous ventricular septal defect ■ transcatheter closure

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Table. Risk Factors for Occurrence of CLBBB After Transcatheter Closure of PmVSD Using ADO-II

Variables	All patients (n=244)	Nonarrhythmia group (n=157)	CLBBB group (n=8)	P value
Body weight, kg	13.5 (7.0–46.0, 14.8±5.3)	13.0 (8.5–33.5, 14.1±4.2)	11.3 (7.0–16.0, 11.4±2.7)	0.073*
Age, mo	34.0 (17.0–166.0, 41.6±24.6)	31.0 (17.0–134.0, 37.6±18.1)	26.5 (22.0–38.0, 28.1±5.9)	0.144*
Sex, n (%)				
Male	128 (52.5)	82 (52.2)	4 (50.0)	1.000†
Female	116 (47.5)	75 (47.8)	4 (50.0)	...
Inlet diameter of VSD on echocardiography, mm	5.0 (1.5–16.0, 5.3±2.3)	5.0 (1.5–12.0, 5.1±2.2)	4.5 (2.0–8.0, 4.8±2.0)	0.538*
Outlet diameter of VSD on echocardiography, mm	3.0 (1.5–6.0, 3.1±0.9)	3.0 (1.5–5.0, 3.0±0.9)	3.0 (2.0–5.0, 3.1±0.9)	0.982*
Subaortic rim on echocardiography, mm	1.0 (0.0–6.0, 1.2±1.4)	1.0 (0.0–6.0, 1.2±1.4)	1.5 (0.0–2.0, 1.1±0.9)	0.966*
VSD size by angiography, mm	2.0 (1.0–5.0, 2.1±0.6)	2.0 (1.0–4.5, 2.0±0.5)	2.0 (1.5–3.2, 2.2±0.6)	0.254*
QP:QS	1.7 (1.3–4.5, 2.0±0.7)	1.7 (1.3–4.3, 1.9±0.6)	1.7 (1.5–3.3, 2.0±0.6)	0.839*
Delivery sheath, n (%)				
4F	167 (68.4)	116 (73.9)	4 (50.0)	0.215†
5F	77 (31.6)	41 (26.1)	4 (50.0)	...
Occluder size, mm	3.0 (3.0–6.0, 3.3±0.6)	3.0 (3.0–5.0, 3.2±0.5)	3.0 (3.0–6.0, 3.5±1.0)	0.509*
Antegrade approach, n (%)	180 (73.8)	119 (75.8)	7 (87.5)	0.682†
Retrograde approach, n (%)	64 (26.2)	38 (24.2)	1 (12.5)	...
Operation time, min	35.0 (15.0–150.0, 40.3±20.8)	35.0 (15.0–130.0, 37.6±16.8)	52.5 (40.0–100.0, 60.6±20.5)	<0.001*‡
Fluoroscopic time, min	5.0 (1.0–75.0, 8.0±9.2)	5.0 (1.0–75.0, 7.1±8.2)	8.0 (5.0–24.0, 12.8±8.6)	0.131*
Radiation dosage, mGy	52.0 (13.0–574.0, 63.0±43.1)	51.0 (13.0–574.0, 60.1±48.5)	70.5 (48.0–188.0, 94.0±59.9)	0.059*

Data are expressed as median (range, mean±SD) or number (percentage). ADO-II indicates Amplatzer duct occluder II; CLBBB, complete left bundle-branch block; PmVSD, perimembranous VSD; QP:QS, pulmonary/systemic flow ratio; and VSD, ventricular septal defect.

*Z values.

† χ^2 values.

‡P values <0.05 that the variable has a statistical difference between the nonarrhythmia group and the CLBBB group.

and incomplete right bundle-branch block in 2 (0.82%), junctional escape rhythm in 14 (5.74%), junctional escape rhythm and incomplete right bundle-branch block in 1 (0.41%), junctional escape rhythm and left anterior hemiblock in 1 (0.41%), junctional escape rhythm and ventricular premature beats in 1 (0.41%), ventricular escape rhythm in 2 (0.82%), escape rhythm and conduction block in 1 (0.41%), first-degree AVB in 2 (0.82%), second-degree AVB in 1 (0.41%), and other impulse formation disorders in 14 (5.74%). Most of arrhythmias were transient, and persistent arrhythmias remained in 15 patients (6.15%). The mean±SD, median, and 95th percentile for QRS duration before the procedure were 80.68±9.20, 80.00, and 96.00 milliseconds, respectively. The corresponding values on latest follow-up were 80.26±9.93, 80.00, and 95.95 milliseconds, respectively. Patients without any type of new-onset arrhythmias postprocedure (n=157) were recruited as

control group. Risk factors for postprocedure CLBBB were determined.

Among the 8 patients with postprocedural CLBBB, early-onset CLBBB was observed in 6 cases (4 cases developed at 1 day and 2 cases developed at 5 days after procedure). After intravenous dexamethasone (1 mg/kg daily) or oral prednisone (1–2 mg/kg daily) treatment for 2 to 5 days and tapered gradually, 4 of 6 patients had restored sinus rhythm within 5 days. The residual 2 cases regressed to normal rhythm at ≥1 month and at 9 months postprocedure, respectively. Late-onset CLBBBs were noticed in 2 cases (1 case at ≥6 months and another at ≥19 months postprocedure). Both experienced persistent CLBBB but were asymptomatic during follow-up. However, left ventricular enlargement, systolic dyssynchrony, and decreased systolic strain (GE Medical System, Horten, Norway) were observed in both patients (case 1, aged ≥6 years: LVEDD, 42 mm; global longitudinal

systolic strain, 9.8%; global circumferential strain, 16.9%; case 2, aged 4 years: LVEDD, 40 mm; global longitudinal systolic strain, 10.3%; global circumferential strain, 8.3%). Only the operation time was identified as a risk factor for occurrence of postprocedure CLBBB ($P < 0.001$) (Table).

With the largest sample size, we first reported the mid-term follow-up outcomes of CLBBB after transcatheter closure of PmVSD using ADO-II in children. Several novel findings were observed: (1) It was different from previous studies³ in that the overall incidence of postprocedure arrhythmias was not low (35.66%), which was even higher than that found in symmetrical double-disk device (25.64%). Fortunately, most of them only exhibited as a short, transient phenomenon and there was no occurrence of complete or high-degree AVB. (2) CLBBB could occur after transcatheter closure of PmVSD using ADO-II despite the fact that it was uncommon (3.28%). The outcome was satisfactory because most of them restored normal conduction. Close follow-up, however, needs to be applied because late-onset CLBBB was observed. (3) Persistent CLBBB could lead to left ventricular systolic dyssynchrony and dysfunction. (4) Unlike our previous study³ in which an oversized occluder was a risk factor for CLBBB with symmetrical double-disk device, longer operation time, which might result from edema and inflammation of conduction tissue caused by repeated passage of small PmVSD, was the only risk factor for CLBBB after transcatheter closure of PmVSD using ADO-II. On the basis of these findings, we suggested that transcatheter closure of PmVSD using ADO-II was technically effective, with several advantages, and could be attempted in PmVSD with hemodynamic changes. However, for asymptomatic children with small size of PmVSD, regular follow-up might be a better choice because higher incidence of postprocedural conduction abnormalities and the possibility of sustained CLBBB were observed despite the use of the softer device of ADO-II.

ARTICLE INFORMATION

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Disclosures

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