Scientific letters

Endocardial Pacing in Infants and Young Children Weighing Less Than 10 Kilograms

Estimulación endocárdica de niños con peso inferior a 10 kilogramos

To the Editor,

Permanent pacemaker implantation is a challenge in pediatric patients, who account for less than 1% of all patients who undergo this procedure.[1] Widespread pacemaker use in children is limited by the absence of devices tailored to this population. Epicardial pacemaker placement used to be the preferred option for young patients, as the size of generators and endocardial leads were considered to be inappropriate and even dangerous for young children. Today, however, endocardial pacemakers are being increasingly used in the pediatric population as they offer several advantages, such as lower sensing and pacing thresholds and a reduced risk of lead fractures.[2]

We report our experience with permanent pacemaker implantation in patients weighing less than 10 kg at our hospital between January 2006 and March 2015. The procedure was performed in 25 patients with a median age of 17 months (range, 6-40 months) and a median weight of 7 kg (range, 4.4-10.0 kg). The indication for pacing in 22 (88%) of the patients was complete atrioventricular block (AVB) after surgery (Table). The AVB had occurred after closure of a ventricular septal defect in all cases except one. The median time between surgery and implantation was 23 days (range, 9-40 days). The pacing leads were inserted by puncturing the right (n = 15) or left (n = 10) subclavian vein. The atrial or ventricular leads, measuring 52 cm in length and 2 mm in diameter, were inserted through 7-Fr introducer sheaths. Bipolar active-fixation leads were used in all cases. For dual chamber pacemakers, a right atrial loop measuring approximately 4 to 6 cm in length was created (Figure). Details of the generator models, implantation sites, pacing mode, and electrical parameters during implantation and follow-up are given in the Table. The generator was placed in a subpectoral pocket. The implantation procedure was completed without complications in most of the patients. One patient developed supraventricular tachycardia without repercussions during fixation of the atrial leads. In another patient, the atrial lead needed to be replaced due to malfunction caused by dislodgement on day 2 after the procedure. Twenty-two of the patients (88%) were followed up for a median of 48 months (range, 1-102 months). Generator replacement due to battery depletion was necessary in 2 children and there was no evidence of venous thrombosis during replacement in either case. Leads were extracted due to pocket-site infection in 3 patients (12%) at 8, 25, and 27 months. There had been no evidence of hematoma at the implantation site in any of the cases. Once the infection had cleared, the lead was removed using an epicardial surgical approach and replaced in 2 patients and was repositioned percutaneously on the contralateral side in the third. All the patients, including those who required lead extraction, were in good clinical health.

A number of factors need to be considered when placing an endocardial pacemaker in young children. Lead displacement caused by growth can interfere with pacing, requiring the insertion of new leads within a relatively short period. Use of a longer atrial lead can prevent this from happening. Gheissari et al.[3] calculated that a right loop of 8 cm would allow a child to grow for 6 to 12 years without the need for reoperation and that approximately 10 mm of lead per year should accommodate for somatic growth. Other authors, however, have warned that a surplus lead of this length could be displaced into the right ventricular outflow tract, possibly causing lung failure.[4] In our experience, a loop length of approximately 4 to 6 cm is adequate. We have detected no problems to date, although we acknowledge that larger series and longer follow-up times are necessary. Another important issue with pacemaker placement in young children is the thinness of the subcutaneous tissue layer, as the generator tends to exert tension against the tissue and can cause lesions. This increases the risk of infection and the need for extraction, as has been previously indicated.[5] The use of subpectoral pockets has been associated

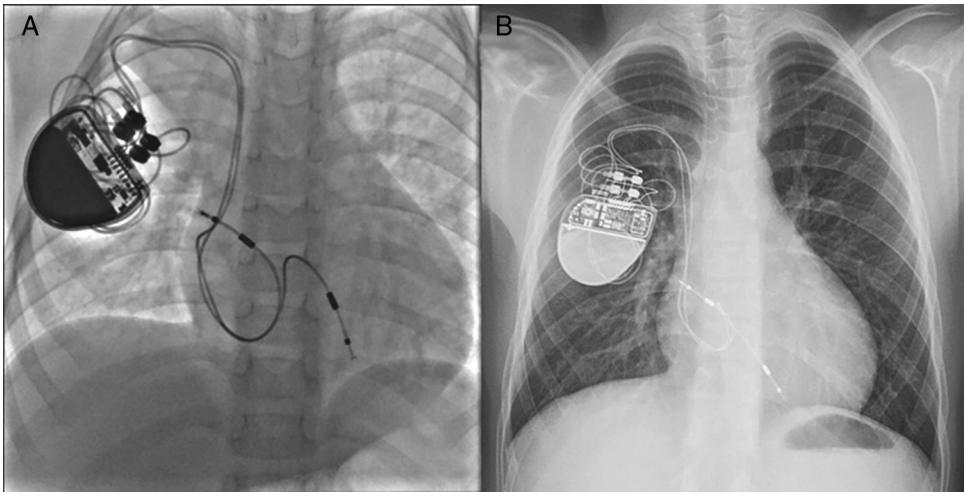

Figure. Two-year-old patient weighing 9 kg with congenital atrioventricular block. Note the position of the leads in both the atrium and at the right ventricle apex (A). The same patient aged 8 years old and weighing 25 kg (B). Note the minimum displacement of the leads despite the significant somatic growth.

Table
Clinical and Electrical Characteristics of Permanent Endocardial Pacemaker Implantation in Young Children

Patient	Congenital heart disease	Generator	Implantation site		Pacing mode	Electrical parameters during implantation						
			Atrium	Ventricle		Atrium			Ventricle			Heart rate, max/min (bpm)
						Sensitivity (mV)	Pacing treshold (mV)	Impedance (Ω)	Sensitivity (mV)	Pacing threshold (mV)	Impedance (Ω)	
1	ASD+ VSD	St Jude Microny II	————	Apex	VVIR	—————	—————	—————	N/A	N/A	N/A	185/90
2	CoAo + PDA + VSD	Guidant Insignia I Entra	Posterior wall	Apex	DDDR	N/A	N/A	464	N/A	N/A	512	150/80
3	Double discordance + VSD	Vitatron	Posterior wall	Apex of LV	DDD	N/A	0.2	450	N/A	0.4	598	170/90
4	AVC defect	St. Jude Microny II	———	RVOT	VVIR	—————	—————	————	N/A	N/A	415	185/90
5	VSD + PDA	Guidant Insignia I Entra	Atrial appendage	RVOT	DDDR	N/A	N/A	610	N/A	N/A	530	180/80
6	Supracardiac-type TAPVC in SVC	Guidant Insignia I Entra	Posterior wall	Apex	DDD	3.5	0.4	420	3.5	0.4	430	180/90
7	Dextrocardia, situs inversus, DORV	Guidant Insignia I Entra	Posterior wall	Apex	DDD	0.75	0.6	447	8.6	0.9	464	150/90
8	Structurally healthy heart	Guidant Insignia I Entra	Posterior wall	Apex	DDDR	1.5		530	8.0		490	185/90
9	TGA + VSD + subpulmonary ring	Guidant Insignia I Entra	Lateral wall	Apex	DDDR	2.0	1.0	400	10	1.25	700	185/110
10	VSD + PDA	Medtronic	Atrial appendage	RVOT	DDDR	0.19	2.4	866	15	2.1	952	180/80
11	VSD + PDA	Boston Scientific Altrua	Atrial appendage	RVOT	DDD	1.0	0.75	470	6.0	0.5	440	185/70
12	Structurally healthy heart + paralysis of right atrium	Boston Scientific Altrua	Posterior wall	RVOT	DDDR	N/A	N/A	420	8.5	N/A	480	185/90
13	VSD + PDA	Boston Scientific Altrua	Atrial appendage	RVOT	DDDR	2.0	1.6	610	15	1.2	530	180/70
14	VSD + PDA	Boston Scientific Altrua	Posterior wall	RVOT	DDDR	3.6	1.5	636	20.7	0.9	870	185/100
15	Juxtaposed atrial appendages	Medtronic	Interatrial septum	Apex	DDD	1.0	0.6	764	6.8	1.1	697	185/100
16	VSD + PDA	Boston Scientific Altrua	Atrial appendage	RVOT	DDDR	1.5	0.9	430	2.5	0.5	480	180/80
17	AVC defect	Boston Scientific Altrua	Lateral wall	RVOT	DDDR	1.2	0.5	780	7.0	0.8	640	185/100
18	ASD + VSD	Boston Scientific Altrua	Posterior wall	RVOT	DDDR	1.2	0.4	560	6.0	0.7	538	185/70
19	VSD	Boston Scientific Altrua	Roof	Apex	DDDR	0.75	0.8	413	2.5	0.4	445	180/80
20	VSD + PDA	Boston Scientific Altrua	Lateral wall	Apex	DDDR	0.75	1.2	534	2.5	1.2	568	180/80
21	Intracardiac-type TAPVC in coronary sinus + VSD	Boston Scientific Altrua	Atrial appendage	RVOT	DDDR	0.5	0.9	474	2.5	0.5	540	185/90
22	DORV	Boston Scientific Altrua	Roof	RVOT	DDDR	0.8	1.3	568	3.0	1.4	620	185/70

Table *(Continued)*
Clinical and Electrical Characteristics of Permanent Endocardial Pacemaker Implantation in Young Children

Patient	Congenital heart disease	Generator	Implantation site		Pacing mode	Electrical parameters during implantation						
			Atrium	Ventricle		Atrium			Ventricle			Heart rate, max/min (bpm)
						Sensitivity (mV)	Pacing treshold (mV)	Impedance (Ω)	Sensitivity (mV)	Pacing threshold (mV)	Impedance (Ω)	
23	CoAo + VSD	Boston Scientific Ingenio MRI	Atrial appendage	RVOT	DDDR	1.0	1.5	610	6.5	0.7	740	185/100
24	VSD	Boston Scientific Ingenio MRI	Atrial appendage	RVOT	DDDR	0.75	0.6	468	2.5	0.8	534	185/90
25	ASD + DORV	Boston Scientific Ingenio MRI	Atrial appendage	RVOT	DDDR	0.75	0.4	788	2.5	0.4	753	185/110

Patient	Electrical parameters during follow-up									
	Atrium			Ventricle			Pacing %		AV interval	
	Sensitivity (mV)	Pacing threshold (mV)	Impedance (Ω)	Sensitivity (mV)	Pacing threshold (mV)	Impedance (Ω)	Atrial	Ventricular	SAV	PAV
1	–––	–––	–––	N/A	N/A	N/A	NF	NF	NF	NF
2	N/A	N/A	N/A	N/A	N/A	N/A	NF	NF	NF	NF
3	1.75	2.5	650	N/A	0.75	450	29	99	NA	NA
4	–––	–––	–––	N/A	N/A	N/A	–––	NA	–––	–––
5	1.2	3.25	310	8.6	5.0	380	6	100	NA	NA
6	N/A	N/A	N/A	N/A	N/A	N/A	NF	NF	NF	NF
7	2.0	0.1	470	N/A	2.5	500	57	100	NA	NA
8	4.2	1.75	470	N/A	1.5	520	0	100	150	80
9	N/A	N/A	N/A	N/A	N/A	N/A	13	98	NA	NA
10	4.0	1.75	460	7.7	5.1	383	21	100	80	140
11	2.0	0.05	370	N/A	0.05	410	0	100	NA	NA
12	2.5	1.16	490	4.4	4.1	490	100	73	NA	NA
13	0.75	0.75	460	N/A	2.5	420	1	99	NA	NA
14	N/A	2.0	410	N/A	1.75	520	97	100	NA	150
15	1.4	1.25	522	N/A	1.25	470	1	100	120	150
16	2.4	1.24	610	N/A	1.25	480	4	100	NA	NA
17	2.2	1.75	420	N/A	1.5	420	19	100	NA	NA
18	0.5	1.5	420	N/A	1.5	420	14	100	NA	NA
19	N/A	2.0	380	N/A	1.75	410	2	100	NA	NA
20	1.0	1.25	530	N/A	1.75	430	40	100	NA	NA
21	0.32	8.75	560	6.5	1.5	440	14	92	NA	NA
22	2.4	1.25	410	N/A	1.25	460	57	100	NA	NA
23	1.9	1.25	400	N/A	1.5	460	11	100	NA	NA
24	0.9	6.25	N/A	12	2.0	N/A	7	2	NA	NA
25	N/A	N/A	N/A	N/A	N/A	N/A	56	100	80	160

ASD, atrial septal defect; AVC, atrioventricular canal; bpm, beats per minute; CoAo, coarctation of the aorta; DORV, doublet outlet right ventricle; LV, left ventricle; N/A, not applicable; NA, not available; NF, not followed up; PAV, paced AV; SAV, sensed AV; PDA, patent ductus arteriosus; RVOT, right ventricular outflow tract; SVC, superior vena cava; TAPVC, total anomalous pulmonary venous connection; TGA, transposition of the great arteries; VSD, ventricular septal defect.

with a lower risk of infection in such cases.[6] Subpectoral placement is preferred not only for cosmetic reasons but also because of the greater protection provided by the pectoral muscle in young patients.

In conclusion, although patients require close lifetime follow-up due to the risk of venous thrombosis and the possible need for lead extraction, we consider that endocardial pacing in pediatric patients weighing less than 10 kg is a reasonably safe and effective option in hospitals with experience.

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A Rare Life-threatening *Kodamaea ohmeri* Endocarditis Associated With Hemophagocytic Lymphohistiocytosis

Inusual endocarditis grave por Kodamaea ohmeri *asociada a linfohistiocitosis hemofagocítica*

To the Editor,

We report the case of a 57-year-old man with a 3-month history of intermittent pyrexia. He received irregular antibacterial therapy and thrombolysis in a local hospital due to occlusion of the right distal popliteal artery. His medical history included multiple fractures, allergic purpura, and hypertension. His medications included prednisone (30 mg orally per day), metoprolol, and amlodipine.

On physical examination, breath sounds were clear and a 3/6 pansystolic murmur was auscultated at the right sternal border. Swelling of the right leg and gangrene at the fifth toe were found. Abdominal palpation revealed mild splenomegaly. The following abnormal laboratory results were identified: white cell count, 3.20×10^9/L; platelet count, 30×10^9/L; hemoglobin, 8.80 g/dL; albumin, 2.99 g/dL; erythrocyte sedimentation rate, 42 mm/h; C-reactive protein, 13.30 mg/L; and ferritin, 674 μg/L.

Three blood cultures were positive and a gram stain showed budding yeast cells. The isolate, after being subcultured on CHROMagar (Becton Dickinson, Paris, France), showed membranous colonies that changed color from pink to blue within 48 hours (Figure A). On corn meal agar (Becton Dickinson), pseudohyphae and blastoconidia were seen 24 hours later (Figure B). The yeasts were identified as *Kodamaea ohmeri* (*K. ohmeri*). Drug sensitivity testing showed that this strain was susceptible to voriconazole, fluconazole, itraconazole, and amphotericin B.

Bone marrow aspiration, performed due to the cytopenia, showed phagocytosis of hematopoietic cells by activated macrophages (Figure C). Thoracoabdominal computed tomography revealed splenomegaly and mild bilateral pleural effusion. Transthoracic echocardiography showed a large vegetation (30 mm × 12 mm) on the aortic valve with mild regurgitation and stenosis.

On hospital day 5, the patient developed persistent pyrexia with a temperature of 39 °C despite antifungal therapy with intravenous voriconazole. Urgent surgery was performed and a large fragile and loose vegetation was found on the aortic valve that almost occluded the orifice (Figure D). The aortic valve was replaced with a 21-mm mechanical prosthesis (St. Jude Medical, St. Paul, MN, United States). Continued blood loss of more than 200 mL/h occurred in the postoperative period. The coagulation profile

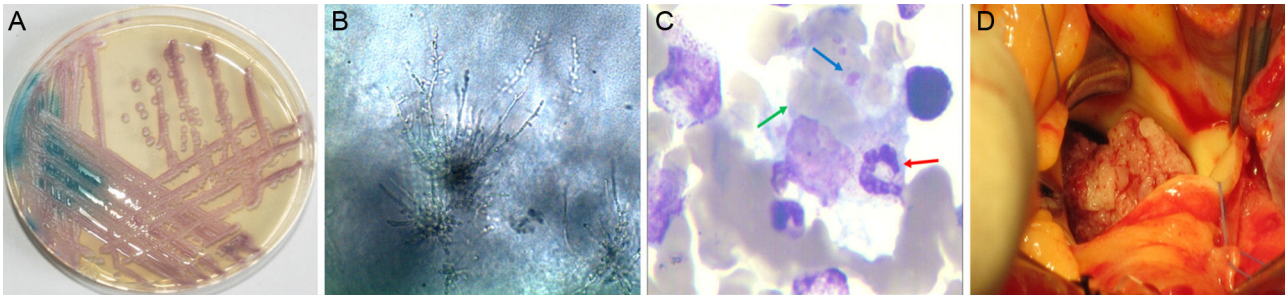

Figure. A: Color change of *K. ohmeri* cultured on CHROMagar Candida medium. B: Subcultured on corn meal agar, the yeast shows pseudohyphae and blastoconidia. C: Bone marrow smear shows macrophage phagocytosis of a band neutrophil (red arrow), multiple red blood cells (green arrow), and platelets (blue arrow) (Giemsa stain; magnification, ×1000). D: Intraoperative view shows a large fragile and loose vegetation on the aortic valve that almost occludes the orifice.