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Implantable cardioverter defibrillator (ICD) in children

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Abstract

Background: Implantable cardioverter defibrillators (ICD) proved to be effective in the prevention of sudden cardiac death in adults. In children, the experience of ICD therapy is limited. This retrospective study was undertaken to review our experience with ICD implantation in children with special consideration of psychosocial impact of this therapy.
Methods and results: Sixteen children (f:5, m:11, median age 12.2 years, range 4–15.9 years) received an ICD. Eleven patients had survived sudden cardiac death with documented ventricular fibrillation (VF) and five patients had sustained ventricular tachycardia (VT) with hemodynamic significance. The underlying heart disease was congenital in 5, hypertrophic cardiomyopathy in 2, myocarditis in 2 and primary electrical in 7 patients. All leads were implanted transvenously. Mean follow up was 43.1 months (range 1–105 months). All patients are alive. In 7 patients, a total of 387 sustained VT episodes were detected by the ICD. At follow-up, 10 inappropriate shocks were delivered in four patients. One early and six late lead revisions were done in seven patients. 12/16 (75%) patients had concomitant antiarrhythmic drug therapy. About half of the adolescents showed signs of depression and/or anxiety.
Conclusion: ICD therapy via transvenous access for prevention of sudden cardiac death is feasible and effective even in small children. However, the occurrence of lead complications is significant. Since about half of the adolescents showed signs of depression and/or anxiety, professional psychological surveillance should be considered in these patients.

Keywords: Implantable cardioverter defibrillator; Children; Psychosocial impact

1. Introduction

Since the initial clinical report in 1980 [1], treatment with an implantable cardioverter defibrillator (ICD) in adults with survived sudden cardiac death and reduced left ventricular function proved to be superior to medical antiarrhythmic therapy [2–7]. Recently, guidelines for ICD implantation in adults were published [8,9]. Similar indications are applied for the pediatric population. However, the experience in children is limited and accounts for less than 1% of all implanted devices [10]. In contrast to adults, children often do not show a normal cardiac anatomy and are not able to consciously decide on ICD implantation. This retrospective study was undertaken to review our experience with ICD implantation in children with special consideration of psychosocial impact of this therapy.

2. Methods

All charts of ICD patients under 18 years of age were reviewed with special attention to diagnosis, prior operation, the history of survived sudden cardiac death (SSCD) and residual lesions. Standard and Holter electrocardiograms were performed as well as standard echocardiography. In patients without known heart disease, myocarditis was excluded by myocardial biopsies. Patients were followed-up regularly every 6 months.

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Table 1
Patient data

ID	Diagnose	OP	Age years	Indication for ICD	EP study	VT induc.	Tachy. no.	VT ATP	ICD shock	Shocks inappropriate	"Follow-up" (months)	Antiarrhy. med.
1	long QT	none	9.6	SSCD	no	–	81	0	55	0	104.3	mex, at
2	DORV	IVR	9.6	VT	yes	yes	261	254	6	1	79.6	am, bis, mex
3	DORV	IVR	13.4	VT	no	–	9	1	6	0	63.7	sotalol
4	long QT	none	6.6	SCSD	no	–	10	0	8	1	26.5	bis
5	prim. elect.	none	10.4	SSCD	yes	no	0	0	0	0	18.6	met
6	DORV	IVR	12.1	VT	yes	yes	0	0	0	0	48.8	bis
7	ventr. aneurys.	Explo.	14.4	SSCD	yes	no	0	0	0	0	17.2	bis
8	crit. PS	com. PV	15.9	SSCD	no	–	0	0	0	0	105.4	none
9	hypertr. CM	none	10.7	SSCD	yes	no	4	0	4	3	18	met
10	AV III	none	5.8	VT	no	–	0	0	0	0	38.4	met, mex
11	prim. elect.	none	13.2	SSCD	no	–	5	0	5	5	53.3	none
12	PB19 myocard.	none	12.2	SSCD	yes	no	5	0	4	0	42.3	met
13	Brugada Sy.	none	4.0	VT	yes	no	0	0	0	0	19.7	none
14	PB19 myocard.	none	14.2	SSCD	no	–	0	0	0	0	49.2	bis
15	hypertr. CM	none	14.3	SSCD	yes	no	0	0	0	0	2.9	none
16	long QT	none	16.9	SSCD	yes	no	0	0	0	0	1.0	bis

DORV=double outlet right ventricle, TGA=transposition of the great arteries, hypertr. CM=hypertrophic cardiomyopathy, IVR=intraventricular repair with tunnel-patch, Explo.=emergency aortic valve exploration, prim. elect.=primary electrical heart disease, PB19 myocard.=biopsy proven Parvo B 19 myocarditis, age years=age at ICD-implantation, EP=electrophysiological, VT induc.=ventricular tachycardia inducible in EP study, VT=ventricular tachycardia, SSCD=survived sudden cardiac death, Tachy.=tachycardia, ATP=antitachycardia pacing, amiodarone, bis=bisoprolol, mex=mexiletine, at=atenolol, met=metoprolol.

2.1. ICD indication

SSCD with documented ventricular fibrillation (VF) was present in 11 patients (Table 1). The other five children had sustained monomorphic ventricular tachycardia (VT) with hemodynamic significance. One of these patients (no. 6) had three different forms of VT.

2.2. Electrophysiological studies

Nine patients had electrophysiological studies (Table 1). For the induction of VT programmed stimulation was performed from the right ventricular apex and outflow tract with a cycle length of 600 ms and 400 ms and up to three premature extra stimuli. In two out of nine patients, the clinical VT was inducible. Accessory pathways were ruled out in all cases.

2.3. Psychological assessment methods

To measure the level of depression and anxiety, the DISYPS-KJ [11] was used. The DISYPS-KJ helps to diagnose psychological disorders in children and adolescents according to the diagnosis criteria of the ICD-10 and the DSM-IV. The test covers five areas of psychological disorders: (1) hyperkinetic disorders, (2) social behaviour disorders, (3) anxiety, (4) depression and (5) development disorders. In this study, the two self-evaluation tests were used which assess depression and anxiety. The ratings may range from 0 (no depression/anxiety) to 3 (severe depression/anxiety).

Ten of sixteen patients participated in this substudy, all being adolescents (Table 2). The assessment was performed at the time of the regular outpatient clinic check-up; one patient (no. 9) was questioned during the initial hospital stay. A semi-structured interview of 40 min was conducted in each patient.

3. Results

3.1. Patient characteristics

Since November 1995, 16 children (female 5, male 11) were treated with an ICD. Median age was 12.2 years (range 4–15.9 years) and median weight was 47 kg (range 16.2–72 kg). Thirteen patients had a normal left ventricular

Table 2
Psychological test

ID	Diagnose class	ICD therapy	Depression rating	Anxiety rating	Red. phys. activity	Comment
1	III	yes	0	0	?	–
2	I	yes	0	1	yes	psychotherapy
3	I	yes	0	0	yes	concerned about future
5	III	no	1	2	yes	little understanding
6	I	no	1	1	no	–
7	I	no	1	0	yes	disabled (stroke)
8	I	no	1	1	no	concerned about future
9	II	yes	1	2	yes	–
11	III	yes	0	0	no	concerned about future
12	II	yes	1	2	yes	psychotherapy

Diagnose class: I=congenital heart disease, II=cardiomyopathy/myocarditis, III=primary electrical disease, ratings from 0 (no depression/anxiety) to 3 (severe depression/anxiety), red. phys. activity=reduced physical activity.