ORIGINAL ARTICLE

Outcome of newborns with asymptomatic monomorphic ventricular arrhythmia

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Background: Frequent premature ventricular contractions (PVCs), couplets (CPLTs) and episodes of ventricular tachycardia are extremely rare in the neonatal population. Limited information is available with regard to clinical relevance and outcome.
Objectives: To evaluate the clinical characteristics and outcomes of a group of newborns with ventricular arrhythmias without heart disease.
Patients and design: Between January 2000 and January 2003, 16 newborns with ventricular arrhythmias in the absence of heart disease were studied. The newborns were divided into three groups: PVC group (n = 8), CPLT group (n = 4) and ventricular tachycardia group (n = 4). All patients underwent physical examination, electrocardiography, Holter monitoring and echocardiography at diagnosis and at follow-up (1, 3, 6 and 12 months, and yearly thereafter).
Results: Mean (standard deviation, SD) age of the patients was 3 (1.19) days in the PVC group, 3.25 (0.95) days in the CPLT group and 6.5 (9.1) days in the ventricular tachycardia group. Median follow-up was 36 months (range 24–48 months). PVCs disappeared during follow-up in all the neonates, in the PVC group, at a mean (SD) age of 2.1 (1.24) months; in the CPLT group, couplets disappeared at a mean (SD) age of 6.5 (1) months. All patients with ventricular tachycardia were treated; ventricular tachycardia disappeared at a mean (SD) age of 1.7 (0.9) months. Neither death nor complications occurred.
Conclusions: Ventricular arrhythmias in newborns without heart disease have a good long-term prognosis. Frequent PVCs and CPLTs do not require treatment. Sustained ventricular tachycardia or high-rate ventricular tachycardia must be treated, but the prognosis is generally favourable.

The neonate shows a broad spectrum of ventricular arrhythmia, ranging from isolated premature ventricular contractions (PVCs) to life-threatening forms of ventricular tachycardia. As in all age groups, this rhythm disturbance may be an incidental finding on a routine physical examination or may be accompanied by cardiovascular collapse.

Moreover, it has become increasingly important that the clinician should be aware of these arrhythmias because they may be an indication of underlying structural or functional cardiac disease.

Isolated PVCs are a relatively common finding in the neonatal period occurring in up to 18% of neonates >30 days of age during 24-h continuous Holter monitoring.[1 2] Isolated PVCs in the absence of associated heart disease are associated with a favourable prognosis.[3]

Conversely, complex ectopy, couplets (CPLTs) or true episodes of ventricular tachycardia are extremely rare in the neonatal population,[4 5] and the clinical relevance has not been systematically investigated in this age group.

Idiopathic ventricular tachycardia, defined as ventricular tachycardia in the absence of associated structural heart disease, is quite rare and only a few newborns are seen at each individual centre. Published paediatric studies have shown that idiopathic ventricular tachycardia basically has a good prognosis.[6–8]

In this report, we describe the clinical characteristics, response to treatment and outcome of a group of newborns without structural congenital heart disease but with frequent ventricular ectopy or ventricular tachycardia.

METHODS

Patient selection

We reviewed the medical records of 16 full-term newborns, hospitalised in the Neonatology Department (Catholic University Medical School, Rome, Italy) between January 2000 and January 2003, who had

- frequent ventricular premature beats, defined as >60 beats/h,
- frequent ventricular couplets (>50/h) and
- ventricular tachycardia.

The neonates were referred for cardiological evaluation because of incidental discovery of arrhythmia on routine physical examination. Rhythm anomalies were diagnosed on 12-lead electrocardiography (ECG) and on ECG Holter monitoring.

Patients with structural congenital heart disease, prolonged QT interval, positive familial factors for cardiomyopathy or sudden death, a history of maternal drug misuse or medication during pregnancy and perinatal asphyxia were excluded.

Diagnostic investigation

All patients underwent a physical examination. The medical history of each patient was taken.

Abbreviations: CPLT, couplet; ECG, electrocardiography; LBBB, left bundle branch block; PVC, premature ventricular contraction; RBBB, right bundle branch block

All patients had standard haematological, serum electrolytes, aspartate alanine aminotransferase, creatine kinase, lactate dehydrogenase and pH investigation, viral culture of the stool and the throat, viral titres of enterovirus, standard ECG, chest *x* ray and 24-h Holter monitoring. All patients were assessed by echocardiography to evaluate the presence of heart disease or ventricular dysfunction. Cardiac magnetic resonance imaging was carried out on neonates with incessant ventricular tachycardia.

Study groups

The patients were divided into three groups: eight neonates (six males and two females) in whom only PVCs were observed throughout the follow-up period (PVC group), four neonates (one male and three females) who showed CPLTs (CPLT group) and four neonates (all males) consisting of three neonates with ventricular tachycardia at the initial examination and one who initially showed CPLTs but later showed ventricular tachycardia.

Follow-up

Standard cardiological follow-up, including physical examination, ECG, Holter monitoring and echocardiography, was carried out at 1, 3, 6, and 12 months, and yearly thereafter.

Resolution of ventricular arrhythmias was defined as a lack of evidence of recurrences during clinical examination and during Holter monitoring on two consecutive examinations.

Definitions

The PVCs were defined as frequent when they were >60 beats/h. PVCs, CPLTs and ventricular tachycardia were considered to have originated from the right ventricle when the Q wave, R wave and S wave (QRS) morphology showed a left bundle branch block pattern (LBBB), and from the left ventricle when it showed a right bundle branch block pattern (RBBB).[9] Ventricular tachycardia was diagnosed when three or more ventricular complexes occurred in sequence at a rate at least 20% greater than the average sinus rate.[3] The fastest rate of ventricular tachycardia and the corrected QT interval were calculated.[10 11] The morphological characteristics of the ventricular tachycardia were classified as RBBB or LBBB.[9] Episodes of ventricular tachycardia were defined as sustained when lasting >30 s; otherwise they were defined as non-sustained.[12]

Incessant ventricular rhythm was defined as the presence of tachycardia for >80% of the 24-h monitoring period.[13]

Statistical analysis

Data are expressed as a frequency or percentage for nominal variables, as the median for the ordinal variables and as the mean (standard deviation, SD) for continuous variables. Differences among groups were tested by one-way analysis of variance. A p value <0.05 was considered significant.

RESULTS

Clinical characteristics

Sixteen (11 males and 5 females) full-term newborns were included in this study and were aged 1–20 days at the time of diagnosis. Extra systoles morphology (RBBB or LBBB) was not siginificantly different among the three groups. Arrhythmias were detected incidentally during physical examination because all patients were asymptomatic. Left ventricular function as assessed by echocardiography during sinus rhythm was normal in 14 patients and mildly impaired in two patients with ventricular tachycardia (ejection fraction 48% and 45%, respectively). Magnetic resonance imaging performed on patients with incessant ventricular tachycardia was normal (table 1).

Electrocardiogram features

Frequent ventricular premature beats were found in all patients. The mean number of extra systoles per hour at 24-h ECG Holter monitoring was significantly higher in the CPLT and ventricular tachycardia groups than in the PVC group. No significant difference was found in the incidence of right or left ventricular morphologies of the extra systoles among the three groups.

Ventricular couplets occurred with a mean frequency of 106/h (range 50–261; fig 1).

Ventricular tachycardia (fig 2) was observed in four patients: sustained ventricular tachycardia (rate 250 beats/min), which was triggered by acceleration of the sinus

Table 1 Patient's clinical data

	PVC group	CPLT group	VT group
Patients	8	4	4
Male/female	6/2	1/3	4/0
Median age (days)	3.5	3.5	2.5
Symptoms	No	No	No
EF	Normal	Normal	↓ (2 patients)

EF, ejection fraction; PVC, premature ventricular contraction; VT, ventricular tachycardia; ↓, decreased.

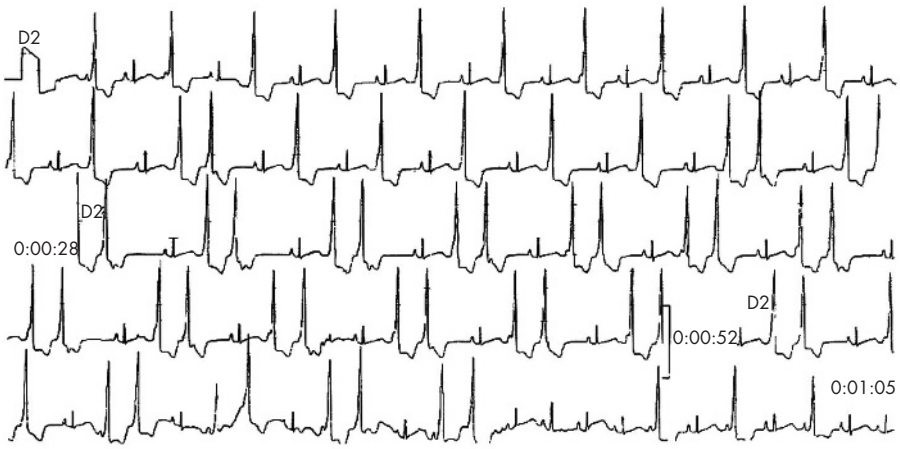

Figure 1 The rhythm strip shows ventricular bigeminy and ventricular couplets.

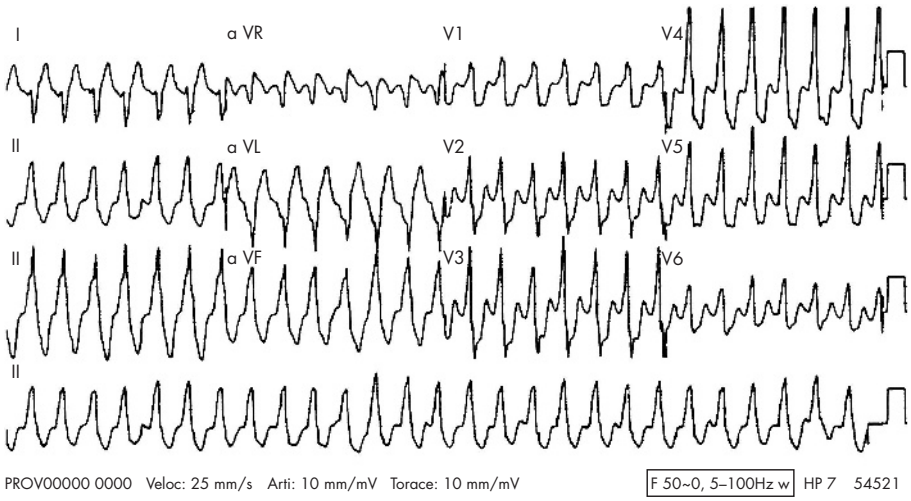

Figure 2 Monomorphic ventricular tachycardia. The electrocardiogram shows a rate of 166 beats/min with left bundle branch block pattern.

rhythm was present in one patient, in two newborns ventricular tachycardia was incessant, with a mean ventricular rate of 120 beats/min (range 165–240) and in one neonate who presented initially only with CPLTs, a non-sustained high-rate ventricular tachycardia (mean 260 beats/min) was observed at the age of 20 days.

Ventricular tachycardia was monomorphic in all patients. RBBB morphology was observed in two patients and LBBB in the others. The ECG morphology of the QRS complexes during tachycardia was the same as that of the PVCs.

Therapy

Eleven of all the patients, never received drug treatment. Four patients (all in the ventricular tachycardia group) initially received drug treatment which was withdrawn during the course of the disease after a mean (SD) time of 10.5 (6–12) months.

In the ventricular tachycardia group, all patients were treated: amiodarone was used in two newborns with incessant ventricular tachycardia and propranolol in the other two. Amiodarone was given orally at a dose of 10 mg/kg/day for 10 days and then decreased to 5 mg/kg once daily; propranolol was given at a dose of 2 mg/kg/day. During amiodarone treatment, a complete serum analysis, with levels of thyroid hormone, and ophthalmological examination were carried out. No patient developed proarrhythmia or had any side effects.

Outcome and follow-up

The median duration of follow-up was 36 months (range 24–48). In the PVC group, PVCs disappeared during follow-up at a mean (SD) age of 2.1 (1.24) months, and in the CPLT group, couplets disappeared at a mean (SD) age of 6.5 (1) months. In the ventricular tachycardia group, ventricular tachycardia disappeared completely at a mean (SD) age of 1.7 (0.9) months. In one patient, ventricular tachycardia disappeared but PVCs persisted. At the last follow-up none had experienced episodes of ventricular tachycardia.

Echocardiographic evaluations showed that left ventricular function was normal in all neonates at the last follow-up (table 2).

DISCUSSION

Ventricular arrhythmias in the neonate may be simple or complex, and may occur in the setting of congenital heart disease, cardiomyopathies and inflammatory myocardial disease, metabolic disease, electrolyte disturbance, channelopathies such as long QT syndrome, and the exceedingly rare myocardial infarction.[3]

Owing to the very low incidence of sudden cardiac death in the neonate, ventricular arrhythmias in this age group have received limited attention in the medical literature. The relative frequency of ventricular arrhythmia and the relative rarity of sudden death complicate the management choices and introduce controversy and uncertainty when interpreting historical data. Another problem is the quantitative assessment of ''frequent'' PVCs. The Lown classification for ventricular arrhythmias (developed for adults) considers >30/h to be ''frequent''. In a child it would be reasonable for 60/h to be considered ''frequent''.[9]

Isolated PVCs are generally associated with a favourable prognosis in the neonate with a normal heart.[3] As far as we know, the prognosis of frequent and repetitive ventricular ectopy has not been investigated, probably because of the low incidence of this arrhythmia in this group of patients.

Paul *et al*[14] reported 22 patients (mean (SD) age 9.7 (6.6) years) with a normal heart and ventricular couplets, but none was a neonate. They concluded that, in children, ventricular couplets appear benign and may resolve spontaneously.

Table 2 Electrocardiogram features and outcome

Groups	PVC morphology		PVC/h	CPLT/h	Shortest coupling interval (ms)	Therapy	Resolution (months)	Median follow-up (months)
	LBBB	RBBB						
PVC	2	6	335 (114)	None	360 (14.14)	No	2.1 (1.24)	36
CPLT	2	2	2235 (984)	106 (103)	335 (17.32)	No	6.5 (1)	42
VT	2	2	1663 (691)	28.8 (43)	310 (11.54)	4	1.7 (0.9)	48

LBBB, left bundle branch block; PVC, premature ventricular contraction; RBBB, right bundle branch block; VT, ventricular tachycardia.

What is already known on this topic

- Frequent premature ventricular contractions (PVCs), couplets and episodes of ventricular tachycardia are extremely rare in the neonatal population.
- In general, asymptomatic ventricular arrhythmias in the absence of heart disease are associated with a favourable prognosis.

What this study adds

- Frequent PVCs and couplets do not require treatment but do require careful follow-up
- Sustained or high-rate ventricular tachycardia even if asymptomatic must be treated appropriately; the prognosis appears to be generally favourable.

Tsuji *et al*[15] reported the clinical characteristics and long-term prognosis of 163 children (mean (SD) age 8.9 (3.4) years) with ventricular arrhythmias and without underlying heart disease. They concluded that ventricular arrhythmias in these children disappeared in many cases, and that their prognosis was favourable.

Ventricular tachycardia in the neonatal population is uncommon and, when associated with cardiovascular disease, carries a guarded prognosis.[3 6 18 19]

Conversely, idiopathic ventricular tachycardia, defined as ventricular tachycardia in the absence of associated structural heart disease, is generally considered to have a good prognosis,[7 8] but sudden deaths have also been reported.[19]

Villain *et al*[8] reported the clinical characteristics and prognosis of 10 neonates with ventricular tachycardia. The authors concluded that isolated, idiopathic ventricular tachycardia of the neonate usually carries a good prognosis, and that simple treatment is usually associated with restoration of sinus rhythm and definitive cure during the first year of life.

Pfammater *et al*[7] described 27 infants (17 neonates) <1 year of age with ventricular tachycardia as part of a larger series of children with ventricular tachycardia. They concluded that ventricular tachycardia was associated with a good prognosis, that resolution was probable in the first year of life and that not all patients required treatment with arrhythmia drugs.

Sustained ventricular tachycardia and high-rate ventricular tachycardia are often reported to be symptomatic.[7 20 21] In our study, all patients were asymptomatic but mild ventricular dysfunction was observed in two neonates at echocardiographic examination. These types of ventricular tachycardia require careful follow-up and appropriate treatment.

In conclusion, our data confirm that newborns with frequent monomorphic ventricular arrhythmia who are asymptomatic and considered healthy on the basis of non-invasive cardiological evaluation have a good long-term prognosis after diagnosis. Frequent PVCs and CPLTs do not require treatment, but require careful follow-up. Conversely, sustained and high-rate asymptomatic monomorphic ventricular tachycardia must be treated appropriately, but the prognosis appears to be generally favourable.

The recognition of ventricular arrhythmias in asymptomatic newborns may be difficult; therefore, these disorders could be more common than diagnosed. A better knowledge of these conditions by paediatricians will probably increase the number of identified cases and favour proper management of these infants.

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