

## ORIGINAL ARTICLE

## Ventricular tachycardia in children with diphtheritic myocarditis

by

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### Abstract

Nine children with diphtheritic ventricular tachycardia ranging in age from 2 to 11 years (mean 6.5 years) were observed and followed up until their terminal state. The ventricular tachycardia showed a left bundle branch block contour in 5 of 9 patients, right bundle branch block in four, multifocal pacemaker in three and unifocal in six patients. Fusion and captured beats were present in two and 4 patients respectively, including one patient who had both. Four cases were without obvious atrio-ventricular dissociation.

All patients were treated with standard therapy for diphtheria, and prednisone was given to patients with myocarditis. Because of its controversial results, antiarrhythmic agent was not given.

The prognosis is very poor; all patients died one to 8 days after ventricular tachycardia appearance.

### Introduction

There are few published of paroxysmal ventricular tachycardia (PVT) in infants and children. Hernandez et al (1975) reviewed the literature and found total reported cases of 57 since 1942.

Ventricular tachycardia (VT) is the most variable, difficult to diagnose, and the most dangerous type of tachycardia. In addition to the threat of heart failure from the rapid heart rate, there is the danger of the rhythm progressing into ventricular flutter or fibrillation. The latter arrhythmias do not provide adequate cardiac output and will eventually result in death unless effective counter measures are instituted at once (Hohn, 1974).

The diagnosis of VT must be considered in every-fast rhythm in which the QRS morphology is different in contour from that seen in sinus rhythm (Gaum et al., 1980). The broad bizarre ventricular complexes usually occur at a rate ranging

from 150 to 200 beats per minute; however, on occasion the rate may be as slow as 100 per minute or as fast as 250 per minute.

Although VT and ventricular fibrillation occur more often in adults with coronary artery disease, these ventricular arrhythmias may appear in young people. They often occur early or late after surgery for congenital heart disease or in association with a variety of cardiac diseases, autonomic imbalance, drugs, as well as in the absence of detectable cardiac disease (Hernandez et al., 1975; Pederson et al., 1979).

In this study we describe the clinical and electrocardiographic findings of 9 young patients with diphtheria who had VT, who were extensively evaluated and followed until they recovered or died. It is shown how dangerous if VT appears in diphtheria patients.

### Materials and methods

All patients with diphtheria underwent history, physical and laboratory examination, as well as multiple 12-lead ECG's. Diagnosis of diphtheria was made on the basis of clinical findings characterized by: 1) fever of two days or more, 2) pseudomembraneous lesions, or 3) local spots, usually on the tonsil, pharynx and adjacent tissues which did not change or extend after one or more antibiotic injections and 4) confirmed by positive direct smear (Wahab et al., 1973).

The diagnosis of VT was confirmed by ECG recordings of episodes of tachycardia (comprising more than 10 beats) which all fulfilled the criterion: a) abnormal, broad QRS complexes, which were different in shape from complexes observed during sinus rhythm. The criterion alone

would not exclude cases of supraventricular tachycardia complicated with aberration block (Hohn, 1974), and it was considered mandatory, that one, or preferably more, of the following criteria be fulfilled; b) atrioventricular dissociation with clearly defined, independent atrial and ventricular complexes and an atrial rate less the ventricular rate; c) ventricular captures and fusion beats; d) occurrence during sinus rhythm of single ventricular ectopic beats with the same configuration as the QRS complexes seen during tachycardia (Videback et al., 1973).

ECG was recorded every day, and if VT appeared, recording was done more than twice a day, until it changed to sinus rhythm or the patient died.

## Results

The age of patients with VT from ranged 2 to 11 years, (mean 6.5 years). There were 3 boys and 6 girls. Diphtheritic myocarditis was the only heart diseases.

On the day of admission all patients were treated with penicilline and anti diphtheria serum (ADS) according to the guidelines therapy for diphtheria serum (ADS) according to the guidelines therapy for diphtheria patients. In penicilline-sensitive patients, we used erythromycine as an alternative; Besredka's method was used in patients sensitive to ADS. Prednison was given to all patients with myocarditis.

Six out of 9 patients presented with VT on admission, two patients had VT a day later, one had it on the second hospital day.

All patients had never received diphtheric immunization.

### Symptoms and signs during tachycardia

In 9 patients the following symptoms were encountered during attack: palpitation (4 cases), tiredness and weakness (3 cases), nausea and abdominal pain (2 cases), dyspnoea (2 cases), and precordial pain (2 cases). The following physical signs were found: cyanosis (5 cases), tachypnoea (4 cases), hepatomegaly (3 cases), dilatation of the neck veins (1 case) and pulmonary edema (1 case).

Sudden loss of consciousness with or without convulsion and incontinence of urine often occurred especially in terminal state. All patients died in the third to eighth

day after appearance of VT

### ECG abnormalities before attacks of VT.

The ECG showed sinus rhythm in 4 patients on admission but with ST segment depression, T wave changes and slight arrhythmias. Two patients had VT on the second day of admission; the others had it on the third, and the fifth day respectively. The rest of them came to us with clinical entity as above and all with VT on admission.

### ECG's during tachycardia

Three of the patients had multifocal, and the rest had unifocal VT. The rate of VT varied greatly, only one patient had ventricular rate of 150 beats/min, and the other eight had rates of VT of less than 150 but greater than 100. In two patients fusion beats were also present whereas captured beat occurred in 4 patients, including one patient who had both. Six patients had QRS morphology similar to left bundle branch block (LBBB) and the morphology of the other three similar to right bundle branch block (RBBB). VT continued to 3 days in 3 patients, 1 day, 2 days, 4 days, 6 days, 7 days, and 8 days in only one patient, respectively (Table 1). In 4 cases atrioventricular dissociation was not present, as the ECG showed retrograde P-waves following the broad QRS complexes (Fig.1). All patients were followed-up until the terminal state, and all of them died.

Table 1. *Electrocardiographic data during tachycardia*

Case No.	Age (year sex)	Rate beats min)	Type of VT	QRS morphology		Onset of VT	Fusion/Captured	Duration of VT	AV dissociation
				before attack	during attack				
1.	7 F	140	Unifocal	Normal	RBBB	2 <sup>nd</sup> day in hospital	-/-	3 days	None
2.	9 F	130	Unifocal	Normal	LBBB	3 <sup>rd</sup> day in hospital	-/+	8 days	+
3.	10 F	115	Unifocal	-	RBBB	on admission	-/+	6 days	+
4.	7 F	130	Multifocal	-	LBBB	on admission	+/+	3 days	None
5.	5: F	130	Unifocal	-	RBBB	on admission	-/+	7 days	None
6.	6 M	150	Multifocal	-	LBBB	on admission	-/-	4 days	+
7.	2 M	125	Unifocal	Normal	RBBB	2 <sup>nd</sup> day in hospital	-/-	1 day	+
8.	8 F	115	Multifocal	-	LBBB	on admission	+/-	2 days	+
9.	4 M	135	Unifocal	-	LBDB	on admission	-/-	3 days	None

## Discussion

The unusually high number of patients with this arrhythmia which we have observed in a relatively short period of time may not represent an absolute increase in the incidence of VT, but probably because of the availability of more effective monitoring system and our greater awareness to the diphtheria patients. The diagnosis of VT in all of our patients was based primarily upon the ECG criteria mentioned above. Occasionally it may be difficult to differentiate VT with supraventricular tachyarrhythmias with aberrant conduction; in this situation we used additional criteria proposed by Hohn in 1974, when tachycardia has a left bundle branch block configuration, it is most likely to be ventricular in origin with the ectopic pacer in the right ventricle, whereas a tachycardia with right bundle branch block pattern could either a supraventricular tachycardia with right bundle branch block or a ventricular tachycardia with right bundle branch block or a ventricular tachycardia with the ectopic pacer in the left ventricle. Accordingly, three criteria are used for differentiation of ventricular from supraventricular

arrhythmias: a) detection of fusion beats, b) comparison with normally conducted beats and c) type of QRS widening and its mode or onset or disappearance. Using these criteria the diagnosis of VT was obvious from the ECG.

Diphtheria up to now is not a rare disease in Indonesia despite its steady decline in the last decades. In USA the incidence of diphtheria decrease rapidly after the intensification of immunization. The average number of reported cases was 248 annually from 1970 through 1976 and since 1976 the average was only 56 cases and the number of deaths for these years decreased accordingly, but case fatality ratio has remained relatively constant at about 5-10% of cases (Feigin and Stechenberg, 1987). Most of the diphtheria cases of Maemunah et al (1965), Asril Aminullah et al (1969) and Sobiran and Wahab (1984) were not immunized; the fatality rates were 33%, 26% and 20% whereas abnormal ECG's rates were 30%, 14.3% and 68% respectively.

Abnormal ECG's were lower in immunized cases than in non-immunized ones

(Sobiran and Wahab, 1984). According to Wallgren (1969) immunization gives an effective protection to children until 5 years or more. On the other hand, Handerson et al (1971) noted effective protection for a decade or more, and protection against a fatal outcome for an even longer period.

Electrocardiographic changes, specifically, ST segment depression, T wave inversions, atrioventricular block, bundle branch block, ventricular tachycardia and fibrillation, may all be seen at the onset of the myocardial involvement. The conduction disturbances are rare, but they are relatively specific to diphtheria, and they signify a more ominous prognosis (Nadas & Fyler, 1972).

Diphtheria bacilli are not found in the heart, and apparently the cardiac effects of the disease are caused by exotoxins liberated by the bacilli. The typical pathologic findings in the heart are edema, congestion, mononuclear cell infiltration and fat accumulation in muscle fibers and the conducting system. For that reason treatment should include strict bed rest until all signs of myocarditis have disappeared and management of arrhythmias, including cardiac pacing. Digitalis is reserved for pa-

tients with frank congestive heart failure but must be used with care because of the possibility of increased sensitivity (Feigin, 1987).

In our patients, treatment was directed to diphtheria infection using penicillin and ADS, whereas for ventricular tachycardia we enforced absolute bed rest and prednisolone. According to the present knowledge, corticosteroids have a beneficial effect in the treatment of circulatory insufficiency and has an antiphlogistic value. However, cortisone reduces the resistance against infection. According to Feigin (1987) prednisolone 1 - 1.5 mg per kg body weight per day for two weeks has been shown to lessen the incidence of myocarditis.

The use of antiarrhythmic agent in the treatment of VT is controversial. Several authors considered antiarrhythmic agent was effective; on the other hand Videback et al. 1973 concluded that the benefit of the administration of antiarrhythmic agent could not be proved.

In conclusion, children with diphtheritic myocarditis who developed VT had a poor prognosis. Up to now immunization is the only mean to prevent diphtheria infection and to decrease the mortality rate.

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