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*From the Department of Child Health, Medical School, University of Indonesia and The Cardiac Center, Dr. Cipto Mangunkusumo General Hospital, Jakarta.*

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## Electrocardiographic Pattern in Children suffering from Diphtheria during 1973 at Dr. Cipto Mangunkusumo Hospital, Jakarta

by

MAEMUNAH AFFANDI, BAMBANG MADIYONO,  
OTTY W. SONITYO and PURWANA K.G.

### Abstract

*ECG abnormalities were found in 39 (45.3%) out of 86 diphtheria cases; 29 cases (33.6%) had significant myocardial involvement. Myocardial involvement comprised minor changes in 24 cases and major changes in 5 cases. Twenty-two cases of myocardial involvement occurred in the first week of hospitalization, while 7 cases occurred after the first week of hospitalization. The ECG abnormalities of the 29 cases disappeared within 1 to 2 weeks or after 3 weeks. Minor changes have a good prognosis, while major changes, especially an AV block, have a poor prognosis.*

### Introduction

A great number of electrocardiographic abnormalities in children with diphtheria have been reported in Indonesia; among others Kwari et al. (1965) found 19.5%, Maemunah et al. (1965) 16.5%, Asril Aminullah et al. (1969) 14.3%, and Sidharta and Tagor (1973) found 78% with 24% definitive myocarditis. Altschuller (1948) reporting on 23.9% of electrocardiographic abnormalities in children with diphtheria said that relationship between this abnormality and clinical symptoms is not clear. Boyer and Weinstein (1948) reporting on 65.6% abnormalities divided the observed abnormalities into 4 degrees and found an increasing mortality rate in line with the severity of changes in the electrocardiograms. Ledbetter et al. and Tahernia et al. reported 20% and 45.1% respectively and saw a definite relationship between the intensity of electrocardiographic abnormality with the seriousness and severity of the clinical symptoms.

The purpose of this study is to find out the frequency of electrocardiographic abnormalities in children with diphtheria: significant ECG aberration of abnormalities and the relationship of abnormalities with the prognosis of the patient.

### Material and methods

Ninety children suffering from diphtheria were admitted to the De-

partment of Child Health, Dr. Cipto Mangunkusumo Hospital Jakarta during 1973; 86 cases comprising 50 boys and 36 girls had ECG recording. Their ages ranged from 6 months to 12 years. The number of ECG was 262 with an average of 3-4 electrocardiograms per case. This study was made retrospectively. Diagnosis of diphtheria was based on clinical findings and laboratory investigations: throat swabs and throat cultures.

ECG were recorded by using a portable Philips Cardiopan 531 with a speed of 25 mm/second and a sensitivity of 10 mm = 1 mV. Each child had a recording of standard leads, augmented extremity leads, and unipolar chest leads (V3R, VI to V6), with at least 3 complexes in each lead. The children were given phenobarbitone and chlorpromazine for premedication at a dose according to the body weight and age. ECG recording were taken on indication. If there were no ECG abnormalities found after a three-week hospitalization, the patients were sent home. We used the criteria according to Keith (1967), Krovetz (1969), and Ledbetter (1969) to determine ECG abnormalities.

### Result

ECG abnormalities were found in 39 (45.3% out of 86 diphtheritic cases (Table I), Table 2 shows the percentage of ECG changes in the 39 cases, of which 1 case had several

changes on ECG. Thirty-eight cases showed ECG abnormalities in the first week of hospitalization; only 1 case showed ECG abnormalities from the 2nd to 5th week. ECG abnormalities were observed as follows: 14.1% with ST depression, T wave changes in 4.7%, prolonged QTc in 3.5%, QRS-T gradient more than 60 degrees in 11.7%, AV block in 2.4%, R.B.B.B. in 3.6%, intraventricular conduction disturbances in 26.4%, sinus tachycardia in 15.3%, right axis deviation in 1.2%, right atrial hypertrophy in 2.4%, right ventricular hypertrophy in 3.6%, and left ventricular hypertrophy in 11.8% (each patient showed several abnormalities). ST depression was found in 12 cases with heart rate of less than 150/minute, and an average of 142/minute. Intraventricular conduction disturbances were found in 47 (55%) cases out of 22 (26%) include other ECG abnormalities. Twenty-five cases with intraventricular conduction disturbances without other ECG abnormalities showed up since the first ECG obtained persistence until the moment the patients were sent home; this group was included in the one called normal ECG category. Tracheotomy was performed in 2 cases with right atrial hypertrophy and right ventricular hypertrophy on ECG; 10 patient had left ventricular hypertrophy with normal arterial blood pressure and an average hemoglobin content of 8 gm %. The average hemoglobin content of

the total sample was 9.2 gm%. We did not find ECG abnormalities such as prolonged P-R interval, left axis deviation, L.B.B.B. and pattern in precordial leads.

The duration of illness before admission ranged from 1 to 14 days, with an average of 4.6 days; one case with AV block was 5 days. "Significant myocardial involvement" on ECG was found in 29 cases (33.6%): 22 cases (25.4%) detected in the first week, and 7 cases (8.2%) in the 2nd to 5th week after admission (Table 3). Significant myocardial involvement means ECG abnormalities implying: ST depression, T wave changes, prolonged QTc, QRS-T gradient more than 60 degrees, AV block and R.B.B.B. (Table 2), ECG abnormalities persisted for 2 to 3 weeks during the time of hospitalization (Table 4). Out of 12 cases who died (31.5%), 3 died within the first 24 hours of hospitalization (Table 4). Three out of 86 cases received incomplete DPT immunization, but only 4 showed signs of ECG abnormalities; 3 of the 4 with ECG abnormalities showed myocardial involvement.

### Discussion

The difference in incidence of abnormal electrocardiographic findings in this study compared to those of previous studies is easy to understand, since there is a difference in the condition of the patients and pro-

gressed criteria used for ECG reading (e.g. QRS — T gradient and QTc interval). Yet we still found a difference in the incidence of abnormal ECG. Recent methods of and criteria for ECG reading as compared to those of 10 years ago are more advanced. The difference between the cases of 10 years ago and those studied now is most likely due to the more advanced methods of measuring ECG and dissimilarity in criteria to determine the abnormalities. Abnormal ECG such as ST — T changes, prolonged QTc interval and QRS — T gradient more than 60 degrees were found in 24 cases (28.2%), which is significant in number. However, these ST — T changes are not specific abnormalities, as they can also be caused by extra cardiac factors. The majority of authors placed this abnormality in the category of minor changes or minor variation (Boyer and Weinstein, 1948; and Tahernia, 1969).

Conduction disturbances were found in 5 cases: 2 with AV block and 3 with R.B.B.B. Partial block as reported by Ledbetter et al. (1964) was not found in this study. On the other hand, 47 cases with intraventricular conduction disturbances were in the form of slurring-splintering and notching of QRS complex showing either a widening of the QRS complex showing either a widening of the QRS interval or a change of the QRS axis. The ECG mentioned above was not reported

by Ledbetter et al. (1964) but by Begg (1937), De La Chapelle and Morales (1971). Maemunah et al. (1965) did not report this observation. They used the same criteria in reading ECG from the first until the last ECG showed no change in intraventricular conduction disturbances; they regarded them as normal ECG.

Similar observation was also found in this study. Similar findings were also seen among bronchopneumonia, and Dengue Haemorrhagic Fever Dengue shock Syndrome cases showing 66.6% and 65.6% respectively (Bambang et al., 1974). Sinus tachycardia was found without any evidence of ECG abnormality in 41 cases (48.2%) which was significant in number (Maemunah et al., 1965). Four cases died after 24 hours due to a complication. Maemunah et al. (1965) reported 6 cases (18.4%) of sinus tachycardia; all survived. Based on the findings above, this study shows ECG with sinus tachycardia or intraventricular conduction disturbances with or without hypertrophic abnormality by voltage criteria which we did not place in the category of myocardial involvement.

Significant myocardial involvement was found in 29 cases (33.7%), while a previous study showed a smaller figure — 16.5% (Maemunah et al., 1965). Out of 29 cases with significant myocardial involvement, 22 (25.4%) showed ECG abnormality during the first week and 7 cases

within the 2nd and 3rd week. This difference is significant ( $p < 0.05$ ). Similar findings were also reported by Sidartha and Tagor (1973). Mae-munah et al. (1965) reported that 14 cases of myocarditis were observed during the first week; while Aryanpur et al. (1971) stated that cardiac complication may occur at any time during illness. The average duration of illness prior to hospitalization was 4.6 days. This shows that there are still a great number of parents who ignore the health of their children, and the prognosis of the illness therefore depends upon an early adequate treatment besides the virulency of the bacteria.

The duration of ECG abnormalities has no relationship to the mortality (Table 4). Boyer and Weinstein (1948) stated that ECG changes to normal limits do not mean that the myocardium affected has returned to normal. Three patients in this study died of apparently a cardiac complication within 24 hours of hospitalization (Table 4). Two out of 9 cases died after 24 hours of hospitalization; 6 cases most likely died of other

complications like bronchopneumonia and gastroenteritis with consequent dehydration, who showed ECG pattern as follows: Sinus tachicardia (4 cases), intraventricular conduction disturbance (1 case), and left ventricular hypertrophy (LVH, 1 case). Minor changes were found in 24 cases: 4 (16.6%) died, while 2 out of the cases with major changes had AV block (RBBB). This indicated that an AV block has a grave prognosis.

It is important for us to consider whether or not diphtheria patients with ECG abnormality like complete AV block can be helped with a pacemaker as generally prescribed to patients with a complete AV block. The relationship between diphtheria immunization with the degree of ECG abnormalities encountered were not evaluated due to the limited number of materials. The extent of the myocardial abnormalities among the patients who died was also not reported here because of the difficulties in obtaining permission for autopsy from the family of the deceased.

TABLE 1 : *Electrocardiographic pattern (ECG) on 86 diphtheritic patients, Jakarta 1973.*

ECG pattern	number of cases	percentage
ABNORMAL	39	45.3
NORMAL	47	54.7
T O T A L	86	100

TABLE 2 : *Percentage of ECG Changes on the 39 diphtheritic cases, Jakarta 1973.*

ECG changes	Percentage of ECG changes		
	1st week	2nd week to 5th	Total
ST depression	9.4	4.7	14.1
T wave changes	1.2	3.5	4.7
QTc prolonged	3.5	0	3.5
QRS-T gradient 60°	10.5	1.2	11.7
AV block	2.4	0	2.4
R.B.B.B.	1.2	2.4	3.6
Intravent. Cond. dist.	23.3	2.4	26.4
Sinus tachycardia	15.3	0	15.3
R. axis deviation	0	1.2	1.2
R.A. hypertrophy	2.4	0	2.4
R.V. hypertrophy	2.4	1.2	3.6
L.V. hypertrophy	2.4	9.4	11.8

Note : 38 cases (out of 39) with ECG abnormalities in the 1st week of hospitalization; only 1 case (out of 39) with ECG abnormalities from the 2nd to the 5th week.

TABLE 3: *Significant myocardial involvement on diphtheria, Jakarta 1973.*

Myocardial involvement		
Occurred	number of cases	Percentage
1st week	22	25.4
2nd to 5th week	7	8.2
T o t a l	29	33.6

TABLE 4: *Relationship between ECG changes — duration of changes in weeks and fatal cases, Jakarta 1973.*

ECG changes	duration of changes in weeks	Fatal cases (number)		Total cases
		within 24 hours	after 24 hours	
ST depression	1 — 2	2	1	12
T wave changes	2	0	0	4
QTc prolonged	3	0	0	3
QRS-T gradient 60	1 — 2	1	0	10
AV block	1	0	2	2
R.B.B.B.	3	0	0	3
Intravent. Cond. dist.	3 — 4	0	1	22
Sinus tachycardia	2 — 3	0	4	13
R. axis deviation	3	0	0	1
R. atrial hypertrophy	2	0	0	2
R.V. hypertrophy	1	0	0	3
L.V. hypertrophy	1 — 2	0	1	10

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