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Levocardia With Situs Inversus Atria
(Case Report)

by

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PELUPESSY and MAEMUNAH AFFANDI.

Abstract

Three cases of Levocardia and situs inversus atria were reported. The clinical diagnosis of the first two cases were based on clinical signs and laboratory findings which were confirmed by Electrocardiography, Chest X-ray, heart catheterization and angiography. The third case died before further investigations could be done. Classification, management and prognosis were also discussed.

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Introduction

Levocardia with situs inversus atria is a condition in which the heart lies on the left hemithorax with its base-apex axis pointing to the left and morphologically the right atrium lies on the left side of the heart.

In the majority of cases the position of the atria corresponds to that of the abdominal viscera, although there are odd cases where discrepancies between the sites of these structures occur (Sharer et al., 1967).

Although there was no similarity of the positional anomalies of the heart in classification and terminology (Rosenbaum et al., 1962; Harris et al., 1965; Campbell et al., 1966; Lev et al., 1969; De la Cruz et al., 1971; De La Cruz et al., 1974; Libe- rthson et al., 1973; Anselmi et al., 1972), Libe- rthson's classification based on the atrial situs is the best according to our opinion, because it is easier to know all the anomalies present, which make adequate correction possible. Final diagnosis can only be done with autopsy.

Prognosis of these patients is not good. Patients usually die before one year old due to unsatisfactory pulmonary blood flow (Keith et al., 1967 and Wood, 1968). This paper reports three patients. One died of excessive pulmonary blood flow.

Case Report

Case I

F., a 2 — year — old boy who was first seen at the outpatient clinic of the Cardiac Centre Dr. Cipto Mangunkusumo General Hospital, Jakarta, on June 15, 1972, had a history of cyanosis from 1 month of age which increased with age. Cya- notic spells were first noted at 3 months of age, about 2 — 3 times a month, which decreased later on. The boy could only take small quantities of food and milk since infancy. He had limited exercise tolerance, delayed growth and development.

Physical examination revealed a boy of approximately 2 years old with a body weight of 9 kg., body length 82 cm., temperature of 37°C, cyanosis on the lips, oral mucosa, and nails.

Pulse was 120 per minute, regular, equal with normal volume. Respiration rate was 28 per minute, blood pressure on the arm was 90/55 mm-Hg, on the lower limb 100/60 mm-Hg. JVP was not raised, hepatomegaly and right-ward reflux was negative. Bulging of the left hemithorax with increased activity of the heart without enlargement was present. There was increased intensity of the first heart sound, the second heart sound was single. There was no murmur. Liver and spleen were not palpable; there was clubbing of the fingers and toes.

Cases as complete AV block, particularly with slow ventricular rate (less than 60) had mostly a fatal outcome with or without signs of congestive heart failure.

Diphtheric myocarditis causes severe changes in the heart muscle, which consist of hyaline degeneration, necrosis and myolysis. Histological studies on autopsy revealed mitochondrial damage with loss of enzyme activity, depletion of glycogen and accumulation of lipid droplets in the damage myofibrils (Burch et al., 1968). In complete AV block external destruction was found in the ventricular septum. If we are aware how severe the diph- theric toxin can damage the myocardium, then we could understand why digitalis is of little or no help, since a sick myocardium will not be benefited by digitalis. Once cardiac decompensation occurred the condition usually deteriorated quickly and the patient will die despite all measurements. Some authors (Friedman et al., 1973) suggest that measurements such as absolute bedrest which can prevent cardiac failure be intensi- fied and excitement or physical stress be avoided. Others (Friedman et al., 1973) believe that the adminis- tration of diuretics (lasix) would be more beneficial that digitalis (Friedman et al., 1973; Gillis and Kagan, 1971).

REFERENCES


of 35 cases with signs of congestive heart failure showed gallop rhythm. The general condition of the patients such as weakness, excessive sweating, pallor, anorexia was of great help, when one was hesitating whether or not congestive heart failure was present, since the hepatic enlargement was due to toxic degeneration of the liver the patient was usually in a good condition. X-ray examination was only performed in 9 cases and the heart size varied from mild to severe cardiomegaly.

The incidence of congestive heart failure was related to the severity of the myocarditis as evidenced by the type of ECG abnormalities. Congestive heart failure was not observed in cases with sinus tachycardia or cases with flat to low T waves, it occurred in only 5.1% of cases with ST depression with or without inverted T waves, while the incidence was high in other ECG abnormalities (intraventricular conduction defect, complete AV block, Bundle Branch Block).

Shock was another fatal complication in 13 cases with complete AV block, 7 died with signs of shock. We believe that this shock state which occurred in severe myocarditis was of cardiac origin and was the result of a low cardiac output. In the absence of severe ECG abnormalities peripheral vascular collapse would be the major cause of this shock.

Out of 35 cases with congestive heart failure 29 were digitalized, only 3 of them survived. These 3 cases were one with ST depression plus inverted T wave and 2 cases with LBBB which only had gallop rhythm. A study (Yap and The, 1962) conducted in the years 1958, 1959 — 1961, on diphtheria in this same hospital, showed also poor results of digitalis therapy in diphtheric myocarditis with decompensator; 4 out of 5 cases with cardiac decompensation died. But of 20 cases with diphtheric myocarditis which had gallop rhythm, poor general condition and ECG changes, only 4 died after digitalis treatment. Controversial opinion arose about the use of digitalis in diphtheric myocarditis (Barrett and Einhorn, 1968; Friedman et al., 1973; Gillis ad Kagan, 1971; Hughes, 1967; Kempe et al., 1970; Nadas, 1972; Nelson et al., 1969).

Some authors believe one should avoid digitalis (Friedman et al., 1973), others recommend the use of digitalis even before signs of congestive heart failure appear (Barnett and Einhorn, 1968; Kempe et al., 1970; Nelson et al., 1969).

From this study and from the results of Yap and The (1962), we learn that satisfactory results were obtained in cases with only gallop rhythm as a sign of myocardial failure. Another factor which is also of influence is the severity of myocarditis as judged by the severe ECG changes.

The electrocardiogram revealed right ventricular hypertrophy with P axis at about +130°. (Fig. 1a). Chest X-ray revealed right aortic arch, slightly enlarged of the heart with upward apex, infiltrations in both lung fields, decreased vascular markings of the lungs. Abdominal X-ray with barium revealed inversion of the gaster and displacement of the colon. (Fig. 1b). Laboratory findings: normal urine and stool, the hemoglobin content ranged from 17 — 18 gm%, and the haematocrit was 50 — 52%.

Catheterization and angiocardiography revealed atrial inversion with persistent left vena cava superior and inferior, functional single ventricle, right aortic arch and pulmonary arteries originating from the aorta. (Fig. 1c). Diagnosis was levocardia, situs inversus atra, single ventricle, pulmonary atresia with visceral heterotaxis.

Case II

E.J., a girl who first came to the outpatient clinic of the Cardiac Centre on February 8, 1971 with a history of cyanosis on crying since 7 months of age, which increased with age. (Fig IIa) Cyanotic spells were first detected 1 month before admission. The girl could only take small quantities of food and drinks since infancy. Sometimes after exercise she complains of headache and chest pain. Exercise tolerance was limited, the patient was easily tired. Cyanosis decreased later on. There is a slightly delayed growth and development. Physical examination revealed a girl of about 4 years old with a body weight of 12.5 kg., body length of 92 cm., temperature of 37°C, cyanosis on the lips, oral mucosa and nails; respiration rate was 28 per minute, pulse was 136 per minute, regular, equal with normal volume. Blood pressure on the arm was 90/60 mmHg, on the lower limb 100/70 mmHg. JVP was not raised, hepatojugular reflux was negative. Increased activity of the heart without cardiac enlargement was present. There was a normal first heart sound, increased intensity of the single second heart sound; there was no murmur. Liver and spleen were not palpable. Clubbing of the fingers and toes was present. The electrocardiogram revealed a left ventricular hypertrophy with P axis of about +180°. (Fig. IIb).

Chest X-ray revealed a normal heart size, right aortic arch and normal vascular markings of the lungs. (Fig. IIc).

Laboratory: normal urine and stool, the hemoglobin content ranged from 15.5 — 17 gm% and the haematocrit was 55%.

Catheterization of the heart and angiocardiography revealed atrial inversion, left vena cava superior and inferior, single ventricle, right aortic arch, pulmonary atresia. The pul-
The electrocardiogram revealed a combined ventricular hypertrophy with P axis of about +90°.

Chest X-ray revealed enlargement of the heart to the left, increased vascular markings of the lungs with para and retrocardial infiltrates. Oesophagogram showed displacement of the gaster to the right. There was silhouette of a tissue at the right and left part of the upper abdomen with configuration similar with the liver. (Fig. IIIa).

Laboratory findings: urine and stool were normal, the hemoglobin content ranged from 12 — 13 mg%: the hematocrit ranged from 45 — 46.5% and the leucocyte count was 11,800 per mm^3.

Diagnosis was levocardia with ventricular septal defect, visceral heterotaxis, bronchopneumonia and congestive heart failure.

Discussion

Levocardia with situs inversus atria is a rare congenital heart disease. In 15 years Liberthson et al. (1973) reported 30 cases of levocardia with heterotaxis among 3500 cases of congenital heart disease or 0.88% and among these there was 6 of levocardia with situs inversus atria or 0.17%.

Usually malposition of the heart and other organs are easily recog-
TABLE 5: Incidence of acute congestive heart failure in the various ECG abnormalities in diphtheric myocarditis.

<table>
<thead>
<tr>
<th>Type of ECG abnormalities</th>
<th>No. of cases with CHF</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sinus tachycardia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low/flat T wave</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ST depression + T wave changes</td>
<td>5 out of 97 cases</td>
<td>5.1%</td>
</tr>
<tr>
<td>RBBB</td>
<td>4 &quot; 9 &quot; 44.4%</td>
<td></td>
</tr>
<tr>
<td>LBBB</td>
<td>10 &quot; 32 &quot; 31.2%</td>
<td></td>
</tr>
<tr>
<td>Intraventricular conduct. defect</td>
<td>10 &quot; 19 &quot; 52.5%</td>
<td></td>
</tr>
<tr>
<td>Complete AV block</td>
<td>6 &quot; 13 &quot; 46%</td>
<td></td>
</tr>
</tbody>
</table>

A total number of 35 patients showed signs of acute congestive heart failure and its incidence was high in the intraventricular conduction defect, complete AV block, RBBB and LBBB. Signs of cardiac failure were not observed in cases with sinus tachycardia and T wave changes. Four dead cases with RBBB had left axis deviation on ECG, while three of 10 dead cases with LBBB had right axis deviation.

RESULTS OF TREATMENT

When the patient was considered to have cardiac failure digitalization was carried out. Only 29 cases were digitalized as outlined in our methods.

TABLE 6: Digitalization in 29 cases of myocarditis diphtherica with congestive heart failure.

<table>
<thead>
<tr>
<th>Type of ECG abnormality</th>
<th>No. of cases</th>
<th>No. of death</th>
</tr>
</thead>
<tbody>
<tr>
<td>ST depression + T wave changes</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>RBBB</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>LBBB</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>Intraventricular conduct. defect</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>29</strong></td>
<td><strong>26</strong></td>
</tr>
</tbody>
</table>

Six cases of complete AV block with cardiac failure were not digitalized and were therefore excluded from the evaluation. Of the 29 cases which were digitalized only 3 survived. These 3 cases were one with ST-depression inverted T and 2 cases with LBBB, which only had gallop.

nized if situs viscerocrural and axis of the apex were known, whereas for certain cases it can only be proved by autopsy and pathologic findings. (Lev. 1954).

Libethson et al. divided their 30 cases of levocardia with visceral heterotaxis into 3 groups based on cardiac lesions, degree of heterotaxis of the body viscera and abnormality of the spleen. The first group consists of patients with atrial situs solitus (morphologically right atrium lies on the right part of the heart and left atrium on the left part of the heart).

All of the patients show abnormal or agenesis of the spleen; other organs only suffer partial situs inversus or heterotaxis and several cases show venoatrial communication disorders. Condition of the great vessels is generally normal, atrial septum is intact; there is usually a lesion on the left side of the heart e.g. coarctation of the aorta, aortic stenosis with mitral atresia.

The second group consists of patients with atrial situs inversus (mor- phologically right atrium lies on the left side of the heart and left atrium on the left side).

The spleen usually is normal, there is complete situs inversus, right aortic arch, normal venoatrial communication and there is cardiac lesion such as ventricular septal defect, single ventricle with pulmonary atro-
The cause of death was determined to be of non-cardiac origin if the patient died because of respiratory paralysis, respiratory obstruction (tracheostomy), bleeding tendency, sepsis, bronchopneumonia, atelectasis. In cases the patient died without any complicating condition mentioned above but with severe ECG changes the cause of death was considered to be of cardiac origin. If other complicating factors were present making the condition severe enough to cause the death (respiratory paralysis) but no signs of cardiac failure were present, the cause of death was considered to be non-cardiac. However, it does not mean that the patient would necessarily survive if the complications did not occur.

**TABLE 4**: Signs of acute congestive heart failure observed in diphtheric myocarditis (35 cases).

<table>
<thead>
<tr>
<th>Signs</th>
<th>Number of patient</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gallop rhythm</td>
<td>6</td>
<td>100%</td>
</tr>
<tr>
<td>Dyspnea</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>Basal rales</td>
<td>30</td>
<td>87%</td>
</tr>
<tr>
<td>Acute hepatic enlargement ± epigastric pain</td>
<td>35</td>
<td>100%</td>
</tr>
<tr>
<td>Peripheral edema</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Poor general condition (weakness, pallor, sweating)</td>
<td>35</td>
<td>100%</td>
</tr>
<tr>
<td>Cardiomegaly</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The cardinal signs appeared to be: dyspnea, acute hepatic enlargement in the presence of poor general condition, Gallop rhythm was only found in 6 cases, while none of the patients had basal rales or peripheral edema. X-ray examination of the chest was only carried out on 9 patients because of several reasons (patients died before X-ray could be taken, technical problems etc.). The heart size in these cases varied between CTR 52% — 60%.
TABLE 2: Incidence of various types of ECG abnormalities in diphtheria.

<table>
<thead>
<tr>
<th>ECG Abnormality</th>
<th>Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>ST depression ± T wave changes</td>
<td>97 cases (29.5%)</td>
</tr>
<tr>
<td>Flat/low T wave</td>
<td>81</td>
</tr>
<tr>
<td>Sinus tachycardia</td>
<td>74</td>
</tr>
<tr>
<td>Intraventricular conduction defect ± nodal rhythm</td>
<td>19</td>
</tr>
<tr>
<td>RBBB</td>
<td>9</td>
</tr>
<tr>
<td>LBBB ± nodal rhythm</td>
<td>32</td>
</tr>
<tr>
<td>Complete AV block</td>
<td>13</td>
</tr>
<tr>
<td>Prolonged QT</td>
<td>3</td>
</tr>
<tr>
<td>Nodal rhythm with normal QRS complex</td>
<td>2</td>
</tr>
<tr>
<td>Ventricular extrasystole</td>
<td>1</td>
</tr>
</tbody>
</table>

Total: 331 patients

Mortality rate (Table 1 — 2)

The overall mortality rate was 9.7% and the mortality rate of cases with ECG abnormalities was 27.4%. The high mortality rate (65.4%) of the cases (82), which had no ECG recorded, could be explained by the fact that they came already in a very bad condition and died within 24—48 hours after admission with numerous complications.

When we look at the various types of ECG abnormalities it was evident that the highest mortality rate was associated with severe ECG changes (Table 3). The lowest was found in cases with flat T wave (7.3%), the highest (100%) with complete AV block followed by intraventricular conduction defect ± nodal rhythm, LBBB + nodal rhythm and RBBB.

TABLE 3: Causes of death (cardiac/non-cardiac) in diphtheric myocarditis.

<table>
<thead>
<tr>
<th>ECG Abnormality</th>
<th>No. of Patient</th>
<th>Causes of Death</th>
<th>Total Death</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sinus tachycardia</td>
<td>7</td>
<td>14</td>
<td>14 (18.9%)</td>
</tr>
<tr>
<td>Flat/low T wave</td>
<td>81</td>
<td>6</td>
<td>6 (7.3%)</td>
</tr>
<tr>
<td>ST-depression ± T wave changes</td>
<td>97</td>
<td>7</td>
<td>5 (12.3%)</td>
</tr>
<tr>
<td>RBBB</td>
<td>9</td>
<td>4</td>
<td>1 (5.5%)</td>
</tr>
<tr>
<td>LBBB ± nodal rhythm</td>
<td>32</td>
<td>17</td>
<td>4 (62.5%)</td>
</tr>
<tr>
<td>AV block</td>
<td>13</td>
<td>13</td>
<td>13 (100%)</td>
</tr>
<tr>
<td>Intraventricular conduction defect</td>
<td>19</td>
<td>13</td>
<td>4 (89.4%)</td>
</tr>
<tr>
<td>Prolonged QT interval</td>
<td>2</td>
<td>2</td>
<td>2 (100%)</td>
</tr>
<tr>
<td>Nodal rhythm with normal QRS</td>
<td>2</td>
<td>2</td>
<td>2 (100%)</td>
</tr>
</tbody>
</table>


Hepatic enlargement could also occur because of the diphtheric toxin, however hepatic enlargement was considered to be caused by congestion if it was accompanied by dyspnea and other signs mentioned above and when the enlargement occurred rapidly. Distended neck veins as a sign of heart failure was difficult to evaluate in smaller children and was also unreliable when they were crying.

Dyspnea was considered to be of cardiac origin if other causes such as respiratory obstruction, bronchopneumonia or other respiratory factors could be excluded. When three or more of these criteria were present the patient was then considered to have cardiac failure.

**Treatment**

1. Anti diphtheria serum was given in a dose of 40,000 to 60,000 IU depending on the severity of the cases.
2. Prednison in a dose of 2 mg/kg BW in toxic cases for two weeks.
3. Penicillin procaine 600,000 IU for ten days.
4. Digitalization was done with ce-dilank parenterally in a dose for children less than 5 years of age 0.03 mg/kg BW as initial dose, over 5 years of age 0.02 mg/kg BW, divided in 3 doses followed by a maintenance therapy orally in a dose of 0.01 mg/kg BW of lanoxin.

5. Suportive treatment as vitamin, intravenous fluid, oxygen, when indicated; alupent was given in cases of AV block.

**Result**

Sixteen hundred and forty nine (1649) patients with diphtheria of varying severity were admitted during a 5 year-period with an overall mortality rate of 9.7% (160 deaths) (Table 1). Electrocardiograms were recorded on 1567 patients, 82 had no ECG because of several circumstances and were therefore excluded. They were patients who were very ill and died before ECG was taken. Of these 1567 patients with ECG recordings, 331 showed abnormalities of varying severity. To these 331 patients special attention was paid for the occurrence of cardiac failure and other features preceding the death.

**TABLE 1: Mortality rate in diphtheria cases with normal/abnormal ECG.**

<table>
<thead>
<tr>
<th>ECG</th>
<th>No. of patient ECG</th>
<th>Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>+</td>
<td>1567 abnormal : 331</td>
<td>92 (27.4%)</td>
</tr>
<tr>
<td></td>
<td>normal : 1236</td>
<td>16 (1.2%)</td>
</tr>
<tr>
<td></td>
<td>82</td>
<td>52 (63.4%)</td>
</tr>
<tr>
<td>Total</td>
<td>1649</td>
<td>160 (9.7%)</td>
</tr>
</tbody>
</table>
Introduction

Myocarditis diphtherica, a frequent complication of toxic diphtheria still has a high mortality rate, depending on the severity of the disease. Most of the patients will die suddenly with signs of shock, dyspnea with or without hepatic enlargement (Kwari et al., 1965; Yap and The, 1962). Cardiac decompensation as a complication of myocarditis diphtherica is a serious condition and remains a problem which is difficult to be managed (Kwari et al., 1965; Morgan, 1963; Yap and The, 1962). The picture of congestive heart failure in children varies depending on the etiology of the heart disease (Mc Namara, 1971).

The purpose of this study is to evaluate the incidence and clinical picture of heart failure in diphtheric myocarditis and the results of its treatment. The mortality rate and causes of death other than cardiac in myocarditis diphtherica will also be discussed.

Materials and methods

Patients subjected to this study were cases with diphtheria of varying severity admitted to the Dr. Soetomo Hospital during the period of January 1, 1969 to January 1, 1974. The diagnosis of diphtheria was based on the following clinical criteria:

1. The presence of a membrane in the pharynx with bullneck appearance or with inspiratory stridor.
2. The presence of a membrane on one or both tonsils covering more than half of the tonsils.
3. A membrane outside the tonsil (posterior wall of the pharynx, uvula).
4. Borderline cases were first treated with penicillin 600,000 IU; if after 3 days no improvement occurred or they even became worse it was considered to be of diphtheric origin.

Clinical criteria were considered to be of more importance than laboratory diagnosis, since a negative culture did not rule out the presence of diphtheria. The incidence of the various types and the degree of the severity of the disease in this study was not determined.

Electrocardiograms were recorded on admission with the Siemens Cardiostat T and repeated every 5 days, if necessary in a shorter time. The main problem was to recognize acute cardiac failure as early as possible, since frank edema almost never occurred (Kwari et al., 1965; Morgan, 1963; Mc Namara, 1971; Yap and The, 1962). The following criteria have been taken for the presence of cardiac failure: 1. gallop rhythm, 2. dyspnea, 3. acute hepatic enlargement, 4. poor general condition such as weakness, pallor, anorexia, sweating, 5. the presence of ECG abnormalities, 6. X-ray changes.
Congestive Heart Failure in Diphtheric Myocarditis

by

A.M. PRASODO, M. NARENDRA, A. JOERI, L. WAHJOENARSISO and F. KASPAN.

Abstract

The picture of congestive heart failure in diphtheric myocarditis was mainly determined by poor general condition, hepatic enlargement ± epigastric pain; dyspnea. Basal rales and peripheral edema were not observed. Cardiomegaly on X-ray examination supported the diagnosis.

Congestive heart failure as a complication of diphtheric myocarditis occurred in 31.2% — 52% of cases with severe ECG changes and only in 5% of cases with ST depression or T wave changes.

Of 29 cases with congestive heart failure only 3 survived. Apparently good results of digitalis treatment were obtained when only gallop rhythm, as an early sign of heart failure, was found.

Extensive myocardial damage by diphtheria toxin may explain why no beneficial effect of digitalis treatment was obtained. Prophylactic digitalization before signs of congestive heart failure appeared, as suggested by several authors, was not performed in this study.

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In case of Nephrolithiasis, \textbf{Nephrolit} is the only answer...

**Composition:**
- Hexamine \(125\) mg.
- Sod. salicylate \(100\) mg.
- Benzoic Acid \(25\) mg.

- Stroblanthus Crispus
- Sonchus Avenalis
- Orthosiphon Stamineus
- Phyllanthus Niruri

const. et corr. \textit{et}

**Indications:**
- Nephrolithiasis
- Divertic
- Urinary antiseptic

**Dosage:**
- Adults: 2 capsules 4 times daily
- Children: 1 capsule 4 times daily or as prescribed by the physician

**Presentation:** Bottle of 50 capsules in boxes.

\textit{P.T. Bintang Tudjuh}
\textit{Pharmaceutical Industries.

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\textit{FIG. II a.}


FIG. II d.
have been found in several cases studied earlier. Significant changes of T wave in the first week of life were detected in the right precordial leads (Scott and Franklin, 1963) which is in accordance with the cases in this study. At the end of the first week the majority showed negative T wave in the right precordial leads and positive in the left precordial leads, the same cases as observed by Datey and Barucha (1960), Scott and Franklin (1963), and Walsh (1964).

Acknowledgement

We are deeply grateful to the Subdivisions of Perinatology and Social Pediatrics, Department of Child Health, Medical School, University of Indonesia, for the facilities used, and to the National Heart Institute for the materials donated to this study.

We also want to express our gratitude to the babies who were the subjects of this study and to their parents for their patience and co-operation especially in the follow-up ECG examination that were necessary to enable us to gather the data presented in this study.

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