Congestive Heart Failure in Diphtheric Myocarditis

by

A.M. PRASODO, M. NARENDRA, A. JOERNIL, WAJHOENARSO 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.

Received 27th. June 1975.
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.
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 ceclidanid 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. Supportive 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</th>
<th>ECG</th>
<th>Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>+</td>
<td>1567</td>
<td>abnormal</td>
<td>331</td>
</tr>
<tr>
<td></td>
<td></td>
<td>normal</td>
<td>1236</td>
</tr>
<tr>
<td>-</td>
<td>82</td>
<td></td>
<td>52 (63.4%)</td>
</tr>
<tr>
<td>Total</td>
<td>1649</td>
<td></td>
<td>160 (9.7%)</td>
</tr>
</tbody>
</table>
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.
The authors are very grateful to A. Hanafiah M.D. of the Cardiac Centre and Soedarmo, M.D. and associates of the Department of Radiology Dr. Ciptomangunkusumo General Hospital for their friendly cooperation.

Acknowledgement

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.

Signs of cardiac failure

Attention was focused on the 331 patients with ECG abnormalities to check for the presence of cardiac failure.

Table 4: Signs of acute congestive heart failure observed in diphtheric myocarditis (55 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>Dypsnea</td>
<td>35</td>
<td>87%</td>
</tr>
<tr>
<td>Basal rales</td>
<td>9</td>
<td>100%</td>
</tr>
<tr>
<td>Acute hepatic enlargement ± epigastric pain</td>
<td>30</td>
<td>87%</td>
</tr>
<tr>
<td>Pericardial effusion</td>
<td>1</td>
<td>100%</td>
</tr>
<tr>
<td>Poor general condition (weakness, pallor, sweating)</td>
<td>35</td>
<td>100%</td>
</tr>
<tr>
<td>Cardiomegaly</td>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>

The cardinal signs appeared to be: dypsnea, 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 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/lat 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>9</td>
<td>44.4%</td>
</tr>
<tr>
<td>LBBB</td>
<td>10</td>
<td>31.2%</td>
</tr>
<tr>
<td>Intraventricul. conduct. defect</td>
<td>10</td>
<td>52.5%</td>
</tr>
<tr>
<td>Complete AV block</td>
<td>13</td>
<td>46%</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: Digitalisation 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>Intraventricul. conduct. defect</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

Total 29  26

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.

The third group consists of patients with indeterminate atria (atria not absolutely diagnosable). The majority of the patients in this group show partial or complete transposition of the great vessels (D-type). Usually there is also common atrium or large combined septal defect and in the majority of cases there is pulmonary atresia or stenosis. Part of this group show right aortic arch and the other part left aortic arch. In some patients inversion of the ventricles can be observed.

According to radiological examination, electrocardiographic findings, catheterization and angiography of the heart, our first two cases could be included to the second group, whereas the third case, although it belongs to levocardia with visceral heterotaxis, can not be included in one of the Libetson's groups because no complete examinations was done. Inversion of atrium is already suspected if on electrocardiographic examination there was inverted P wave in lead I (P axis 90 — 140) (Nadas, 1963; Libetson et al., 1973), whereas the presence of the common ventricle is already imagined if there is a single second heart sound (Keith et al., 1967 and Wood, 1968).
monary arteries originated from the aorta descendens. (Fig. 1Id).

Diagnosis was levocardia, atrial inversion, single ventricle, right aortic arch and pulmonary atresia.

Case III

E., an eight-month-old girl who was admitted on November 15, 1972 with a history of recurrent fever, cough and dyspnea for about 1 month before admission. Cyanosis appeared on crying since 1 month of age; cyanotic spells were never noted. There was slightly delayed growth and development with slightly limited exercise tolerance. Physical examination revealed a female infant of about 8 months old with a body weight of 6700 gm, body length of 67 cm, temperature of 39°C and cyanosis and dyspnea. Pulse rate was 140 per minute, respiration rate was 48 per minute, blood pressure was 80/40 mmHg. JVP was not raised with negative hepatoglobular reflex. She had a symmetrical chest, increased activity of the heart, with enlargement of the heart to the left and right. There was a normal first heart sound with increased intensity and a normal split second heart sound. Panasystolic murmurs grade II/IV at the third left sternal border were detected. Lungs revealed an increased vesicular respiration; moist rales at both lungs were heard. Liver was enlarged but the spleen was not palpable. Clubbing of the fingers and toes was present.

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 mm³.

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 Libérrthson 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-

rhythm. After digitalization the patients were checked for the pulse, blood pressure and ECG. Only one case with LBBB got complete AV block. Six patients died within 24 hours after digitalization, while the remainder could survive for 2 and a few only for 3 days. The general impression was that as soon as acute congestive heart failure occurred, the condition of the patients deteriorated rapidly and digitalis appeared to be of little help.

Discussion

Three hundred and thirty one ECG abnormalities (21%) were found in 1567 patients admitted with diphtheria of varying severity. The overall mortality of diphtheria was 9.7%, however the mortality of the cases with ECG abnormalities was 27.4% as opposed to 1.2% of the cases with normal ECG. The morbidity and mortality of myocarditis were clearly determined by the type of the ECG changes. Sinus tachycardia did not necessarily mean a myocardial involvement since this abnormality was usually observed in cases with respiratory obstruction and cases with fever. After a few days to one week the heart rate usually returned to normal.

Flat to low T waves without other clinical signs of myocarditis were non-specific changes which would not bring much concern. It was also noted that the cause of death in these two groups was mostly of non-cardiac origin (respiratory obstruction etc.).

ST depression with inverted T wave, bundle branch block, complete AV block, intraventricular conduc-
tion defect, nodal rhythm, certainly indicated myocarditis and these patients should be observed for the occurrence of acute cardiac failure or shock. The image of congestive heart failure in children varies a great deal, depending on the age of the patient and the type of heart disease (Mc Namara, 1971). In newborns or infants with congenital heart disease, peripheral edema and basal rales are usually not found (Mc Namara, 1971). In older children with congestive heart failure caused by rheumatic heart disease, the classical picture of lung edema with pulmonary congestion and basal rales is a frequent finding and peripheral edema is also not uncommon, while ascites occasionally may occur in long standing congestive heart failure.

Firstly the congestive heart failure caused by myocarditis diphtherica is acute. As a sensitive parameter for congestion appeared to be the acute hepatic enlargement, mostly accompanied by epigastric pain, which occurred in 30 out of 35 cases with congestive heart failure and almost always was this accompanied by dyspnea. Gallop rhythm appeared to be not a constant finding. Only 6 out
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 (Barnett 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 at 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 g/m%, 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 atria, 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 g/m% 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-
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 visera, 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; Dela Cruz et al., 1971; De La Cruz et al., 1974; Liberman et al., 1975; Anselmi et al., 1972), Liberman’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. Cyanotic 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 mmHg, on the lower limb 100/60 mmHg. JVP was not raised, hepato-jugular 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 diphtheric 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 intensified and excitement or physical stress be avoided. Others (Friedman et al., 1973) believe that the administration of diuretics (lasix) would be more beneficial that digitalis (Friedman et al., 1973; Gillis and Kagan, 1971).

REFERENCES


From the Department of Child Health, Medical School, University of Indonesia, Jakarta.

Levocardia With Situs Inversus Atria
(Case Report)

by

BAMBANG MADIYONO, IRAWATI PULUNGAN, P.M.C.
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.

Received 28th. April 1975.