Long-term Follow-up of Electrocardiographic Findings in Patients with Acute Myocarditis Proven by Endomyocardial Biopsy

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MICHIKSI HIROE, M.D., AND KOSHIRO HIROSAYA, M.D.

Sixteen cases of acute myocarditis, proven by endomyocardial biopsy, of possible viral origin which were described in a previous paper have been followed up for up to 5 years. The cases were divided into 3 groups according to the electrocardiographic (ECG) patterns: with conduction disturbance at the early stage (Group I, 9 cases); without conduction disturbance (Group II, 4 cases); early death cases in which the follow-up could not be carried out (Group III, 3 cases). In Group I, 2 cases revealed persistent complete A-V block, 4 showed incomplete recovery of right bundle branch and/or fascicular blocks, and 3 showed complete recovery of the ECG abnormalities. In Group II, all 4 cases showed a pseudoinfarction pattern which consisted of abnormal Q waves, poor R wave progression and ST elevation. These findings disappeared during the follow-up period. All patients of Groups I and II are still alive after a follow-up period of up to 5 years.

It is well known that in cases of myocarditis various electrocardiographic (ECG) changes are seen. The diagnosis, however, has been ascertained only by autopsy or positive serological tests such as viral neutralizing antibody titer. As these tests do not always give positive results, the ECG changes can be interpreted only if there is a suspicion of myocarditis. In addition, myocarditis is often difficult to distinguish from ischemic heart disease unless coronary angiography is carried out. We have studied myocarditis employing endomyocardial biopsy and followed the course of this disease from its onset to the convalescent stage using ECG. Such study is important in helping to disclose the interrelation between myocarditis and cardiomyopathy.

This paper is a result of ECG changes during a long-term period of up to 5 years in patients with myocarditis.

MATERIALS AND METHODS

Sixteen patients, consisting of 7 males and 9 females, aged from 11 months to 65 years (mean ± SD: 37.6 ± 17.2 years), were investigated. Their diagnoses were based on “diagnostic criteria of acute idiopathic myocarditis of possible viral origin” which included endomyocardial biopsy findings obtained at the early stage of the disease. Serial ECGs taken during periods ranging from 29 days to 5.3 years (2.3 ± 1.5 years) in 13 patients except for 3 who died during the early stage (Group III) were studied.

Key Words:
Viral myocarditis
Long-term follow-up
Endomyocardial biopsy
Etiology of cardiomyopathy

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Japanese Circulation Journal Vol. 46, November 1982 1227
<table>
<thead>
<tr>
<th>Group</th>
<th>Case</th>
<th>Year</th>
<th>Principal signs</th>
<th>Peak CPK</th>
<th>Peak GOT</th>
<th>Peak LDH</th>
<th>HBE</th>
<th>Leads showing ST elevation</th>
<th>Leads showing abnormal Q</th>
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<td>(−)</td>
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<td>7500</td>
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<td>(−)</td>
<td>(+)</td>
<td>(−)</td>
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<tr>
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HBE = His-bundle electrography, CHF = congestive heart failure, A-S = Adams-Stokes syndrome, ARF = acute renal failure, CE = cerebral embolism
The patients were classified into the following 3 groups: 9 cases with conduction disturbance at the early stage (Group I), 4 cases without conduction disturbance (Group II) and 3 early death cases where the ECG follow-up could not be carried out (Group III) (Table I). Early clinical profiles of most of the present cases have been reported previously. In 2 cases ECGs prior
Fig. 2. ECG abnormalities observed on admission and during follow-up periods in 13 surviving cases.

to the onset of the disease were available. His-bundle electrograms were also taken at the time of biopsies.

RESULTS

A breakdown of the cases is presented in Table I.

Group I (Fig. 1a)

Nine cases of this group were divided into 3 sub-types according to the type of A-V block: Group Ia of 2 cases (22%), where permanent pacemaker implantations were performed due to 3rd degree A-V block; Group Ib of 4 cases (44%), where the conduction disturbance showed incomplete recovery; Group Ic of 3 cases (33%), where complete recovery from the conduction disturbance occurred. The ECG findings during the total follow-up period are shown in Fig. 1. All 9 cases of Group I showed 3rd degree A-V block within 8 days after the onset of the disease and, therefore, transvenous cardiac pacing was temporarily necessary. In 7 cases who recovered (Groups Ib and Ic), the duration of 3rd degree A-V block was up to one week. In Group Ic, however, it took from 2 weeks to 2 months until the complete recovery of either heart block or other QRS abnormalities occurred. The residual ECG signs of conduction disturbance in Group Ib were right bundle branch block (RBBB) + left axis deviation (LAD), RBBB + right axis deviation (RAD), RBBB only and LAD only in one case each. In 6 of the 9 cases His-bundle electrograms were taken and A-H block, H-V (or intrahisian) block and normal recordings were obtained in 2 cases each.

Group II (Fig. 1b)

All 4 cases of this group showed abnormal Q waves, poor R wave progression, ST elevation or depression, and T wave abnormalities, suggesting a pseudoinfarction pattern, and complete recovery of these took place from 2 weeks to 5 months afterwards. Except for Case 10 with a short follow-up period, all cases showed a complete recovery to the normal findings or to the condition seen just prior to the onset of the disease. (In all of Group I, the ECG abnormalities which characterized Group II were also observed.)

Among the 13 cases of Groups I and II, only one (Case 6) had remaining abnormal Q waves and poor R wave progression.

Arrhythmias (Fig. 2): Arrhythmias were observed in all 13 cases. The ECG abnormalities, including arrhythmias, seen on admission and during the entire course are illustrated in Fig. 2. Among these, sinus tachycardia (10 cases) and premature ventricular contraction (7 cases) were frequently observed, which were followed by supraventricular tachycardia (PAT) or ectopic supraventricular contraction (PAC) (4 cases each), sinus bradycardia (3 cases), atrial fibrillation (2 cases), and ventricular fibrillation or tachycardia (2 cases). Except in 2 cases (Cases 4 and 12), where PAC was still recognizable 3 months after the onset, the above-mentioned arrhythmias disappeared within 3 weeks.

Group III

The principal ECG findings in this group were 3rd degree A-V block (Case 14), pseudoinfarction pattern (Case 15) and RBBB + LAD followed by ventricular tachycardia (Case 16). ECGs from representative cases in each group are shown in Fig. 3.

DISCUSSION

There have been a few reports which describe

Japanese Circulation Journal Vol. 46, November 1982
Fig. 3-a. Case 6 (Group Iib). This 47-year-old male suffered from fever, lumbago and general fatigue on March 31, 1977. On April 4, after a decrease of the fever, he had recurrent fainting attacks and was transferred to our hospital by our mobile CCU, where a 3rd degree A-V block associated with cardiogenic shock was found. On April 9 the patient recovered to sinus rhythm with CRBBB plus LAD. However, on April 12 atrial fibrillation occurred with a QS pattern in leads I, II, III, aVF and V2–3. Poor R wave progression was also observed through leads V4–6. Afterwards, the R wave recovered gradually and the RBBB disappeared. However, LAD and poor R wave progression in leads V2–3 and abnormal Q wave in leads V4–5 and aVF were observed and have persisted up to the present time as fixed ECG abnormalities.

ECG findings taken during the follow-up period in acute viral myocarditis1,6–8 and they included several cases of myocarditis with other etiologies. Sainani et al6 described 19 cases of acute myocarditis and 8 of these were viral myocarditis, 5 of which were due to coxsackie B viral infection. They investigated ECG changes from 6 to 10 weeks after discharge and found that 4 cases had a normal pattern and the remaining 4 had ST-T changes.

Japanese Circulation Journal Vol. 46, November 1982
A 17-year study using the endomyocardial biopsy technique has shown that this method is useful for recognizing various kinds of specific heart muscle diseases including myocarditis. In cases of idiopathic cardiomyopathy, although non-specific findings are obtained, it has been shown that a sophisticated analysis may contribute to an understanding of the disease and also to the patients' prognosis. In assessing acute myocarditis, we have followed the course of the disease at the biopsy level and have concluded that the biopsy is a very useful aid for making an appropriate diagnosis and an assessment of the patients' condition. In cardiomyopathy, especially in the dilated form, myocarditis is the most likely etiological factor. Our above-mentioned serial biopsy studies one of which has been reported here, revealed that a large amount of evidence which links myocarditis and chronic dilated cardiomyopathy exists. We examined 734 biopsy specimens from cases of idiopathic cardiomyopathy and selected those showing post-myocarditic changes according to our definition. We then reviewed the clinical histories and findings of these patients during hospitalization. Post-myocarditic changes were observed in 15% of the cases of dilated cardiomyopathy, 8% of the arrhythmia and conduction disturbance group, and in only 3% of hypertrophic cardiomyopathy. This evidence leads to the conclusion that in many cases, especially in those of dilated cardiomyopathy and of arrhythmia and conduction disturbance, myocarditis is one of the most important agents in its etiology.

The present study revealed that cases of acute myocarditis show 4 basic ECG patterns through the course from the acute stage to the chronic stage. The first is the almost complete normalization of the ECG findings even if the patient had suffered from severe myocardial damage in the acute stage, showing 3rd degree A-V block, advanced intraventricular conduction disturbance, pseudo-infarction pattern and so on.

Such a complete ECG recovery is supported
by the fact that myocarditic changes usually
recover to a great extent as proven by our
biopsy studies$^{3}$ An electronmicroscopic study
also revealed that the myocytes, which were
almost completely destroyed due to myocytolytic changes, recovered surprisingly and
regained their normal architecture$^{4}$ This may be
due to an adequate coronary perfusion during

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Fig. 3-c. Case 11 (Group II). This 36-year-old female suffered from cough, headache and
nausea on December 14, 1977, and vomiting associated with cold sweat occurred
on December 20, which was followed by chest pain. An ECG taken at that time
revealed elevation of ST segment in leads I, aVl and V2–6. On December 21,
poor R wave progression through leads V2–3 and negative T waves in most of
the leads were observed. This patient was admitted with a tentative diagnosis of
unstable angina by an general practitioner. Coronary angiography revealed no
abnormalities and right ventricular biopsy revealed numerous cellular infiltrations.
Four months after the onset her ECG returned to the same findings as
those observed before the onset of the disease, associated with a slight LAD.

Japanese Circulation Journal  Vol. 46, November 1982
the recovery process of the disease.

The second is a pseudo-infarction pattern where the abnormal Q waves or poor R wave progression may recover almost completely within one or 2 months. Therefore, it can usually be differentiated from myocardial infarction, in which such a rapid and complete recovery cannot be observed.

The third pattern is conduction disturbance consisting of bundle branch block or fascicular block. Once it occurs, it may remain to a certain extent, although the severity may vary.

The fourth pattern is supraventricular or ventricular arrhythmias. Once malignant arrhythmias such as ventricular tachycardia or ventricular fibrillation occur, the patients may be in a serious condition and eventually die as a result of refractory arrhythmias. This condition was seen in Case 16. Three patients of Group III were admitted to our hospital in a later stage after the onset of the disease, and it was too late for these patients to be cured. If such patients once show a favorable recovery, then their prognosis may become more favorable.

Congestive heart failure was seen in 12 of 16 cases in the present study. In one case treated by permanent pacemaker implantation complete A-V block still remained 2 years after the onset when the lithium powered pacemaker expired due to a malfunction of the pacemaker generator.

With reference to our previous endomyocardial biopsy study, which included serial biopsies and analyses of clinical pictures we suggest that when patients show unexplainable A-V block, fascicular block, ventricular arrhythmias, intraventricular conduction disturbance and pseudo-infarction pattern, the physician should ask whether symptoms of a flu-like syndrome (which we described in a previous paper) had occurred in order to attempt to find any link between the ECG findings and viral infection.

It may be concluded that viral myocarditis is a contributing etiological factor in the pathogenesis of the heart muscle disease, especially dilated cardiomyopathy. It should be stressed that even in those cases with a normal ECG pattern the presence of severe acute myocarditis should not be dismissed. The patients may show some cardiac abnormalities after a long period or may not show any cardiac problems throughout their life. This problem is the theme of a further investigation which is now under progress.

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REFERENCES


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