Electrocardiography

Observational Data Suggesting There Are Electrocardiographic Abnormalities That Strongly Suggest the Presence of Chronic Heart Failure

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Summary

Almost nothing is written about the electrocardiographic abnormalities that may suggest the presence of chronic heart failure. Indeed, one often hears that the electrocardiogram does not indicate anything about the function of the heart. This paper discusses several abnormalities that often predict the presence of chronic heart failure. The information presented is from observations and not from scientific studies. The author urges those who are interested to complete a scientific study based on the premise that such observations may be correct. After all, many scientific studies have been created because of observational data that suggested a certain phenomenon.

Key words: chronic heart failure, electrocardiography

Introduction

Many scientific studies and clinical trials are prompted by the nonscientific observations of obsessive clinical observers. Accordingly, it is hoped that the observations reported in this essay will stimulate appropriate research to prove or disprove their clinical usefulness.

General Comments

Most individuals who are interested in electrocardiography believe that the tracings give little information about the function of the heart. They, of course, accept the fact that there is no car-

diac function when there is no electrical activity. They also recognize that the presence of electrical activity does not guarantee that myocardial contractility follows like night follows day.

The electrocardiogram (ECG) is usually abnormal in patients with chronic congestive heart failure (CHF). There are obvious exceptions to this rule, but they have not been clearly defined. One would postulate that almost all patients with lower than normal systolic ejection fraction and chronic CHF would have abnormal ECGs. On the other hand, some patients with diastolic dysfunction and chronic CHF might have normal ECGs.

The purpose of this article is to suggest that there are several rather specific abnormalities in the ECG that may indicate the presence of chronic CHF. These observations are offered to the inquisitive individual who might create a scientific study that answers the question—are there ECG abnormalities that indicate a high probability of chronic CHF?

Examples of Electrocardiograms that Illustrate the Deductive Reasoning Used to Suspect Chronic Heart Failure

Figure 1

This ECG shows complicated left ventricular conduction system block because the duration of the QRS complexes is 0.18 s and the mean QRS vector is directed to the left and posteriorly. The duration of the QRS complexes in uncomplicated left conduction system block is 0.12 s. A QRS duration of 0.18 s is often associated with a dilated left ventricle. The conduction defect may be due to stretching the conduction system to the point that parts of it become disconnected. It seems that cardiac myocytes may stretch more easily than the conduction system that serves them.

The part of the conduction system that produces the initial QRS forces seems to be intact because there are prominent R waves noted in leads V₁–V₃. Accordingly, extensive cardiac damage must be located in a large portion of the myocardium that is served by the distal parts of the conduction system.

Patients who exhibit ECGs such as this commonly have chronic CHF because the conduction system abnormality is often associated with, and may actually be due to, a dilated left ventricle. This ECG was recorded from a 66-year-old patient with idiopathic dilated cardiomyopathy and chronic CHF.¹

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FIG. 1 This electrocardiogram shows complicated left ventricular conduction block with intact initial QRS forces and strongly suggests chronic heart failure. Reprinted from Ref. No. 1 with permission.

Figure 2

This ECG shows complicated right ventricular conduction system block because the mean QRS vector is directed at -110° in the frontal plane and about 80° anteriorly where the right ventricle is located.¹ It is complicated because the direction of the mean QRS vector is located superiorly and because the QRS duration is >0.18 s. This type of conduction system block is usually associated with a dilated right ventricle. The conduction system abnormality may be due to stretching the finer parts of the conduction system that serves the right ventricle.

Patients who exhibit ECGs such as this commonly have heart failure because the conduction system abnormality is often associated with, and may actually be due to, a dilated right ventricle. This ECG was recorded from a patient who, at a young age, had total correction of tetralogy of Fallot and had persistent pulmonary valve regurgitation and chronic CHF.²

Figure 3

This ECG reveals subtle signs of chronic CHF. Note the abnormal P waves. The mean P wave vector is directed about $+70^\circ$ in the frontal plane and about 20° anteriorly. The latter is

FIG. 2 This electrocardiogram shows complicated right ventricular system block and strongly suggests chronic heart failure. See text. Reprinted from Ref. No. 2 with permission.

FIG. 3 This electrocardiogram shows a right atrial abnormality and a primary T-wave abnormality suggesting left ventricular damage. This combination of abnormalities suggests the presence of chronic heart failure. See text.

borderline. The P-wave amplitude in lead aV_F is 3 mm. This is definitely abnormal and is due mainly to a right atrial abnormality. The first half of the P wave, which is due to right atrial depolarization, is directed $+50^\circ$ in the frontal plane and 20° anteriorly. The second half of the P wave, which is due to depolarization of the left atrium, is directed at $+70^\circ$ in the frontal plane and about 10° posteriorly. The area is subtended by the second half of the P wave, which, as measured in lead V_1 , is slightly less than -0.04 mm/s.

The duration of the QRS complexes is 0.09 s. The amplitude of the mean QRS complexes is normal. The mean QRS vector is directed normally at about $+10^\circ$ in the frontal plane and about 50° posteriorly. The mean T vector is directed abnormally at about $+140^\circ$ in the frontal plane and about 50° anteriorly. This abnormally large QRS-T angle is most likely due to dilation of the left ventricle. The ventricular gradient is di-

rected at $+80^\circ$ and is considered to be borderline in location. This suggests that there is additional cause, such as ischemia, for the abnormal T waves.

Here we have evidence of a dilated left ventricle and a right atrial abnormality. One can conclude that the most common way that this combination of abnormalities can develop is the production of left atrial hypertension and heart failure. This tracing was recorded from a 45-year-old man with dilated cardiomyopathy and heart failure due to the repeated use of cocaine.

Figure 4

The tracing shown in Figure 4 reveals a massive anterior myocardial infarction, left anterior superior division block, and a definite left atrial abnormality.

FIG. 4 This electrocardiogram shows a left atrial abnormality and an extensive anterior myocardial infarction. This combination of abnormalities suggests the presence of chronic heart failure. See text.

The mean P vector is directed at about $+30^\circ$ in the frontal plane and is almost parallel with the frontal plane. The area subtended by the second half of the P wave in lead V_1 is >0.04 mm/s, indicating a left atrial abnormality.

The duration of the QRS complexes is 0.09 s. The 12-lead amplitude of the QRS complexes is approximately 234 mm, indicating the presence of left ventricular hypertrophy. The mean QRS vector is directed at -80° in the frontal plane and $>20^\circ$ posteriorly (the exact amount cannot be determined without additional leads). This is caused by left anterior superior division block. The initial forces of the QRS complexes are directed superiorly and posteriorly, indicating a large anterior myocardial infarction. The mean T vector is directed about $+85^\circ$ in the frontal plane and at least 40° anteriorly. The ventricular gradient is directed 0° in the frontal plane, which is borderline in location.

The massive myocardial infarction plus a left atrial abnormality suggest the possibility of chronic CHF. This patient, with coronary atherosclerotic heart disease, was 77 years old. He was normotensive at the time the tracing was recorded. Chronic heart failure was present and the ejection fraction was 15%.

Conclusion

Little is written about the ECG abnormalities that indicate the high probability that a patient has chronic CHF. Therefore, certain combinations of ECG abnormalities that seem to indicate the presence of heart failure are described in this essay. It is hoped that these observations will be used by others to create appropriate studies that will answer the question—are there ECG abnormalities that indicate the presence of chronic CHF?

Addendum

I would, of course, like to do the scientific study myself, but being realistic, the opportunity should be passed to those who are younger.

References

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