10 (1970)

The relation of the position of the normal and the enlarged heart to the electrocardiogram.

By ALFRED E. COHN and MILTON J. RAISBECK

[*From the Hospital of the Rockefeller Institute for Medical Research, New York, N. Y.*]

It is well known that when the heart enlarges, it gives rise to alterations in the electrocardiogram; the curve takes on one form when the left ventricle is hypertrophic as in aortic insufficiency; it takes on an opposite form when the right ventricle is principally involved, as in mitral stenosis. These electrical signs have been useful in the clinic, but they have on occasion been misleading, for we have obtained curves resembling those found in enlarged hearts, in young soldiers and in civilians who, we were quite certain, were not the subjects of disease. It occurred to us that the position of the heart in the chest might be an important contributing factor in producing the abnormal electrocardiograms. It is well known that changes in the curves are possible as the result of respiratory movement; of the posture of the body. An exaggerated instance occurs in dextrocardia, as the result of which the electrocardiogram assumes the appearance of a mirrored image of the usual curve. Having these experiences to guide us we planned to ascertain in a systematic manner precisely what was the effect of the position of the heart in the chest. Obviously we could not rotate the heart in the chest, but we could rotate the chest about the heart Our method was as follows: Instead of taking the usual limb leads, we placed electrodes at the apices of the largest equilateral triangle which we could apply to the chest, the base of the triangle stretching between the shoulders, the apex below the sternum. We assured ourselves that the curves taken from these leads resembled closly those from the limb leads. We proceeded then to rotate this triangle through successive arcs of 40°, taking curves at each new position from those points of the chest wall to which the apices of the triangle pointed. We photographed the three leads simultaneously, using three galvanometers. By this means, we did in effect rotate the chest about the heart. In normal in-

dividuals, by small changes in the position of the triangle of leads, resulting in a change of the anatomical angle of the heart of 40° or less, we obtained curves which actually resembled curves found in disease and resembled closely those often thought to be abnormal found in the young soldiers and civilians already mentioned. These were curves like those seen when the left side of the heart is large; in other positions, though anatomically quite improbable, we obtained curves resembling enlargement of the right side of the heart.

In patients whose hearts were known to be diseased and whose curves were characteristic of these conditions we applied the same technique. We found that at some position in the course of rotating the leads, curves were obtained which approached the appearance of normal.

That curves of approximately normal appearance can be obtained is of theoretical interest. But that in obviously normal persons, yielding abnormal curves, normal curves can be obtained by a slight alteration of the position of the heart in the chest is a matter of genuine practical importance. It does not simplify the interpretation of electrocardiograms, but for the moment it does something quite as important; it shows how the normal individual may be saved from being considered the subject of chronic heart disease because of an abnormality in his curve. This danger is not theoretical.

We have not by these experiments solved the problem of the relation of hypertrophy of the heart to patent abnormality in the electrocardiogram, but we have shown systematically and clearly that, especially in doubtful cases, the position of the normal heart in the chest must be taken into account as a factor in the production of abnormal curves as well as the position of the abnormal heart in the chest in the production of normal ones.