INTRAVENTRICULAR BLOCK

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Since Rosenbaum reported the characteristic findings of left anterior and posterior hemiblock in the electrocardiogram, those hemiblocks have been highlighted.

The criteria of left anterior hemiblock in the electrocardiogram were reported by Rosenbaum, Benchimol and other investigators. In the vectorcardiogram, Benchimol and his co-workers described the VCG's findings in cases which satisfied their criteria in ECG. Medrano and Sodi-Pallares mentioned the criteria in VCG based on their experimental study in dogs.

It is well-known that the criteria of left anterior hemiblock in ECG is the marked left axis deviation. Therefore, one is often tempted to make a diagnosis of left anterior hemiblock with the marked left axis deviation. But, is it correct to do such a diagnosis? How many degrees of the frontal QRS vecer are most adequate to pick up cases with left anterior hemiblock? Are Rosenbaum's or Benchimol's criteria of left anterior hemiblock suitable?

In order to re-examine those criteria, we collected cases above minus 30 degree of the frontal QRS vector, and divided into the following groups depending upon the configurations of the horizontal QRS loop in VCG with the Frank system.

As we are afraid that ECG's findings are not sufficient to discuss this problem, the VCG's findings are used in this study.

Group 1. The direction of inscription of the horizontal QRS loop is a figure of eight or clockwise. (Fig. 1).

In Group 1, some cases with anterior infarction are included. The upper case of this slide is a case with anterior infarction. The direction of inscription of the horizontal QRS loop is a figure of eight and the angle of the maximal QRS vector in the frontal plane is minus 45 degree. Namely the middle portion and the afferent limb of the QRS loop is dislocated to the left and anterosuperiorly due to the delayed excitation of the upper portion of the anterior wall, and that might be produced by left anterior hemiblock. Such cases are often observed in anterior infarction. However, the middle case of this slide shows also the change of the QRS loop due to myocardial infarction. but the direction of inscription of the horizontal QRS loop is counterclockwise and the afferent limb of the horizontal QRS loop is located posteriorly. The afferent limb of the frontal QRS loop is dislocated superiorly, but the middle portion is not located more superiorly than that of the upper case. Therefore, the superior dislocation of the afferent limb might not be due to left anterior hemiblock. Consequently, in cases with the marked left axis deviation in anterior infarction, it might be said that the middle portion or the afferent limb of the QRS loop is dislocated to the left anterosuperiorly, when left anterior hemiblock is present.

In the lower case of this slide, the configuration of the horizontal QRS loop is a figure of eight and the afferent limb is located to the left and posteriorly, and is similar to that in anterior infarction. But he has not experienced the attack of myocardial infarction. The middle portion and afferent limb of the frontal QRS loop are dislocated to the left and superiorly. Therefore, the left-superior dislocation of the QRS loop might be produced by left anterior hemiblock without anterior infarction. Of course, it can not be completely neglected that a part of such posterior dislocation of the afferent limb is induced by anterior infarction, as he is 76 year-old.

Group 2. The direction of inscription of the horizontal QRS loop is counterclockwise and the afferent limb is located to the left and posteriorly (Fig. 2).

In Group 2, the frontal QRS loop of the upper side of this slide is very similar to that of the lower case in the last slide, and it can not be denied that the left-posterior dislocation of the horizontal QRS loop might be produced by left anterior hemiblock. The horizontal QRS loop of the lower side resembles to that in left ventricular hypertrophy.

And we can say that Group 1 and 2 except left ventricular hypertrophy might be cases with left anterior hemiblock.

Group 3. The afferent limb is located posteriorly (Fig. 3).

In most cases of Group 3, the main QRS vector is directed superiorly, and in the remainder, that is directed to the left. In the latter, it is difficult to consider that left anterior hemiblock participates the left-superior dislocation of the QRS loop, and in the former, the force of the superior dislocation of the QRS loop is localized postero-superiorly. Therefore, it is also impossible to consider left anterior hemiblock as a source of this location.

Group 4. The afferent limb is located to the right posteriorly (Fig. 4).

In Group 4, cases can be divided depending on the QRS pattern in lead I. According to Rosenbaum' criteria, qR pattern or qRs pattern in this group are suitable, but Rs pattern and r^s pattern are also adequate to Benchimol's criteria. The configuration of the frontal QRS loop in this group is also divided into the following three types: (1) The main QRS loop is located to the left and somewhat superiorly—Type I, (2) The afferent limb is located to the left and the afferent limb is located to the right and superiorly—Type II, (3) The initial QRS vector is directed to the left, but the main QRS loop is dislocated to the right and markedly superiorly—Type III. Most cases in this group belong to Type II and III. Namely, the characteristic finding in this group is the right-postero-superior dislocation of the afferent limb of the QRS loop.

Do you think it is reasonable to consider that the right posterosuperior dislocation is produced by left anterior hemiblock? If you do, no further discussion is needed. In the report of Medrano, Sodi-Pallares, that type was included in the vectorcardiogram of left anterior hemiblock. However, those cases of Type II-III are often observed and according to the location, we can not easily obey that the dislocation might be due to left anterior hemiblock.

However, it is of no use to discuss the configuration of the QRS loop in clinical cases.

Then, in order to examine the effect of left anterior hemiblock on the dislocation of the QRS loop, we are going to use our constructed method of the QRS loop with a computer.

(Fig. 5). This method is as follows: The right and left ventricles including ventricular septum are divided into 14 segments. The direction and time history of each segment are assumed, and each value is in-put into a computer and after calculation with a computer, the QRS loops in three planes are drawn on the X-Y plotter.

The upper side of this slide shows the normal QRS loops. From left side to right side, the QRS loops in the horizontal plane, left sagittal plane and frontal plane are shown.

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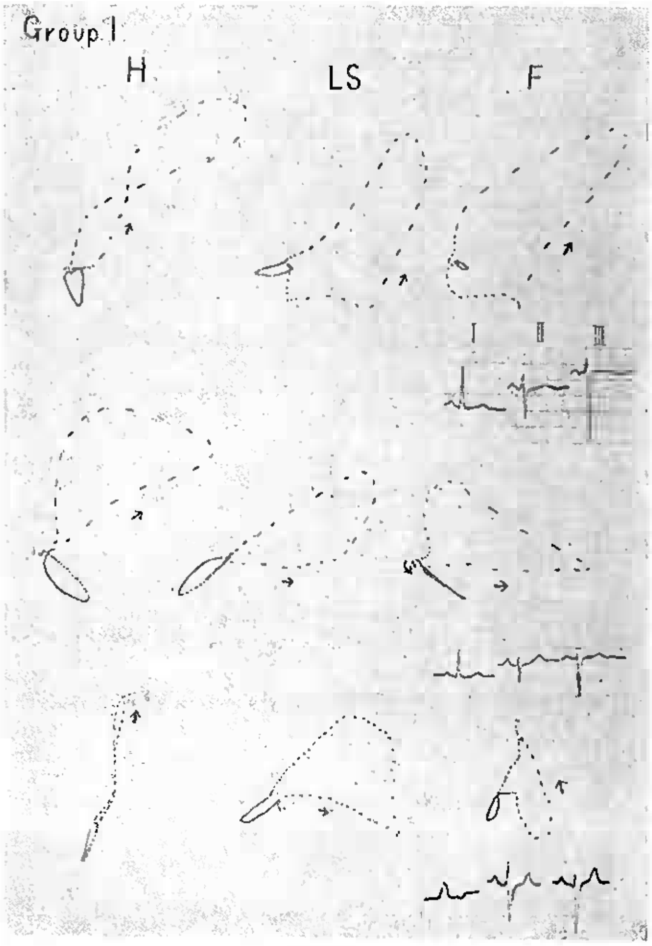

Fig. 1.

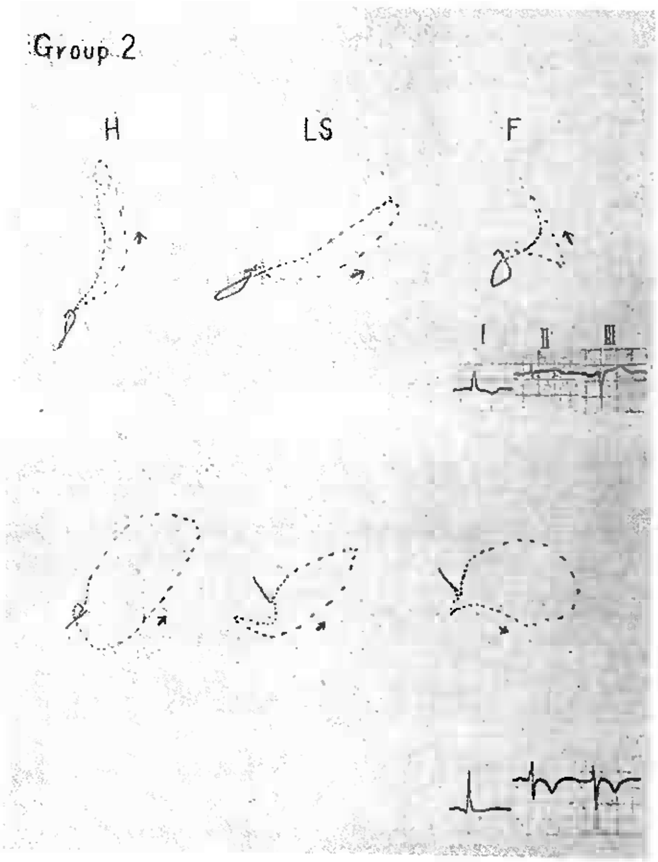

Fig. 2.

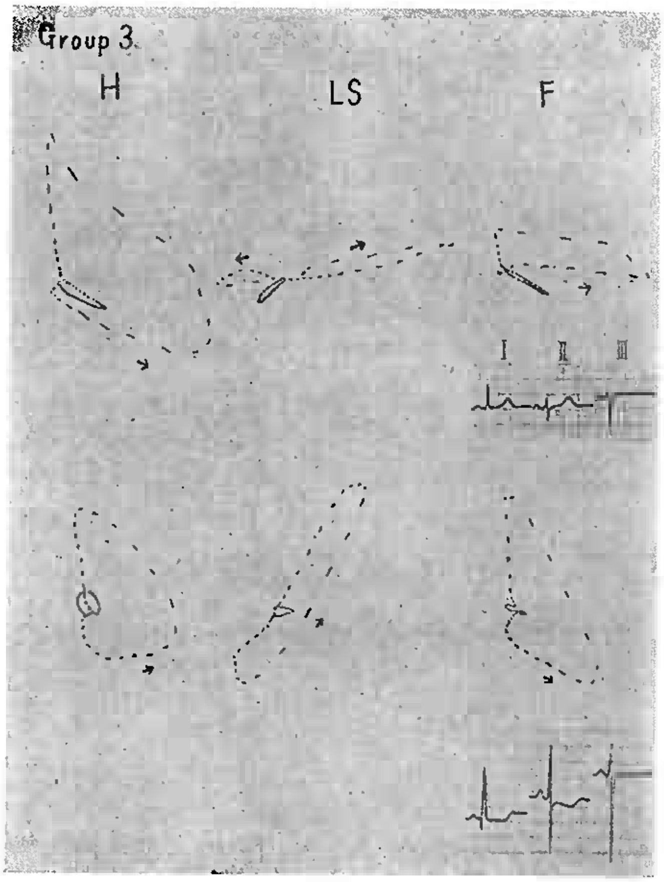

Fig. 3.

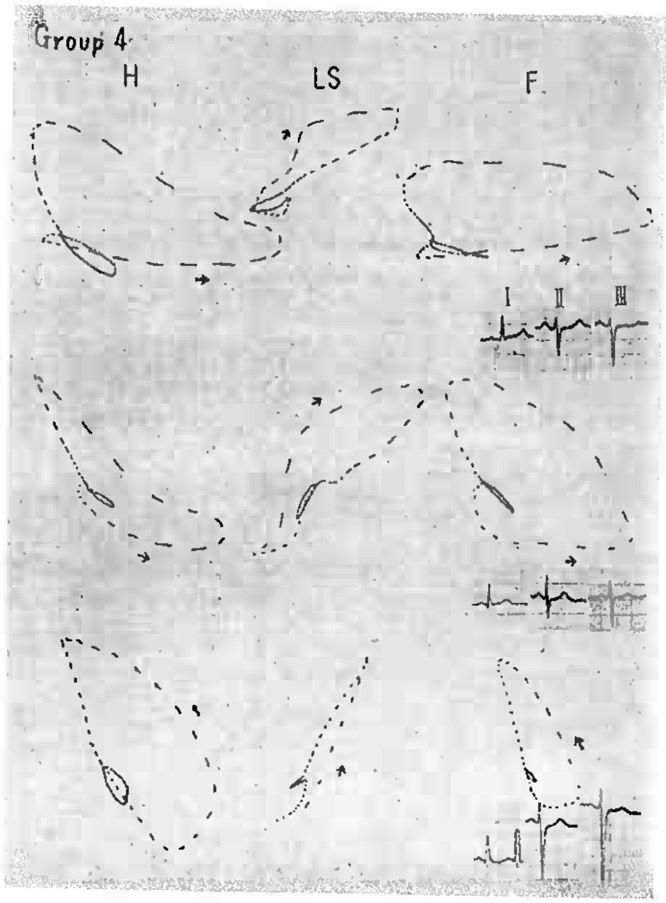

Fig. 4.

Then the depolarization process of the anterior wall in the left ventricle is delayed 10 msec. with the normal depolarization process, the afferent limb of the QRS loop is displaced more anteriorly and somewhat superiorly, as shown in the lower side of this slide (Fig. 6).

When the depolarization process of the anterior wall in the left ventricle is delayed with prolonged depolarization and the upward direction of the vector (15 degree) as shown in the upper side of this slide, the afferent limb of the horizontal QRS loop is dislocated more anteriorly and the direction of inscription of the horizontal QRS loop is a figure of eight. In the frontal QRS loop, the afferent limb is dislocated more superiorly.

In clinical cases of the lower side of this slide, the QRS loop, especially the horizontal QRS loop is very similar to that in this constructed method. The similar QRS loop was reported by Professor Mori, Tokushima University, and the horizontal QRS loop is also similar to that in our method. That case developed into complete left bundle branch block.

You may notice that the superior dislocation of the afferent limb of the frontal QRS loop is not marked in those clinical cases.

(Fig. 7). In order to produce more markedly superior displacement of the QRS loop, the direction of the vector of the anterior segments in the left ventricle is directed upward with delayed and prolonged depolarization as shown in the upper side, the frontal QRS loop is dislocated more superiorly, and the horizontal QRS loop is also located more posteriorly with a narrow shape of counterclockwise inscription. In this calculation, even though the direction of the vector of the anterior wall is just perpendicular to the direction of the normal depolarization, the horizontol QRS loop is very narrow and located to the left and posteriorly with the counterclockwise inscription.

Sodi-Pallares described that in left anterior hemiblock (the left anterior subdivision block), the activation of the upper area of the anterolateral portion of the free left ventricular wall was affected. In this method, the superior segment of the anterior wall is delayed and prolonged with the postero-superior direction of the vector. But the QRS loop is located to the left and postero-superiorly with counterclockwise inscription. Therefore, we can not get the QRS loop similar to the right postero-superior dislocation of the afferent limb of the QRS loop in Type II-III in Group 4.

Then, what is the reason of such a dislocation? As shown in the lower side, when the depolarization of the posterior wall in the left ventricle is delayed and prolonged with the right superior direction of the vectors in the superior and inferior segments, the afferent limb of the QRS loop is dislocated to the right and postero-superiorly, and is similar to that of Type II. There is no difference, even though the depolarization of the posterior walls in both ventricles are altered.

Consequently, the right postero-superior dislocation of the afferent limb of the QRS loop might be produced by the abnormal depolarization process of the posterior wall in the left ventricle or both ventricles.

Although an abnormal depolarization process of the ventricular septum can not be produced in our method, calculation of an abnormal depolarization process of the posterior wall might be substitute for that of the ventricular septum, and the postero-superior dislocation of the QRS loop might be illustrated with this assumption.

As we already have mentioned, we could not obey a simple conclusion drawn from the collected vectorcardiograms which were suitable to the criteria in the electrocardiogram. Therefore, our constructed method is used to confirm this problem. Of course, this method is not prefect, because it is calculated with

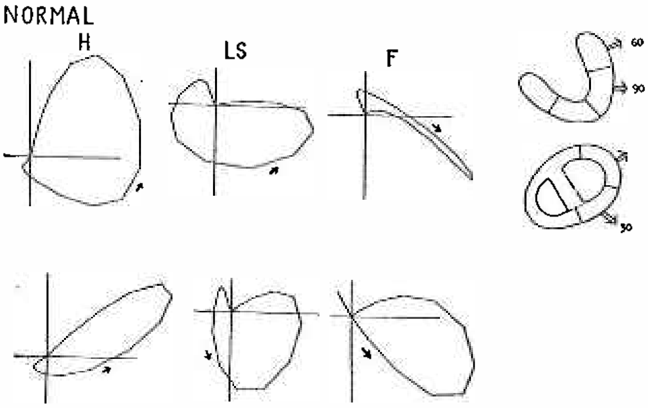

Fig. 5.

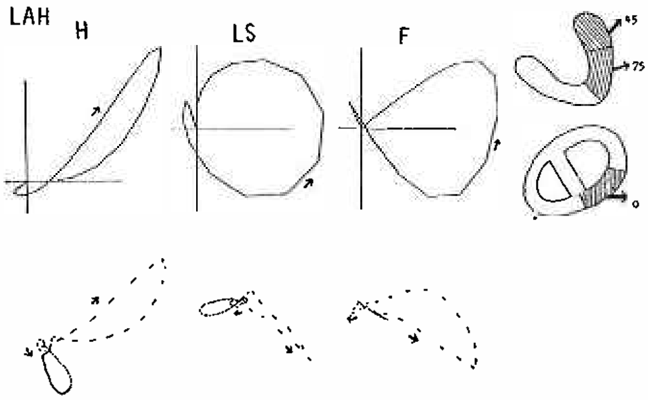

Fig. 6.

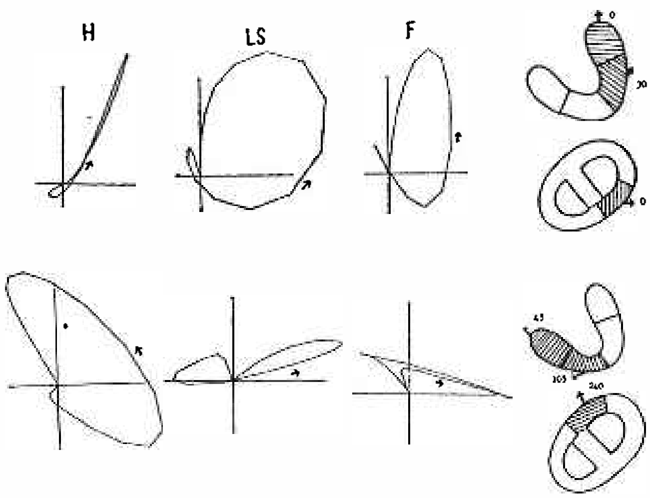

Fig. 7.

many kinds of assumptions. However, various QRS loops similar to those in clinical cases are obtained. In some clinical cases with marked left axis deviation (Group 1 and 2), there is a coincidence of the QRS loops in clinical cases and those constructed with our method. But, in other cases (Group 3 and 4), the resembled QRS loops are not obtained with the assumption of left anterior hemiblock.

Therefore, it is doubtful that the right postero-superior dislocation of the QRS loop is produced by left antèrior hemiblock, and rather, we believe that the right postero-superior dislocation is due to the abnormal depolarization of the posterior wall. In cases with idiopathic hypertrophic subaortic stenosis, it might be due to the abnormal depolarization at the ventricular septum caused by the septal hypertrophy. Then, we would like to say that the typical pattern of left anterior hemiblock in the vectorcardiogram is the left anterosuperior displacement of the afferent limb of the QRS loop and it is not always responsible for the marked left axis deviation. Therefore, the criteria of the angle proposed by Rosenbaum and others are questionable and when the criteria of QRS patterns by Benchimol are used, there is a risk to reach a misdiagnosis. Finally, we want to insist that the electrocardiographic findings are not adequate to make a diagnosis of left anterior hemiblock, and the configuration of the QRS loop is more suitable.