Left Axis Deviation in Inferior Infarction; Vectorcardiographic Recognition of Concomitant Left Anterior Hemiblock

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The vectorcardiograms of 30 patients with inferior infarction and abnormal left axis deviation were studied. In 23 cases, the frontal plane loop was clockwise rotated and the initial vectors were superiorly displaced. The remaining seven tracings also showed superior orientation and clockwise rotation of the initial forces, but the second half of QRS was displaced further superiorly and counterclockwise inscribed. The vectorcardiographic pattern observed in those seven cases was postulated to indicate inferior wall infarction with concomitant left anterior hemiblock. This hypothesis was substantiated by the clinical observation of two patients in whom the separate components of the complete pattern appeared successively. It is concluded that in inferior infarction, abnormal left axis deviation may result either from the infarction alone, or from the concomitant presence of left anterior hemiblock which can be depicted from observation of the frontal plane vectorcardiogram.

Left anterior hemiblock is generally considered to be the most frequent cause of left axis deviation in adults.1-4 Its electrocardiographic and vectorcardiographic patterns have been thoroughly described.1-6 The mean QRS axis is shifted to the left (higher than —30°) and the QRS complexes show an rS morphology in leads II, III and aVF of the standard electrocardiogram. The frontal plane loop of the vectorcardiogram is counterclockwise rotated with inferior orientation of the initial vectors.

Inferior wall myocardial infarction is another condition which may lead to abnormal left axis deviation. Therefore, whenever left axis deviation is observed in a patient with inferior infarction, the problem always arises whether the axis shift is due to rupture of the electrical balance produced by the infarction itself or might be related to a concomitant left anterior hemiblock.

The present paper is concerned with a vectorcardiographic study of 30 patients with left axis deviation and inferior wall myocardial infarction. Its purpose is to try to define criteria permitting the diagnosis of left anterior hemiblock in the presence of inferior wall myocardial infarction.

Patients and Methods

The following criteria were used for selection of the patients. (1) All subjects in this study had presented with clinical signs of acute myocardial infarction with transient diagnostic rise of serum lactate dehydrogenase. (2) At the time of the acute episode, the electrocardiogram showed the classic criteria of inferior infarction, ie Q wave of 0.03 sec or more with a depth 25 percent or more of a succeeding R wave and characteristic ST segment and T wave changes in leads II, III and aVF.7-10 Patients displaying coexistent anterior or posterior infarction were not excluded from the series. (3) At the time of the vectorcardiographic study, the electrocardiograms showed, in all cases, a leftward deviation of the mean QRS axis in the frontal plane (—30° or higher).

Over the past two years, 30 such cases were collected. There were 25 men and five women, ranging in age from 35 to 86 years with an average age of 60. Their electrocardiograms showed unequivocal features of inferior infarction in all cases. In addition, changes of coexistent anterior infarction were observed in six patients and of posterior infarction in five. The interval between the acute episode and time of vectorcardiographic study ranged between five months and four years.

Spatial vectorcardiograms were recorded using the McFee–Parungao axial system.11 The frontal, horizontal and left
LEFT AXIS DEVIATION IN INFERIOR INFARCTION

FIGURE 1. Electrocardiogram and vectorcardiogram of a patient aged 35, with inferior infarction. The mean QRS axis is located at about \(-30^\circ\). The frontal plane loop is clockwise rotated and the initial vectors are superiorly displaced. The loop is interrupted every \(1/40\) sec. Calibration: 500 \(\mu\)V in both vertical and horizontal directions.

Results.

It was readily apparent that the vectorcardiograms of the present series might be divided into two subgroups.

In subgroup A which comprised 23 cases, (Fig 1), the frontal plane loop was entirely clockwise rotated and the efferent limb was superiorly displaced. The duration of superior forces was always greater than 25 msec. The horizontal plane loop showed an overall counterclockwise rotation. In the sagittal plane loops as well as the scalar tracings X, Y and Z were photographed by means of a Polaroid camera. A five-fold amplification was taken to provide better delineation of the early forces. Timing of the various points of the loop was obtained by counting dots on the photograph from the onset of QRS.

Subgroup B consisted of seven patients whose vectorcardiograms showed obvious differences from those described in subgroup A (Fig 2). The main distinctive features were seen in the frontal and left sagittal plane projections. In the frontal plane, the beginning of the loop was also displaced superiorly with clockwise rotation, but an abrupt shift was present of isolated inferior infarction, the morphology of QRS in this projection appeared to be normal. In the six patients with coexistent anterior infarction, there was a posterior displacement of the 20 msec vectors. On the other hand, in the five cases with coexistent posterior necrosis, anterior forces with increased magnitude and duration (\(>40\) msec) were noted. The left sagittal plane projection confirmed the superior displacement of the initial portion of the loop.

Figure 2. Electrocardiogram and vectorcardiogram of a patient aged 53 with inferior infarction and left axis deviation. In the frontal plane, the initial forces are superiorly displaced and clockwise rotated. At about 40 msec, there is an abrupt shift of the loop. The second half of QRS is located superior to the efferent limb and turns in a counterclockwise fashion. The loop is interrupted every \(1/400\) sec. Calibration 900 \(\mu\)V.
observed at about 40 msec. The intermediate vectors (50 to 60 msec) were inscribed in the left superior quadrant above the efferent limb, and the middle and terminal portions of QRS showed a counterclockwise rotation. In the left sagittal plane, the initial portion was inscribed superiorly. After it had reached its maximally anterior extent, the loop started to proceed posteriorly and then gradually to descend. At about 40 msec, a second inflection point was observed and the following portion of QRS was located more superiorly and posteriorly than the rest of the loop. None of these seven patients was found to have associated anterior infarction.

**DISCUSSION**

In inferior wall infarction, the presence of an "electrically inert zone* in the diaphragmatic portion of the heart results in a rupture of the balance of the electrical forces normally generated by cardiac depolarization. The infarction thus allows superiorly directed forces to be unopposed. This may result in a mean QRS axis oriented superiorly and to the left which produces an abnormal left axis deviation.12

From a vectorcardiographic viewpoint, this type of left axis deviation appears to be quite different from that described in left anterior hemiblock.5,6,12 The main distinctive findings are as follows: (1) The initial vectors (10 to 20 msec) are inscribed inferiorly in left anterior hemiblock. On the contrary, they were superiorly directed in all our cases of inferior wall infarction. (2) The frontal plane loop is always inscribed entirely counterclockwise in left anterior hemiblock. On the contrary, in inferior wall myocardial infarction, the initial portion of QRS was always inscribed clockwise in the frontal plane, the rest of the loop being also clockwise rotated in 23 out of the 30 cases.

Therefore, it seems that the distinction between the two mechanisms of left axis deviation is rather straightforward in most instances. However, there are fewer cases where the situation appears less clearcut.

In seven subjects of this series, the initial vectors were oriented superiorly and inscribed clockwise in the frontal plane, but the second half of QRS was counterclockwise rotated and displaced further superiorly. This particular vectorcardiographic aspect associates features of inferior wall myocardial infarction with signs of left anterior hemiblock and one is therefore tempted to consider the two abnormalities to be concomitant. The possibility of the coexistence of left anterior hemiblock and inferior wall infarction has already been suggested by

![Image of electrocardiogram and vectorcardiogram](http://journal.publications.chestnet.org/pdfaccess.ashx?url=/data/journals/chest/21522/...
Grant and Rosenbaum and associates from vectorial studies of standard electrocardiograms.

The following two observations seem to corroborate this hypothesis: (1) The first example is that of a man with left anterior hemiblock who suddenly developed an inferior infarction (Fig 3). This patient had suffered from unequivocal angina pectoris since 1964. The successive electrocardiographic tracings recorded between 1964 and April 1970 were characteristic of left anterior hemiblock with right bundle branch block. In May 1970, the patient suddenly developed an acute episode of myocardial infarction with definite transient rise of both creatinphosphokinase and lactic-dehydrogenase. Following this, a Q wave appeared in leads II, III and aVF of the standard electrocardiogram. The vectorcardiogram showed in addition to the right bundle branch block, a superior orientation of the initial vectors and a counterclockwise rotation of the QRS loop. This pattern was very similar to that described in group B of the present series.

(2) The second example (Fig 4) is that of a patient admitted to the coronary care unit for an episode of acute inferior wall infarction. Aberrantly conducted ventricular beats were obtained in this case by introduction of artificially induced atrial premature beats. The method used in this study was described by Cohen and co-workers. Atrial premature beats were produced by electrical stimuli delivered to the right atrium by means of an R wave coupled pulse generator (Medtronic model 5837). The control tracings showed unequivocal changes of inferior infarction but the mean QRS axis remained normal. In the frontal plane, the initial portion of QRS was located superiorly and the rotation of the loop was entirely clockwise. In the experimentally induced beats, aberrant conduction resulted in a leftward shift of the mean QRS axis with deep S wave in leads II, III and aVF. This modification was interpreted as caused by the presence of left anterior hemiblock. The corresponding frontal vectorcardiogram still showed initial vectors superiorly oriented and clockwise rotated. On the other hand, the second half of QRS was now inscribed counterclockwise and the intermediate forces were located in the upper left quadrant higher than the efferent portion of the loop.

Those two observations corroborate the hypothesis that the vectorcardiographic pattern described in subgroup B of this series corresponds to an association of inferior wall infarction with left anterior hemiblock. This conclusion is in agreement with the results recently presented by Chahine and colleagues.

It is therefore concluded that when abnormal left
half of QRS is counterclockwise rotated and lies superior to the efferent limb.

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Joseph Priestley (1733-1804), theologian and scientist, grasped the true nature of oxygen, but, unfortunately, failed to comprehend the significance of his discovery. On August 1, 1774, he concentrated the sun's rays with a burning-glass over mercuric oxide; and readily obtained a gas in which "a candle burned in this air with a remarkably vigorous flame." This air, he found, not only supported combustion but prolonged the life of animals breathing it. He named this new gas "dephlogisticated air," but misunderstood the role of this gas in respiration and combustion.