Vectorcardiographic Residua of Inferior Infarction

Seventy-eight Cases Studied with the Frank System

By Irwin Hoffman, M.D., Robert C. Taymor, M.D., and Abraham Gootnick, M.D.

The vectorcardiographic picture of inferior infarction has become increasingly clear during the past decade. Superior forces of abnormal magnitude and duration that exhibit clockwise rotation in the frontal plane have been described by all authors.1-9

This paper describes the long-term vectorcardiographic findings in 78 instances of well-documented inferior infarction studied an average of 37 months after the acute episode. A study of this material has cast additional light on a number of vectorcardiographic findings in cases of inferior infarction. These include (1) the significance of reversal of rotation in the sagittal projection, (2) the value of quantitative measurements of the duration, direction, and voltage of the early forces, and (3) the meaning of upward deformities of the mid-loop area.

Materials and Methods

The files of the electrocardiographic department for the years 1953-1961 were screened for appropriate cases. Requirements for inclusion were progressive electrocardiographic changes of acute inferior infarction, including the appearance of Q waves in leads III and aVF, which met the usual criteria.10 An additional requirement was a clinical illness diagnosed as acute myocardial infarction. No case was included unless pre-infarction tracings were available indicating the absence of Q waves in III and aVF.

Seventy-eight patients were studied by the Frank electrode system.11 Vectorcardiograms were displayed on a Sanborn vector system and photographed with a Polaroid camera. Most of the loops were photographed at a standardization of 1 mv. = 5 cm. Time interval between “blips” was 0.0025 second.

In each case, measurements were made of the duration (milliseconds) and voltage (millivolts) of the superior and anterior forces. Additional voltages measured were the posterior forces and the leftward displacement of the superior forces. Figure 1 indicates, in diagrammatic fashion, the measurements made and the abbreviations used for identification. The rotational characteristics of the loops were also recorded.

A standard 12-lead electrocardiogram was obtained on each patient immediately after the vectorcardiogram. These tracings were reviewed with special attention to QRS changes of infarction, left ventricular hypertrophy, and conduction defects.

Table 1 presents a summary of the data obtained and is referred to frequently in the text.

Results and Discussion

The rotational characteristics of the frontal plane loops provided a convenient and fruitful approach to classification (fig. 2). Of the 78 cases, all but two displayed clockwise rotation of the efferent (outgoing) limb in the frontal plane, confirming previous observations.1 9 These 76 examples could be divided into two subgroups, depending on the remainder of the frontal plane loop. In 52 of the 76, clockwise rotation continued throughout the loop, producing a rather smooth, ovoid appearance. The remaining 24 frontal loops exhibited reversed, or counterclockwise, rotation of the afferent (returning) limb. This resulted in some degree of narrowing in the frontal plane, producing a “scimitar” appearance. The term “minor axis compression” was used by Milnor10 to describe this phenomenon while

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Table 1

Data on 76 Cases of Inferior Infarction with Clockwise Movement of Early QRS Forces in the Frontal Plane

<table>
<thead>
<tr>
<th>Group</th>
<th>No. cases</th>
<th>Months since infarction</th>
<th>Frontal rotation</th>
<th>Sagittal rotation</th>
<th>Superior forces</th>
<th>Anterior forces</th>
<th>Anterior forces equal or exceed posterior</th>
<th>Sagittal &quot;pollywog&quot; forces</th>
<th>Anterior infarction in V1-4 no. cases</th>
<th>Normal or QS 0.10 sec or more</th>
<th>Anterior infarction</th>
<th>High voltage frontal</th>
<th>High voltage precordial</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>29</td>
<td>38 (8-84)</td>
<td>CW</td>
<td>CW</td>
<td>31 (17-42)*</td>
<td>0.21</td>
<td>0.55</td>
<td>41 (15-57)</td>
<td>0.51 (1-1.2)</td>
<td>13 (4-1.2)</td>
<td>45 (37-57)</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>B</td>
<td>14</td>
<td>35 (8-72)</td>
<td>CW</td>
<td>CCW</td>
<td>31 (20-40)</td>
<td>0.23</td>
<td>0.66</td>
<td>29 (0-45)</td>
<td>0.19 (0-0.4)</td>
<td>0 (0-0.4)</td>
<td>0 (37-57)</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>C</td>
<td>9</td>
<td>40 (22-56)</td>
<td>CW</td>
<td>CCW</td>
<td>40 (27-50)</td>
<td>0.21</td>
<td>0.55</td>
<td>20 (0-32)</td>
<td>0.11 (0-0.3)</td>
<td>0 (0-0.3)</td>
<td>0 (37-57)</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>D</td>
<td>10</td>
<td>27 (6-58)</td>
<td>CW-CCW</td>
<td>CW</td>
<td>26 (15-32)</td>
<td>0.18</td>
<td>0.43</td>
<td>41 (32-60)</td>
<td>0.50 (25-1.3)</td>
<td>3 (4.1-3.4)</td>
<td>48 (40-60)</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>E</td>
<td>3</td>
<td>45</td>
<td>CW-CCW</td>
<td>Part. CCW</td>
<td>30</td>
<td>0.17</td>
<td>0.37</td>
<td>40 (0-32)</td>
<td>0.25 (0-1.1)</td>
<td>0 (0-1.1)</td>
<td>0 (47-52)</td>
<td>1</td>
<td>0</td>
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<tr>
<td>F</td>
<td>11</td>
<td>45 (19-60)</td>
<td>CW-CCW</td>
<td>CW-CCW</td>
<td>44</td>
<td>0.19</td>
<td>0.68</td>
<td>†</td>
<td>† (1.1-1.1)</td>
<td>† (1-1.1)</td>
<td>3 (1.1-1.1)</td>
<td>49 (47-52)</td>
<td>0</td>
</tr>
</tbody>
</table>

* Average values and extremes (in parentheses) are given when appropriate. CW, clockwise; CCW, counterclockwise; MS Sup., milliseconds superior; MV Sup., maximum leftward deviation of superior forces; LMV Sup., leftward displacement of superior forces; MV Ant., millivolts anterior; MS Ant., milliseconds anterior.
† Average and extreme values are not meaningful. See discussion of group-F cases.
‡ Reversed rotation in horizontal or posterior position of 0.02-second vector.
§ R<sub>3</sub> + S<sub>3</sub> greater than 25 mm. or R<sub>4</sub> + S<sub>4</sub> greater than 11 mm.
∥ R<sub>4</sub>, V<sub>5</sub>, or V<sub>6</sub> of 25 mm. or more.
the reversals in the returning portion alone have been called “bites,” “arcs,” and “mid-loop deformities.”\(^{1,2}\) The division of inferior infarction vectorcardiograms into two groups, based on the behavior of the afferent (returning) limb in the frontal plane was first proposed by Burch et al.\(^3\) and described more recently by Walsh et al.\(^6\)

In each case of the two major subgroups just described, the sagittal loop rotation was either clockwise, partially clockwise, or entirely counterclockwise, thus resulting in six categories based on rotational characteristics alone (fig. 2 A-F).

The measurements of MS Sup., LMV Sup. were reviewed for all 76 cases with clockwise efferent (outgoing) limbs in the frontal plane.

The superior forces had a duration (MS Sup.) of 25 milliseconds or more in 66 of the 76 cases (87 per cent). This corresponds well with data published by others\(^1,2,6,7\) and in our experience is the most reliable single indication of inferior infarction. An analysis of the magnitude of the leftward deviation of the superior forces (LMV Sup.) was also valuable. Young, using the double cube method, has described the leftward arching of the superior forces in the inferior infarction and has stated the normal value of the leftward deviation of the early QRS forces to be less than 0.13 millivolt.\(^4\) In 63 of our 76 cases (83 per cent) this measurement was 0.3 millivolt or more, and was 0.4 millivolt or more in 59 (78 per cent). Of the 13 cases with LMV Sup. of less than 0.3 millivolt, three had extensive anterior infarction with clockwise rotation in the horizontal plane. Only four patients had low values for both MS Sup. and LMV Sup. Stated another way, of 10 patients with inferior infarction and MS Sup. less than 25 milliseconds, six had LMV Sup. values of 0.3 millivolt or more. Of the 13 with inferior infarction not detectable by abnormal LMV Sup. values (0.3 millivolt or more), nine had MS Sup. values of 25 milliseconds or more.

Published data on the normal magnitude of frontal superior forces\(^13,14\) indicate that values up to 0.16 millivolt may be expected.

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Many of our inferior infarction cases have MV Sup. of less than 0.16 millivolt, despite obviously abnormal values for MS Sup. and LMV Sup. However, when all of the cases of inferior infarction having MV Sup. of 0.20 millivolt or more were reviewed, none was found to have MS Sup. of less than 0.3 millivolt. These observations have a negative value. That is, if inferior infarction is suspected because of superior forces of 0.2 millivolts or more (with corresponding Q waves in leads II, III, aV\textsubscript{F}, and orthogonal Y) the diagnosis is not secure unless MS Sup. is 25 milliseconds or more and LMV Sup. is 0.3 millivolt or more.

These considerations of the relative diagnostic importance of superior force duration, as compared with magnitude, confirm the long-established electrocardiographic evidence that the duration of Q waves has greater significance than the depth. Moreover, these observations suggest that Q waves with a duration of less than 0.04 second may be significant in the diagnosis of inferior infarction.

The data for LMV Sup. and MS Sup. are not easily obtained from scalar tracings recorded at 25 mm. per second. With higher paper speeds, the duration of superior forces can be approximated in leads F or orthogonal Y. In vectorcardiographic records, however, the measurement is easily made as diagrammed in figure 1.

**Group A (Figures 1 and 2, Table 1, Line A)**

This group of 29 cases displayed clockwise rotation of the entire QRS loop in both frontal and right sagittal planes. Thus, sagittal plane reversal must not be considered necessary for the diagnosis of inferior infarction.

The duration of superior forces (average: 31 milliseconds) corresponds well with the over-all figures and with previous studies of inferior infarction which emphasize the superior orientation of 0.02- and 0.03-second vectors. Attention is again called to the unreliability of the 0.01-second vector in diagnosing infarction. When this vector is inferior in position, an R wave is inscribed in leads III, aV\textsubscript{F}, and orthogonal Y, making the

![Figure 2]

*Distribution of 78 cases of inferior infarction according to rotational characteristics of frontal and right sagittal plane loops.*

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Electrocardiogram and vectorcardiogram of 57-year-old man 37 months after inferior infarction. Maintenance of clockwise rotation in frontal and right sagittal loops places the case in group A. The anterior forces measure 0.9 millivolt, exceed the posterior forces, and have a duration of 40 milliseconds. The 0.01 vector is inferior, producing small R waves in III and aV₆. High voltage in the precordial leads, V₁-V₆. Posterior infarction, as well as inferior, is indicated.

electrocardiographic diagnosis difficult (fig. 3). Yet the rotational characteristics and duration of superior clockwise forces establish the diagnosis. Cases of this kind were rare in our series owing to the requirement for inclusion of Q waves in leads III and aV₆.

Prominence or preservation of anterior forces was characteristic of cases in group A (fig. 4). In 13 instances, the anterior forces were equal to or exceeded the posterior forces. In this subgroup, the average duration of anterior forces was 45 milliseconds and magnitude of anterior forces averaged 0.72 millivolt.

High voltage in the left precordial electrocardiographic leads was noted in five group-A cases, yet none of these exhibited frontal plane criteria for left ventricular hypertrophy. Presumably the high voltage observed resulted from the leftward, as well as anterior, position of the early forces. Of the 13 cases with presumed complicating posterior infarction, 10 exhibited largely leftward anterior forces, while in two leftward and rightward forces were equally prominent.

Noteworthy was the low incidence of anterior disease or left ventricular enlargement in group A. No case displayed QRS changes of anterior or lateral infarction, and in only one was high voltage in the frontal plane leads observed. Electrocardiographic records were considered normal or borderline in six instances. Considering the long interval between acute infarction and vectorcardiographic study, such cases were anticipated. Four of these six fell into the presumed posterior involvement group, with anterior forces equal to or exceeding posterior forces. Thus, it is possible that subsequent or concomitant posterior wall disease obscured the electrocardiographic picture of old inferior infarction in these cases. Despite the normal or equivocal electrocardiograms in these six cases, MS Sup. exceeded 25 milliseconds in

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three, and LMV Sup. was 0.5 millivolt or more in four. In only one of the six, were all vectorcardiographic measurements within normal range. These results confirm those of others that the vectorcardiogram may be abnormal in the presence of a normal or borderline electrocardiogram and extend these observations to include cases studied as long as 7 years after the infarction.

**Group B (Figure 2, Table 1, Line B)**

The 14 group-B cases displayed clockwise rotation in the frontal plane and counterclockwise rotation of part of the sagittal loop. Inspection of line B of table 1 reveals striking differences from group A in that the incidence of anterior disease and left ventricular enlargement is sharply increased. Although high voltage of the left precordial leads was not observed in this group, four of the 14 cases displayed high voltage in the frontal plane leads. In two cases QRS changes of anterior or lateral infarction were noted. In four additional cases in group B, very small anterior forces were noted in the horizontal plane with a posterior position of the 0.02-second vector, suggesting anterior infarction in these cases.5, 7, 8, 15-17 Thus, of the 14 cases in group B, 10 had evidence of either anterior disease (fig. 6) or of left ventricular enlargement (fig. 5). It seems clear that even partial reversal of rotation in the sagittal plane, when the frontal loop is entirely clockwise, is strong evidence for associated anterior disease or left ventricular enlargement. The mechanism in either case is probably that of simple reduction in the relative magnitude of early anterior forces.

The values for MS Sup. (31 milliseconds) and MV Sup. (0.23 millivolt) were strikingly similar to group-A cases. The values for LMV Sup. (average: 0.66 millivolt) were higher, perhaps due to the inclusion of the four cases with presumed left ventricular enlargement.

**Figure 4**

Electrocardiogram and vectorcardiogram of a 43-year-old man 75 months after inferior infarction. The completely clockwise frontal and right sagittal loops place the case in group A. The anterior forces measure 0.6 millivolt, exceed the posterior forces, and have a duration of 47 milliseconds, indicating the presence of complicating posterior infarction.

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The high values for LMV Sup. indicate that leftward deviation of the early portion of the loop occurs in the absence of prominent anterior forces as noted in group A. Thus, since LMV Sup. was high independently of the magnitude of anterior or posterior forces, the measurement assumes added validity as a residual of inferior infarction alone. Clearly the leftward displacement of the superior forces indicates that loss of rightward, as well as inferior, forces occurs with uncomplicated inferior infarction. Indeed, such leftward displacement may be anticipated.

**Group C (Figure 2, Table 1, Line C)**

These nine cases all displayed complete or almost complete reversal of the QRS loop in the sagittal projection but maintained clockwise rotation throughout the frontal plane. The data in table 1, line C, indicate an even longer average duration of superior forces (40 milliseconds) than in groups A and B but about the same magnitude of superior forces (0.21 millivolt).

Evidence for anterior or lateral disease was found in all nine cases. In four, the QRS changes were evident. Three displayed clockwise rotation in the horizontal plane. In six, the 0.02-second vector in the horizontal was abnormally posterior, and in three, gross mid-loop deformities consistent with anterior or lateral disease were present (figs. 7 and 8). Thus, all cases of group C have evidence for concomitant anterior or lateral infarction. In no case did the frontal plane leads display high voltage, and in no case did anterior forces equal or exceed posterior forces.

The results in groups B and C, taken together, generally confirm Hugenoldt’s observations on the significance of sagittal plane reversal in inferior infarction.1, 2 Even when incomplete, sagittal reversal is strong evidence for concomitant left ventricular enlargement or anterior infarction. *Most important, our observations suggest that sagittal reversal*

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*Figure 5*

Electrocardiogram and vectorcardiogram of a 51-year-old man 13 months after inferior infarction. Clockwise rotation throughout the frontal plane and partial reversal in the sagittal plane place the case in group B. High voltage QRS complexes in the frontal plane leads indicate complicating left ventricular enlargement.
has great significance in the presence of a completely clockwise frontal loop.

Groups A, B, and C were characterized by an entirely clockwise frontal loop. In contrast, groups D, E, and F present counterclockwise movement of the returning limb in the frontal plane, with upward bowing of this late segment. Observations on the latter groups now follow. In these 24 cases, sagittal plane reversal has different significance than was pointed out for groups B and C with completely clockwise frontal loops.

**Group D (Figure 2, Table 1, Line D)**

In this group of 10 cases, the frontal loops exhibited reversal of the afferent (returning) limb, producing a narrowed or “scimitar” effect. Clockwise rotation was maintained in the sagittal plane although the minor axis of the sagittal loops was often narrowed.

The combination of well-preserved anterior forces with an upward bowing of later forces resulted, in six of 10 cases, in a “pollywog” appearance of the right sagittal loop (figs. 9 and 10). In three of these six cases, anterior forces were equal to or exceeded posterior forces. In these three cases, presumably with posterior involvement, the duration (48 milliseconds) and magnitude (0.76 millivolt) of the anterior forces were strikingly similar to corresponding values for group-A cases with presumed posterior as well as inferior infarction.

Group D had the highest incidence of normal or borderline scalar electrocardiograms (five of 10 cases). In one of these, the characteristic sagittal “pollywog” was present, as well as a typical value (0.4 millivolt) for LMV Sup. In another, MS Sup. was 30 milliseconds and anterior forces (0.6 millivolt) were five times the posterior forces. However, in the remaining three cases, quantitative vectorcardiographic evidence for infarction was lacking. Of the three groups (D, E, F) with late mid-loop

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**Figure 6**

Electrocardiogram and vectorcardiogram of a 40-year-old man 12 months after inferior infarction. The clockwise rotation throughout the frontal plane and the partial reversal in the sagittal plane place the case in group B. The 0.02-second vector in the horizontal plane is posterior, suggesting the presence of complicating anterior infarction.
deformities in the frontal plane, group D was thus alone in exhibiting decreased abnormalities of MS Sup. and LMV. Sup. In such cases the clue to the diagnosis of inferior infarction may be the sagittal “pollywog” or the general configuration of the frontal plane loop.

**Group E (Figure 2, Table 1, Line E)**

Group E cases, only three in number, displayed reverse rotation of the returning limb in the frontal plane, but only partial reversal in the sagittal. One of these cases displayed a “pollywog” sagittal loop (fig. 11), but in none were anterior forces equal to or in excess of posterior forces.

Unlike group B, in which partial sagittal reversal was associated with a high incidence of anterior disease and left ventricular enlargement, no case in group E presented such associated findings. Although the group is small, this suggests, that in the presence of upward bowing of the returning limb in the frontal plane, partial reversal in the sagittal may not indicate associated anterior disease or left ventricular enlargement. Stated another way, reversed rotation in the sagittal plane may be the result of abnormal late superior forces alone.

**Group F (Figure 2, Table 1, Line F)**

Group F comprises 11 cases in which reversal of the returning frontal limb was associated with complete or almost complete sagittal reversal. No other group in this material contained obvious examples of both anterior and posterior disease complicating the inferior infarction. In five of these 11 cases, vectorcardiographic evidence for anterior infarction was present, and in two additional cases left ventricular enlargement was diagnosed according to the frontal plane voltage criteria. Presumably when inferior infarction has reversed the direction of the afferent (returning) limb in the frontal plane, due to decreased inferior forces in the second half of the QRS cycle, the additional loss of early

*Electrocardiogram and vectorcardiogram of a 55-year-old man 43 months after inferior infarction. MS Sup., 50. The frontal loop is entirely clockwise and the sagittal completely reversed, placing the case in group C. The horizontal loop exhibits clockwise rotation with marked posterior position of the 0.02-second vector, establishing the presence of anterior infarction in addition to the inferior infarction. LMV Sup., 0.70.*

*Figure 7*
anterior forces due to infarction or left ventricular hypertrophy may result in major sagittal reversal. This is in contrast to cases in group B. In these, without late mid-loop frontal deformities, left ventricular hypertrophy or anterior infarction commonly resulted in only partial sagittal reversal. Thus, when inferior infarction deforms both efferent (outgoing) and afferent (returning) frontal limbs, associated anterior disease or left ventricular hypertrophy results in major reversal in the sagittal reference plane.

Three cases in group F presented anterior forces equal to or greater than posterior forces, presumably due to concomitant posterior infarction. In all three, the sagittal reversal was produced by a markedly superior position of the afferent (returning) limb. Figure 12 illustrates this point well. Apparently reversal in the sagittal plane, in these cases, was produced by the mid-loop effects of concomitant inferior infarction. In our experience partial or complete sagittal reversal with inferior infarction occurs in one of three situations. These are complicating anterior or lateral infarction (fig. 13), left ventricular enlargement (fig. 5), or marked upward displacement of the mid-loop resulting from inferior infarction (fig. 12). Others have reported sagittal reversal by virtue of a markedly anterior afferent (returning) limb in posterior infarction. Such loops were not observed in any group of the present study, which included 19 examples of presumed inferoposterior combinations (groups A, D, and F).

In three instances of large anterior forces noted in group F the quantitative data for MV Ant. (0.76 millivolt) and MS Ant. (49 milliseconds) were again strikingly similar to data for comparable cases in groups A and D. No instances of borderline or normal electrocardiograms were found in group F. Indeed, the high average values of MS Sup. (44 milliseconds) and LMV Sup. (0.68) led to wide

![Figure 8](http://circ.ahajournals.org/)

Electrocardiogram and vectorcardiogram of a 36-year-old man 31 months after inferior infarction. The completely clockwise frontal with almost complete sagittal reversal places the case in group C. Abnormal Q waves are evident in V, and V, and a large lateral mid-loop deformity is present in the horizontal loop, indicating the presence of lateral infarction in addition to inferior. MS Sup., 42; MV Sup., 0.37.

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Conduction Defects

Large Anterior Case in Intraventricular and Deep Electrocardiographic Defects

Electrocardiogram of a 44-year-old man 31 months after inferior infarction. Reversal of the afferent (returning) limb in the frontal plane with maintenance of normal rotation in the sagittal plane place the case in group D. The preservation of anterior forces with posterior narrowing produces the "pollywog" effect. MS Sup., 30; LMV Sup., 0.8.

and deep Q waves in leads III and aVF, so that no difficulty was experienced in making the electrocardiographic diagnosis of inferior infarction.

Conduction Defects

Of the 76 cases in groups A through F, 23 had intraventricular delay indicated by QRS time of 0.10 second or more and terminal slowing in the vectorcardiogram. The incidence of conduction defects was much more frequent in groups D, E, and F (11 of 24 cases) than in groups A, B, and C (12 of 52 cases). Groups D, E, and F include those cases in which inferior infarction caused mid-loop (afferent limb) deformities. Thus, upward bowing (mid-loop deformity) in the frontal plane and conduction defects are associated in many cases resulting in the picture of peri-infarction block. 18

Large Anterior Forces

In the entire series, 19 examples of anterior forces equal to or exceeding posterior forces were encountered (13 in group A, three each in groups D and F). Presumably these patients had complicating posterior infarction. The vectorcardiogram has found one of its chief applications in the diagnosis of posterior (dorsal) infarction. 6-8, 19-21 All observers agree on the prominent duration and magnitude of anterior forces, but quantitative data are few. In the 19 cases presumed to have posterior infarction, anterior forces averaged 0.73 millivolt, the range being 0.4 to 1.3. The duration of anterior forces averaged 46 milliseconds, the range being 37 to 60 milliseconds. The normal positions for the 0.02-, 0.03-, and 0.04-second vectors have been stated by several authors. 7, 22-24 In Forkner's series of 60 normal subjects it is of interest that 10 had 40-millisecond vectors at or anterior to the 0 to 180° axis in the horizontal plane. We have commonly encountered cases with anteriorly placed 40-millisecond vectors who did not
Figure 10
Electrocardiogram and vectorcardiogram of a 48-year-old man 12 months after inferior infarction. Reversal of the afferent (returning) frontal limb and maintenance of clockwise rotation in the sagittal plane place the case in group D. Preservation of anterior forces results in the sagittal “pollywog.” Right and posterior conduction defect is also present.

Figure 11
Electrocardiogram and vectorcardiogram of a 54-year-old man 47 months after inferior infarction. Counterclockwise rotation of the afferent (returning) frontal limb with partial sagittal reversal places the case in group E. Preservation of anterior forces results in the sagittal “pollywog.” Posterior, inferior conduction defect is also present.

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Figure 12
Electrocardiogram and vectorcardiogram of a 49-year-old man 36 months after inferior infarction. Reversal of the (returning) limb in the frontal plane and complete sagittal reversal place the case in group F. The anterior forces are 1.1 millivolts, greatly exceed the posterior, and have a duration of 52 milliseconds, indicating the presence of complicating posterior infarction.

Figure 13
Electrocardiogram and vectorcardiogram of a 62-year-old woman 58 months after inferior infarction. The counterclockwise rotation of the afferent (returning) limb in the frontal plane and the complete sagittal reversal place the case in group F. The posterior location of the 0.02 vector indicates complicating anterior infarction.
display anterior forces equal to or exceeding posterior forces. Klajman et al.20 and Young et al.21 have given data for the magnitude of anterior forces in normal subjects, with use of the cube system, but similar figures for the Frank system, which may accentuate anterior forces, have not been presented.

A consideration of the 19 cases, presumed to have posterior involvement, indicates that, in 14 of the 19 (74 per cent), the horizontal loop remained anterior to the 0-180° axis for 45 milliseconds or more. In these 14 cases, the anterior forces were always 0.5 millivolt or more. In 16 of the 19 cases (84 per cent) the anterior forces were 0.5 millivolt or more. When the duration of anterior forces of these 16 was reviewed, it was noted that in only three cases was this duration less than 45 milliseconds. Thus, anterior forces of 0.5 millivolt or more which are equal to or exceed the posterior forces and which have a duration of 45 milliseconds or more suggest coexisting posterior infarction. The significance of large anterior forces but even larger posterior forces remains to be explored.

Summary

Seventy-eight patients with well-documented inferior infarction were studied by the Frank vectorcardiographic technic.

The commonest residual was superior and leftward orientation of the early forces that moved clockwise in the frontal projection.

Quantitative data on the duration, magnitude, and leftward sweep of these forces are presented.

In 52 cases, the entire frontal loop was clockwise. When sagittal loop reversal, partial or total, occurred in this group, a high correlation with associated anterior infarction or left ventricular enlargement was noted.

In 24 patients, the returning frontal limb was deformed due to upward bowing. When anterior forces were well preserved in the presence of this deformity, a characteristic "pollywog" shape in the sagittal loop resulted.

Conduction defects were twice as common in the cases with mid-loop frontal deformity as in the cases without such defects.

Anterior forces of prominent voltage and prolonged duration were noted in 19 cases. Quantitative data on these cases, presumably reflecting associated posterior infarction, are presented.

The vectorcardiographic residua of inferior infarction may be classified according to rotational characteristics of the frontal and sagittal loops. Classification may be of value in providing clues to associated anterior disease, left ventricular enlargement, and conduction defect.

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References

The Scientific Attitude

Even if it is admitted that opposition towards ideas is an attitude of mind not best calculated to extract what value they may contain, we are apt to be told that the true scientific position is that of the famous 'suspense of judgement.' It cannot, however, be conceded that even this time-honoured phrase represents an attitude quite free of the defensive taint. The truly scientific mind is altogether unafraid of the new, and while having no mercy for ideas which have served their turn or shown their uselessness, it will not grudge to any unfamiliar conception its moment of full and friendly attention, hoping to expand rather than to minimize what small core of usefulness it may happen to contain. It is this capacity in scientific workers for what we may call provisional acceptance that encourages in science the steady flow of ideas and tends to preserve it from those periods of intellectual languor to which, as we have seen, the purely experimental sciences seem in some degree to be prone.—The Collected Papers of Wilfred Trotter, F.R.S. London, Oxford University Press, 1946, p. 123.
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