Prognosis of Men Returning to Work after First Myocardial Infarction

By GEORGE E. DIMOND, M.D.

THE PROGNOSIS after the first myocardial infarction is usually based on those living for 1 or 2 months beyond the acute attack. This paper is to report the prognosis of 202 railway operating employees who returned to full-time work following their first myocardial infarction.

Cole and associates\(^1\) found that of 285 patients who lived more than 2 months after their initial infarction, 66 per cent survived 5 years and 43 per cent 10 years. In a similar study Weiss and Gray\(^2\) reported on 484 patients and 61 per cent lived 5 years. Weiss\(^3\) followed 211 cases 10 years or more: 60 per cent lived 5 years and 37 per cent 10 years. Honey and Truelove\(^4\) reporting 348 cases indicated 61 per cent 5-year and 32 per cent 10-year survival rates. Juergens and associates\(^5\) found that of 224 patients who survived 1 month following the initial attack, 55 per cent lived 5 years and 29 per cent 10 years.

Authors agree that those patients capable of returning to full-time activity after the initial infarct have the better prognosis. Fifty-nine of the 285 patients reported by Cole and associates\(^1\) returned to full activity and 71 per cent lived 10 years or more. Seventy-one of those followed by Juergens and associates\(^5\) returned to complete activity and 73 per cent lived 5 years. In a 5-year follow-up of 431 men returning to some form of gainful employment after their initial myocardial infarction, Weiss and Weiss\(^6\) found that 22 per cent were dead and an additional 11 per cent had retired.

Material and Methods

Coronary artery disease among operating personnel became a major concern of the New York Central Railroad Medical Department during 1935 to 1940. A study of 1,000 consecutive deaths in operating personnel indicated that 22 per cent of these deaths were clinically attributable to coronary heart disease. An increasing number of men who survived their initial myocardial infarction were applying for return to service in the operating division. It was the practice of the medical director to return these men to work, if functional recovery was good, but engineers were removed from passenger service and restricted to yard work. Some of these restricted engineers, having worked a few years in the yard without further disability, were demanding restoration of their road rights.

The medical director in 1940 initiated a series of discussions among the chief surgeons of the railroad and consulting cardiologists, concerning the problem of coronary artery disease in operating train personnel. A system-wide policy resulted from these discussions and stipulated that men applying for return to service after having a myocardial infarction were to be examined by an internist. If this examination indicated a good functional recovery, the man was returned to work and re-examined periodically. Engineers were routinely and permanently restricted to yard service after a myocardial infarction. This policy has been followed since 1940.

Two hundred and two men were selected for this study. Characteristic electrocardiograms, a definite clinical history, and date of onset of the first infarct were requirements. Those with co-existent valvular heart disease were excluded. The period during which the first myocardial infarction occurred was between July 1, 1940, and July 1, 1955. All men were followed to July 1, 1960. Ninety-seven of the 202 men had their initial infarct between July 1, 1940, and July 1, 1950, and are the basis of the 10-year survival rates.

All men had been given pre-employment examinations and routine periodic examinations after their employment. These records gave information concerning health prior to the initial myocardial infarction.

With the exception of engineers the majority of these employees returned to their usual work. Many took easier assignments in accordance with the seniority rules.

Causes of death were based on reports from attending physicians, death certificates, and records of The National Railroad Retirement Board. A number of these deaths were sudden or relatively sudden, and the diagnosis of recurrent myocardial infarction on the death certificate was

\(^{1}\) From the Medical Department, New York Central Railroad, Detroit, Michigan.

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possibly based only on history. Necropsy data on patients dying within minutes or a few hours after an episode of chest pain may fail to reveal a recurrent infarction, and it is assumed that death is due to myocardial ischemia that initiates a fatal cardiac arrhythmia. In this report those dying suddenly are included in the group described as having second clinical infarctions.

Results
At the conclusion of the period of observation on July 1, 1960, 118 men were living and 84 were dead. The average survival time to date is 8 years. Seventy-three men are still actively employed, having had their initial infarct at an average age of 51. Fifty men who incurred their first infarct at average age of 60 retired in the usual manner between ages 65 and 70. Thirty-nine men returned to work and subsequently retired on disability pension before reaching age 65. Forty men died while still actively employed and these men survived an average of only 4 1/2 years after the initial infarction.

One hundred sixty-eight men (83 per cent) survived 5 years. During the first 5 years after the initial infarct 49 men sustained a second clinical infarction. Sixteen men although living at the end of 5 years, had medically retired before age 65 for cardiac causes. Included in this group are seven who retired following a second infarction and the remainder retired because of incapacitating angina or myocardial failure. At the end of 5 years 17 per cent of the 202 men were dead, 24 per cent had sustained a second clinical infarct, and in addition to these dead 8 per cent were totally disabled by cardiac disease.

The 5-year survival rates for the 97 men followed 10 years or more were the same as for the total group. Fifty-seven per cent lived 10 years or longer. During the 10 years after the initial infarct 45 per cent had a second clinical infarction. Eight per cent of the men, although living past 10 years, were totally disabled by cardiac disease.

The causes of 84 deaths are listed in table 1. Sixty-five per cent of the deaths were due to second or third clinical myocardial infarctions. Recurrent myocardial infarction or a sudden type of cardiac death are the most common causes of death in men who survive the initial infarction.

Juergens and associates found that myocardial failure without second infarction was the cause of death in 21 per cent of 79 cases at necropsy. Only 10 men in this series died of myocardial failure. Five of these survived a second myocardial infarction by 2 months or more but subsequently died of myocardial failure.

Eighty-two second clinical myocardial infarctions have occurred in this series to date. Thirty-six survived, giving a mortality rate for the second infarct of 56 per cent. Cole and associates found that during the first 5 years after the initial infarction a second episode was fatal in 87 per cent, and in those surviving beyond 5 years the second infarct was fatal in 70 per cent. Of the 36 men who lived following the second infarction, 10 retired and 26 returned to full-time railroad employment. Twelve men who survived their second infarct subsequently had a third, and only one survived the third infarction.

The yearly incidence of second clinical myocardial infarctions five years after initial infarction is given in table 2.

**Table 1**

<table>
<thead>
<tr>
<th>Cause</th>
<th>Number</th>
<th>Number (65%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recurrent clinical myocardial infarction</td>
<td>55</td>
<td>55 (65%)</td>
</tr>
<tr>
<td>Myocardial failure</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Malignancy</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Cerebral vascular accident</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Unknown</td>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>

**Table 2**

<table>
<thead>
<tr>
<th>Years after onset of initial infarct</th>
<th>Number of surviving second infarct</th>
<th>Number of fatal second clinical infarcts</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>8</td>
<td>13</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>5</td>
<td>7</td>
</tr>
</tbody>
</table>

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myocardial infarctions occurring in the first 5 years after the initial attack is given in table 2. With some yearly fluctuations, 5 percent of the second clinical infarcts occurred annually. During the first 3 years after the initial infarct less than one third of the second infarcts were fatal. This is in contrast to the prognosis described for those surviving their initial infarct by 1 or 2 months in whom the first and second years accounted for the greatest number of deaths.4

Younger patients have been observed to survive for longer periods after the first infarct.1,5 This better prognosis is not evident when the normal life expectancy of the different age groups is considered. Honey and True-love4 indicated that the chance of death in patients over 60 making a good recovery from the initial infarction was about the same as that of the general population over 60. In those under 60 the mortality rates were approximately 3 times the normal expectations within 5 years after the first infarction. This increased mortality rate was almost entirely due to recurrent myocardial infarction.

In this study the average age at the time of the initial infarct was 55 years. Sixty-eight percent of the men were under 60 and none was over 70. The 5-year and 10-year prognosis in relation to age is indicated in tables 3 and 4. The differences are not of statistical significance. Younger men are more likely to sustain a second infarction and older men are less likely to survive 10 years or more, being more subject to death from noncardiac causes.

Table 3
Five-Year Prognosis in Relation to Age at Initial Infarction

<table>
<thead>
<tr>
<th>Age at onset, years</th>
<th>Total</th>
<th>Lived 5 years or more</th>
<th>Had second clinical infarct within 5 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>30-39</td>
<td>7</td>
<td>7 (100%)</td>
<td>2 (28%)</td>
</tr>
<tr>
<td>40-49</td>
<td>44</td>
<td>36 (82%)</td>
<td>13 (29%)</td>
</tr>
<tr>
<td>50-59</td>
<td>105</td>
<td>89 (85%)</td>
<td>25 (24%)</td>
</tr>
<tr>
<td>60-69</td>
<td>46</td>
<td>36 (80%)</td>
<td>9 (20%)</td>
</tr>
</tbody>
</table>

Table 4
Ten-Year Prognosis in Relation to Age at Initial Infarction

<table>
<thead>
<tr>
<th>Age at onset, years</th>
<th>Total</th>
<th>Lived 10 years or more</th>
<th>Had second clinical infarct within 10 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>30-49</td>
<td>25</td>
<td>17 (68%)</td>
<td>11 (44%)</td>
</tr>
<tr>
<td>50-59</td>
<td>47</td>
<td>25 (53%)</td>
<td>24 (51%)</td>
</tr>
<tr>
<td>60-69</td>
<td>25</td>
<td>12 (48%)</td>
<td>9 (36%)</td>
</tr>
</tbody>
</table>
likely to make a good functional recovery. The location of the initial infarct had no influence on the 5-year prognosis.

Electrocardiographically 164 initial infarcts were transmural and 38 were subendocardial. Cole and associates found a better prognosis for long-term survival in people with subendocardial infarction. In this series the survival rates and the incidence of recurrent clinical infarctions at the end of 5 years are the same for both groups.

Twenty-eight men had cardiac enlargement, confirmed by chest x-ray or fluoroscopy, on return to service following the first infarct. Cardiac enlargement after the initial myocardial infarction had an adverse effect on the 5-year prognosis.

During the period of this study 51 men were examined following their initial myocardial infarction and advised to retire. The average age of these men was 59 years. The majority had angina pectoris or myocardial damage which precluded return to a vigorous occupation. Only 28 (55 per cent) of these men lived 5 years or more.

**Discussion**

It should be emphasized that the men in this study are a highly selected group. Prior to their initial myocardial infarction they had a pre-employment examination and routine periodic examinations. These examinations largely eliminated diabetes, severe hypertension, and gross obesity as factors in this study.

The prognosis for men able to return to work is better than that for those retiring. This better prognosis is due in part to a lesser incidence of myocardial failure and a better ability to survive a second infarction. Weiss and Weiss indicated that sudden or relatively sudden death occurred in 25 per cent of their patients who died following return to work. Twenty-four per cent of the patients in this series were subject to recurrent clinical infarctions within 5 years. These figures emphasize the necessity of restriction to work where sudden death or disability will not be hazardous to others.

The time elapsed after the initial infarction cannot be regarded as a factor in freedom from future myocardial infarcts. Of the second clinical infarcts, 44 occurred in the 97 cases followed 10 years, 23 in the first 5 years and 21 in the second 5 years. The second clinical infarcts during the first 5 years were fatal in 52 per cent and the infarcts in the second 5 years were fatal in 80 per cent.

Some factors adversely influence the prognosis following the first myocardial infarction.

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**Table 5**

*Five-Year Prognosis in Relation to Hypertension, Obesity, Location and Extent of Initial Infarct, and Cardiac Enlargement after Initial Infarct*

<table>
<thead>
<tr>
<th>Factor</th>
<th>Alternatives</th>
<th>Total</th>
<th>Lived 5 years or more</th>
<th>Had second clinical infarct within 5 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension prior to infarct</td>
<td>Present</td>
<td>50</td>
<td>38 (76%)</td>
<td>17 (34%)</td>
</tr>
<tr>
<td>Overweight prior to infarct</td>
<td>Absent</td>
<td>152</td>
<td>130 (88%)</td>
<td>32 (21%)</td>
</tr>
<tr>
<td>Location of initial infarct</td>
<td>Anterior</td>
<td>63</td>
<td>70 (84%)</td>
<td>21 (25%)</td>
</tr>
<tr>
<td>Extent of initial infarct</td>
<td>Transmural</td>
<td>164</td>
<td>136 (83%)</td>
<td>39 (24%)</td>
</tr>
<tr>
<td>Cardiac enlargement after initial infarct</td>
<td>Present</td>
<td>28</td>
<td>20 (71%)</td>
<td>12 (43%)</td>
</tr>
</tbody>
</table>

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*DIMOND*

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The prognosis is subject, however, to the well-known, bizarre, and unpredictable nature of the disease. Authors\(^1\)\(^,\)\(^6\) agree that no single physical finding or test can be a prognostic guide. Pending better methods to estimate the efficiency of the coronary circulation, prognosis can be best judged by the degree of functional recovery.

Periodic examinations are of no value in predicting the occurrence of the second infarct. Re-examinations are of value in detecting the earlier evidences of myocardial failure, the symptoms and electrocardiographic signs of increasing myocardial ischemia, and in controlling factors that adversely effect the prognosis.

None of the men reported in this series was treated with anticoagulants following the first infarct. Four men now working following their second infarct are taking anticoagulants.

**Summary**

The 5-year prognosis of 202 railway operating employees returning to full-time work after their initial myocardial infarction and the 10-year survival rates of 97 of these men have been described. The 5-year survival rate was 83 per cent and the 10-year survival rate was 57 per cent.

Twenty-five per cent of these men died or were totally disabled at the end of 5 years and 50 per cent at the end of 10 years. The cause of death or disability following the initial infarction was largely due to recurrent myocardial infarction.

The prognosis for men returning to full-time activity after the first myocardial infarction is better than that reported for those surviving without consideration for their functional recovery. This better prognosis is not due to freedom from second infarctions but to a decreased incidence of myocardial failure and the ability better to survive and tolerate a second infarction.

**References**


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**Introspection**

Perpetual self-inspection leads to spiritual hypochondriasis.—OLIVER WENDELL HOLMES, M.D. *Pages from an Old Volume of Life*, 1883.
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