Mortality Study of the Significance of Extrasystoles in an Insured Population

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SUMMARY
The prognostic significance of extrasystoles was evaluated in 712 insured persons with this finding who were followed for an average period of 18 years. At the end of the study 356 persons were alive and 125 were dead. Two hundred and thirty-one persons had terminated their policies at a prior date by maturity or discontinuance and were not followed further. Although the lack of follow-up to 1968 of this latter group imposes limitations on the results and conclusions of the study, their exclusion resulted in no significant change in the mortality ratio of the remaining group of 481 persons followed to death or the anniversary of their policies in 1968.

The observed mortality ratios showed no appreciable increase in a group of 604 individuals who were considered to have a normal life expectancy except for the presence of extrasystoles at the time of evaluation for insurance. Similar normal mortality ratios were observed in subgroups with simple and complex supraventricular and ventricular extrasystoles. There was no appreciable difference in mortality when those under 40 and those 40 years of age and over at the time of discovery of extrasystoles were compared. There was no significant difference in mortality between those who responded to exercise with an increase in the number of extrasystoles and those who had no change or a decrease immediately after exercise. An increase in the number of extrasystoles per minute was associated with an increase in mortality. There was a low incidence of sudden death among those with supraventricular extrasystoles.

Ventricular extrasystoles, particularly those of complex types, were associated with a high incidence of death from myocardial infarction, often of a sudden nature, particularly in persons under the age of 50 years. There were too few cases of the individual types of complex ventricular extrasystoles to determine whether this was a characteristic of the group as a whole or of one or more of its constituent types. Ventricular extrasystoles in the presence of other cardiac abnormalities and/or elevation of the blood pressure were associated with an increase in mortality. The mortality experience in such persons was distinctly higher than in those with similar degrees of substandard expected mortality whose abnormalities were not of a cardiovascular nature.

Additional Indexing Words:
Mortality ratio    Simple extrasystole    Standard risk
Complex extrasystole Substandard risk Myocardial infarction T wave

CONSIDERABLE interest has attended a number of recent reports that follow-up studies of persons with ventricular premature beats show a heightened incidence of sudden death. This, together with recognition of the great frequency of ectopic ventricular beats in monitored patients with acute myocardial


Received March 29, 1971; revision accepted for publication June 7, 1971.
infarction and their significance as harbingers of the more serious arrhythmias of ventricular tachycardia and fibrillation, has raised further question whether ventricular premature beats are as benign as has been generally considered.

The study herewith reported extends an investigation of the significance of extrasystoles among an insured population reported in 1941, updating and extending this material, which at that time did not allow conclusion as to mortality, although 1,142 persons with extrasystoles were studied, because of the paucity of deaths.\(^1\) In brief, it was found then, and the findings are confirmed in this study, that ventricular extrasystoles are much more frequent than supraventricular extrasystoles. The present study documents that mortality experience in persons with atrial and other supraventricular extrasystoles is normal. What has not been previously investigated, and is shown by the data of the present study, is that mortality experience of persons with ventricular extrasystoles as an isolated finding likewise is relatively normal.

**Methods**

This study is based on 712 individuals insured by the Equitable Life Assurance Society of the United States between 1930 and 1956 in whom one or more extrasystoles were found in the electrocardiogram. Six hundred and four persons were considered standard risks for insurance, that is, having a normal life expectancy if extrasystoles had been absent. One hundred and eight persons were considered substandard risks for insurance, that is, having a decrease in life expectancy of up to approximately 7 years due to other abnormalities even if the extrasystoles had been absent. The persons were selected from approximately 30,000 individual applicants for insurance between 1930 and 1956 in whom one or more electrocardiograms had been reviewed in the Home Office Medical Department.

The following data were recorded: age at time of discovery of extrasystoles, age at time of examination for insurance, pulse rate, number of extrasystoles per minute, abnormalities other than extrasystoles, cause of death, and duration of the terminal illness as recorded on the death certificate. In the great majority of persons, the electrocardiogram with extrasystoles was recorded on the day of examination for insurance or within a short interval of time thereafter.

The persons in the study were observed from the year the electrocardiogram was recorded to the anniversary of this date in 1968 if they were alive or the year of termination of the policy by death, maturity, or discontinuance prior to this date. Thirty-one of the persons were declined for insurance; they were followed in an identical manner as the other 681 persons through policies previously issued to them by the Society. No attempt was made to follow up persons whose policies were terminated for reasons other than death. At the end of the study 356 persons were alive, 125 were dead, and 231 had terminated their insurance policies at a prior date by maturity or discontinuance. The duration of observation ranged from a minimum of 1 year to 45 years, resulting in 12,900 exposure years, an average of 18 years per person.

The group was made up almost completely of men. The age range at the time of admission to the study was from 17 to 65 years. Twenty-five persons were under 24 years, 178 were 25 to 35 years, 258 were 35 to 45 years, 190 were 45 to 55 years, and 61 were 55 through 65 years of age at this time.

Actuarial principles were applied in the computation of the expected number of deaths by means of the Male Intercompany 1955–1960 Basic Select Tables and the Male Intercompany 1957–1960 Basic Ultimate Tables. These tables were compiled from data supplied by the 16 largest insurance companies in the United States.* The mortality of the insurance applicants is

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*In effect, persons insured by the insurance industry constitute the control groups for the computation of the expected number of deaths. They consist of: (a) persons who had been insured at standard rates for not more than 15 years and whose mortality was observed between 1955 and 1960 for each age and duration of exposure (the Male Intercompany 1955–1960 Basic Select Tables); and (b) persons who had been insured at standard rates at least 15 years prior to their entry into the period of observation, 1957 to 1960 (the Male Intercompany 1957–1960 Basic Ultimate Tables). In the second group, any effects of the initial medical examination in lowering mortality during the early policy years are no longer present and the rate of mortality becomes a function of the person's attained age. Thus, expected deaths were calculated for cohorts similar in age distribution and length of follow-up to the entrants presented in the various tables.

As a substantial portion of the exposure in this series occurred between 1930 and 1955, when mortality rates were higher than in the 1955 to 1960 base period used in this study for calculating the number of expected deaths, the mortality rates we have presented are presumably overstated.

*Circulation, Volume XLIV, October 1971
measured by dividing the number of actual
deaths by the number of expected deaths. The
resulting quotient multiplied by 100 is a
percentage known as the mortality ratio and is
the measuring rod used in all actuarial comparisons of
mortality. A group in which the number of actual
deaths equals the number of expected deaths has
a mortality ratio of 100%. Persons insured at
standard rates are used as a control group and
their mortality is taken as 100%. Therefore, for
example, a ratio of actual to expected deaths of
150% of a subgroup would indicate that the
mortality of those in question is 50% greater than
that in the control group of the same age
distribution over the period of observation.
Extrasystoles were classified as supraventricu-
lar, including those of atrial and atrioventricular
nodal origin, and as ventricular. They were
further subdivided into categories of simple and
complex. Complex extrasystoles were those with
the following characteristics: aberrant conduction
(supraventricular only); paired, multifocal origin,
with postextrasystolic T-wave inversion on or
close to the preceding T wave (within 0.04
second of the termination of the T wave); and
bigeminy or trigeminy. Unifocal extrasystoles
without any of these characteristics were classi-
ced as simple.

Results

The mortality ratio of the 604 persons
without other significant abnormalities was
102% (table 1). The difference in mortality
ratios between the subgroups of simple and
complex extrasystoles was not of statistical
significance. Comparison of those under 40 and
those 40 years of age and over revealed no
significant difference in mortality ratios.

Subgroups of persons with various types of
complex extrasystoles without other abnor-
malities were too small for determination of
meaningful mortality ratios, with the except-
ion of the group in whom the ventricular

Table 1

Mortality of Individuals with Extrasystoles without Other Abnormalities*

<table>
<thead>
<tr>
<th>Type of extrasystole</th>
<th>Entrants</th>
<th>Actual deaths</th>
<th>Expected deaths</th>
<th>Ratio actual to expected deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supraventricular</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simple</td>
<td>83</td>
<td>15</td>
<td>12.69</td>
<td>118%</td>
</tr>
<tr>
<td>Complex</td>
<td>39</td>
<td>6</td>
<td>6.22</td>
<td>96%</td>
</tr>
<tr>
<td>Ventricular</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simple</td>
<td>359</td>
<td>56</td>
<td>59.79</td>
<td>94%</td>
</tr>
<tr>
<td>Complex</td>
<td>123</td>
<td>21</td>
<td>17.34</td>
<td>121%</td>
</tr>
<tr>
<td>All</td>
<td>604</td>
<td>98</td>
<td>96.04</td>
<td>102%</td>
</tr>
</tbody>
</table>

*Standard insurance risks in the absence of extrasystoles.
195% confidence limit.

Table 2

Mortality of Individuals with Extrasystoles without Other Abnormalities* by Type of Ventricular Extrasystole

<table>
<thead>
<tr>
<th>Type of extrasystole</th>
<th>Entrants</th>
<th>Actual deaths</th>
<th>Expected deaths</th>
<th>Ratio actual to expected deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple</td>
<td>359</td>
<td>56</td>
<td>59.79</td>
<td>94%</td>
</tr>
<tr>
<td>Bigeminy or trigeminy</td>
<td>50</td>
<td>5</td>
<td>6.68</td>
<td>75%</td>
</tr>
<tr>
<td>Paired, multifocal, and with</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>postextrasystolic T inversion</td>
<td>14</td>
<td>4</td>
<td>1.99</td>
<td>†</td>
</tr>
<tr>
<td>On or close to preceding T wave</td>
<td>59</td>
<td>12</td>
<td>8.68</td>
<td>138%</td>
</tr>
<tr>
<td></td>
<td>482</td>
<td>77</td>
<td>77.14</td>
<td>100%</td>
</tr>
</tbody>
</table>

*Standard insurance risks in the absence of extrasystoles.
†A/E ratios not shown for fewer than five deaths.
‡95% confidence limit.
extrasystoles were on or close to the T wave of the preceding normal beat. There were 59 such persons, among whom there were 12 deaths and the mortality ratio was 138% (table 2).

The mortality ratio of the 108 persons with extrasystoles and other abnormalities was 167% (table 3A). Among such associated abnormalities were blood pressure elevation, localized apical systolic murmurs, overweight, elevation of blood sugar, hernias, enteritis, gastritis, colitis, migraine, sciatica, spinal disc disease, and varicose veins. The subgroup with ventricular extrasystoles together with blood pressure elevation and/or a cardiac abnormality had a mortality ratio of 223%. The mortality ratio of the subgroup with ventricular extrasystoles together with noncardiovascular abnormalities was 131%. The difference between these two mortality ratios, while suggestive, is not statistically significant (table 3B).

When deaths from accident and suicide were excluded, 38% of the entire group died from acute myocardial infarction. Thirteen of those with complex ventricular extrasystoles (54%), 21 of those with simple ventricular extrasystoles (34%), and four of those with supraventricular extrasystoles (27%) died of acute myocardial infarction (table 4). At the time of death from acute myocardial infarction the average age of the group with complex ventricular extrasystoles was 55.8 years; seven of the 13 persons were under 56 years of age. The average age at the time of death from acute myocardial infarction of the group with simple ventricular extrasystoles was 61 years; 10 of 21 persons were under 56 years of age.

Among the 21 persons who had ventricular extrasystoles with fatal acute myocardial infarction in whom the duration of the terminal event was noted, sudden death

| Table 3A |
|------------------|------------------|------------------|------------------|------------------|
| Type of extrasystole | Entrants | Actual deaths | Expected deaths | Ratio actual to expected deaths |
| Supraventricular | | | | |
| Simple | 14 | 2 | 1.79 | † |
| Complex | 8 | 2 | 1.54 | † |
| Ventricular | | | | |
| Simple | 62 | 15 | 8.71 | 172% |
| Complex | 24 | 8 | 4.08 | 196% |
| All | 108 | 27 | 16.12 | 167% |

*Rated up to 195% expected mortality for conditions other than extrasystoles.
†A/E ratios not shown for fewer than five deaths.
‡95% confidence limit.

| Table 3B |
|------------------|------------------|------------------|------------------|------------------|
| Type of other abnormality | Entrants | Actual deaths | Expected deaths | Ratio actual to expected deaths |
| Rating for blood pressure and/or cardiac condition | 42 | 15 | 6.70 | 223% |
| No rating for blood pressure or cardiac condition | 44 | 8 | 6.10 | 131% |
| All | 86 | 23 | 12.80 | 180% |

*Rated up to 195% expected mortality for conditions other than extrasystoles.
†95% confidence limit.
occurred in 16. Fourteen of 15 persons with ventricular extrasystoles who died of acute myocardial infarction under the age of 56 years had neither elevation of blood pressure nor other evidence of cardiac disease at the time of examination for life insurance. Of the 22 sudden deaths in the entire series, only two occurred among those with supraventricular extrasystoles.

An increase in the frequency of extrasystoles from less than 10 to 10-30 per minute was accompanied by an increase in mortality from 92% to 123%. Among those aged 45 years and over this increase was from 104% to 148% (table 5).

The persons with an increase in the number of extrasystoles immediately after exercise, and those with a decrease or no change, had similar mortality ratios, 96% and 105%, respectively (table 6). This test was performed in 333 persons without other abnormalities. It consisted of 15 vigorous hops or stepping on and off an ordinary chair 15 times in 1 min, with the pulse rate reported before, immediately after, and 2 min after exercise.

Discussion

Following accepted actuarial practice, the 231 persons who terminated their insurance policies at a date prior to 1968 by maturity or discontinuance were included in the study for as many years as we had information about them, an average of 12.2 years. This lack of follow-up imposes certain limitations on the results and conclusions of the study. If this group had been excluded from the study the mortality ratio for the remainder would have been 126%, rather than the figure of 102% found for the entire group. This difference is insignificant at the 95% confidence level.

Among the applicants for insurance who were considered to have a normal life expectancy except for the presence of extrasystoles, the observed mortality ratios for the entire group and for the subgroups with simple and complex supraventricular and ventricular extrasystoles were essentially normal, ranging between 94% and 121% and falling within the standard insurance-premium classification. These findings are consistent with the opinion of Campbell2 that the presence of extrasystoles in the absence of other evidence of heart disease has little prognostic significance. Thus, the group of cases with extrasys-

Table 4

<table>
<thead>
<tr>
<th>Type of extrasystole</th>
<th>Number</th>
<th>Percent of all causes*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supraventricular</td>
<td>4</td>
<td>27</td>
</tr>
<tr>
<td>Ventricular</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simple</td>
<td>21</td>
<td>34</td>
</tr>
<tr>
<td>Complex</td>
<td>13</td>
<td>54</td>
</tr>
<tr>
<td>All</td>
<td>38</td>
<td>38</td>
</tr>
</tbody>
</table>

*Excluding deaths due to accident, suicide, and in which the cause of death was not ascertained.

Table 5

<table>
<thead>
<tr>
<th>Number of extrasystoles per minute</th>
<th>Issue age (years)</th>
<th>Entrians</th>
<th>Actual deaths</th>
<th>Expected deaths</th>
<th>Ratio actual to expected deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 10</td>
<td>Under 45</td>
<td>249</td>
<td>25</td>
<td>31.55</td>
<td>79%</td>
</tr>
<tr>
<td></td>
<td>45 and over</td>
<td>142</td>
<td>36</td>
<td>34.53</td>
<td>104%</td>
</tr>
<tr>
<td></td>
<td>All ages</td>
<td>391</td>
<td>61</td>
<td>66.08</td>
<td>92%</td>
</tr>
<tr>
<td>10 and over</td>
<td>Under 45</td>
<td>151</td>
<td>19</td>
<td>17.79</td>
<td>107%</td>
</tr>
<tr>
<td></td>
<td>45 and over</td>
<td>62</td>
<td>18</td>
<td>12.17</td>
<td>148%</td>
</tr>
<tr>
<td></td>
<td>All ages</td>
<td>213</td>
<td>37</td>
<td>29.96</td>
<td>123%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>604</td>
<td>98</td>
<td>96.04</td>
<td>102% (81% to 123%)</td>
</tr>
</tbody>
</table>

*95% confidence limit.

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toles is apparently so heavily weighted with normal individuals whose extrasystoles are of physiologic origin that on the whole the finding does not carry a significant adverse prognosis. The number of those with undetected or subclinical cardiovascular disease with pathologic causes for their extrasystoles is apparently too small to affect the prognosis to a significant degree.

These results are similar to those of studies conducted in the Medical Department of the Equitable Life Assurance Society with regard to the effect on mortality of electrocardiographic low T waves and right bundle-branch block in otherwise normal applicants for insurance.3,4 There are a few comparable studies; the results are similar. Brandon et al. found a mortality ratio of 141% among all applicants for insurance to the Aetna Life Insurance Company with normal electrocardiograms except for the presence of extrasystoles, irrespective of the number and degree of other physical impairments.5 Lyle conducted a mortality study among 11,000 Home Office employees of the Prudential Life Insurance Company over the period of 1933 to 1960. No differentiation was made into groups with supraventricular and ventricular extrasystoles. Among males without other abnormalities the mortality ratio was 115% for those with simple extrasystoles and 130% for those with complex extrasystoles.6 Comparable groups in our series had mortality ratios of 98% and 115%, respectively.

The discovery of extrasystoles at a later age was not related to an increase in mortality in this study. This is contrary to the assumption that a higher mortality would be expected in older individuals since in them extrasystoles, particularly those of ventricular origin, are more likely to be manifestations of subclinical and undetected coronary artery disease. Our findings may be due to the absence of an appreciable number of individuals over 54 years of age at the time of discovery of extrasystoles. The results in Lyle's series were similar. The increase in mortality noted in this series with an increased frequency of extrasystoles, particularly among those over 45 years of age, is similar to the findings in Lyle's series.6

The group of persons in whom there was an increase in the number of extrasystoles immediately after exercise demonstrated no significant increase in mortality. The mortality ratio of 185% among those 45 years of age and over who had an increase in the number of extrasystoles with exercise is suggestive. It is not significant, as it is based on only five deaths among 16 entrants. Lamb and Hiss found that in the absence of definite supporting evidence of valvular disease, angina, or other signs of coronary artery disease an increase in the number of extrasystoles after exercise, or

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Table 6

<table>
<thead>
<tr>
<th>Issue age (years)</th>
<th>Entrants</th>
<th>Actual deaths</th>
<th>Expected deaths</th>
<th>Ratio actual to expected deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Decreased or Remained Same after Exercise</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Under 45</td>
<td>181</td>
<td>19</td>
<td>24.40</td>
<td>78%</td>
</tr>
<tr>
<td>45 and over</td>
<td>90</td>
<td>29</td>
<td>21.43</td>
<td>135%</td>
</tr>
<tr>
<td>All</td>
<td>271</td>
<td>48</td>
<td>45.83</td>
<td>105%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(75% to 135%)</td>
</tr>
<tr>
<td><strong>Increased</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Under 45</td>
<td>46</td>
<td>5</td>
<td>7.74</td>
<td>65%</td>
</tr>
<tr>
<td>45 and over</td>
<td>16</td>
<td>5</td>
<td>2.71</td>
<td>185%</td>
</tr>
<tr>
<td>All</td>
<td>62</td>
<td>10</td>
<td>10.45</td>
<td>96%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(43% to 180%)*</td>
</tr>
</tbody>
</table>

*95% confidence limit.
their appearance de novo, is not indicative of significant heart disease.\textsuperscript{7} Mann\textsuperscript{8} found no evidence of coronary insufficiency in the majority of persons in whom extrasystoles present at rest persisted or became more frequent after exercise; he found evidence of coronary insufficiency in all 21 persons in whom extrasystoles appeared for the first time after exercise.

The normal mortality ratios in the entire group and in the subgroups of simple and complex supraventricular and ventricular extrasystoles in this study do not negate the fact that extrasystoles may be manifestations of acute or chronic coronary artery disease and myocardial involvement from a variety of causes. Nor do they contradict the findings of epidemiologic studies such as those of Chiang et al.,\textsuperscript{9, 10} Hinkle et al.,\textsuperscript{11} and Pell and D'Alonzo,\textsuperscript{12} which indicate a relationship between the finding of extrasystoles, evidence of coronary disease on examination, and an increased tendency to death, particularly of a sudden nature, from acute myocardial infarction.

The number of persons in our group with supraventricular extrasystoles who died of acute myocardial infarction or had associated cardiovascular abnormalities was too small for meaningful analysis. However, of the 24 persons in the entire series in whom the duration of the terminal cardiovascular illness was noted as sudden, only two had prior supraventricular extrasystoles. This finding is in accordance with both the Tecumseh study\textsuperscript{6, 10} and Hinkle's study\textsuperscript{11} in which sudden death among those with prior supraventricular extrasystoles was rare. In these studies, supraventricular extrasystoles were not associated with evidence of coronary artery disease at the time of initial examination, and no increase in the number of expected coronary deaths occurred in the period of follow-up. The considerable preponderance of sudden deaths in those with preexisting ventricular extrasystoles versus those with preexisting supraventricular extrasystoles in the present study suggests that ventricular premature beats signify a predisposition to electrical instability of the ventricles, so that when a major ischemic episode occurs fatal arrhythmias may ensue.

A mortality ratio of 223% among those who had ventricular extrasystoles together with minor elevation of blood pressure and/or other cardiac abnormality compared with the 131% mortality ratio among those with ventricular extrasystoles together with noncardiovascular abnormalities suggests that those ventricular extrasystoles associated with cardiovascular disease have an adverse effect on mortality. In Lyle's series similar results were found in a group of persons in whom extrasystoles and elevation of blood pressure coexisted.

Another adverse effect of ventricular extrasystoles is shown by the death from acute myocardial infarction of 54% of those with complex ventricular extrasystoles when deaths from accident and suicide were excluded. Approximately half died under age 56. This contrasts with a figure of 34% for those with simple ventricular extrasystoles, which is borderline for a male group of this age distribution. No cardiovascular abnormality was found in the great majority of both groups at the time of initial examination, including 14 of the 15 persons who subsequently died of acute myocardial infarction under the age of 56. The implications of these findings are in accord with the results of Pell and D'Alonzo, who found that in a 6-year follow-up study of 86,570 employees of the DuPont Corporation those with antecedent ventricular extrasystoles had a significantly higher early, 30-day, case-fatality ratio from acute myocardial infarction.\textsuperscript{12}

In the Tecumseh study there was a significantly higher incidence of coronary artery disease among those over 30 years of age with ventricular extrasystoles, and a significant increase in the incidence of sudden death among those with antecedent ventricular extrasystoles.\textsuperscript{9} The findings from the Tecumseh study have been criticized because only one of the sudden deaths occurred among persons under 70 years of age without preexistent coronary artery disease. In addition, in the age group 40 to 69 years the

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The incidence of sudden death in those with prior ventricular extrasystoles was 2.8% (three of 107 persons) compared with 1.3% (24 of 1,835 persons) without preexistent ventricular extrasystoles. This was not considered to be a marked difference. Hinkle et al., employing 6-hour periods of continuous electrocardiographic recording, also found ventricular extrasystoles to be associated with increased evidence of coronary artery disease at the time of first examination and an increased risk of subsequent coronary death, often of a sudden nature.

The effect on mortality of the various types of complex ventricular extrasystoles is a subject of great current interest, as they are infrequent in normal individuals, are frequently associated with organic heart disease, and are often precursors of sudden death from ventricular tachyarrhythmias when they occur in the course of acute myocardial infarction. Lown and Ruberman have recently emphasized the urgent need for thorough studies of ventricular extrasystoles as to type, frequency, multiform appearance, site of origin, repetitive patterns, and relation to sudden death. Ventricular extrasystoles frequently trigger ventricular tachyarrhythmias in the necrotic, hypoxic, hyperkalemic, and acidicotic myocardium of an individual with an acute myocardial infarction, but this does not signify that they are necessarily as dangerous in an otherwise normal individual. However, one might hypothesize that if they were a recurrent or persistent phenomenon in a given individual over the course of many years they would assume a more ominous significance when an acute heart attack supervened. Unfortunately, the number of persons with each type of complex ventricular extrasystoles in this study is too small to answer these questions.

Among the 123 persons with complex ventricular extrasystoles without other abnormalities, there were only 14 persons and four deaths with extrasystoles which were either paired, multifocal, or of the type with postextrasystolic T-wave inversion. This is too small a group for the calculation of a meaningful mortality ratio. Among 67,375 asymptomatic Air Force subjects Hiss et al. found only three individuals with multifocal ventricular extrasystoles. Many authors have commented on the frequent association of this type of extrasystole with evidence of organic heart disease. Levine et al. noted the rarity of ventricular extrasystoles with postextrasystolic T-wave inversion in the absence of organic heart disease, also observed by Ungerleider and Gubner.

There were 50 persons and five deaths in the group with ventricular extrasystoles manifesting as bigeminy or trigeminy. The mortality ratio was 75%. This figure is not statistically significant, but is in accord with the statements by Katz and Pick and Massie and Walsh to the effect that such extrasystoles are frequently seen in normal persons. However, Hinkle et al. found them associated with a significantly greater number of deaths than expected. Hiss et al. noted their rarity in asymptomatic Air Force personnel.

Among 59 persons with ventricular extrasystoles occurring on or close to the T wave of the preceding normal beat there were 12 deaths, a mortality ratio of 13.8%. This type of ventricular extrasystole, falling as it does on or near the vulnerable phase of the T wave or in the supernormal phase following it, has been considered extremely dangerous, particularly during the course of acute myocardial infarction, as these extrasystoles may trigger ventricular fibrillation and sudden death. In addition, such extrasystoles have been reported as frequently associated with other evidence of organic heart disease. The modest increase in mortality associated with such extrasystoles in our study indicates that they are not as dangerous in otherwise normal individuals.

Finally, comment may be made on the objection to this type of study based on the known variability in occurrence of extrasystoles in routine electrocardiograms and the finding that of 283 persons monitored for 6-hour periods only 22 failed to show at least one extrasystole, which, however, represents an average of 30,472 beats per individual. These findings do not detract from the
significance of the occurrence of extrasystoles in a routine electrocardiogram since, as noted by Hiss, while “few individuals ever live an entire lifetime without an occasional premature contraction, the probability of a chance prematurity occurring during the brief duration of a routine electrocardiogram is quite small.”15

Acknowledgment

We wish to thank Dr. Leon Warshaw, Vice President and Chief Medical Director of the Equitable Life Assurance Society of the United States, for his most valuable advice and suggestions.

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Circulation. 1971;44:617-625
doi: 10.1161/01.CIR.44.4.617

Circulation is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
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Print ISSN: 0009-7322. Online ISSN: 1524-4539

The online version of this article, along with updated information and services, is located on the World Wide Web at:
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