
Relationship Between Clinical Features of Acute Myocardial Infarction and Ventricular Runs 2 Weeks to 1 Year After Infarction

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SUMMARY Ten-hour electrocardiographic (ECG) monitoring was performed on 289 survivors of myocardial infarction (MI) at 2 weeks, at monthly intervals for 6 months and then at 9 and 12 months after MI. Four hundred thirty episodes of ventricular runs were recorded on 88 patients (30%). The clinical features during the acute phase of MI of these 88 patients were evaluated prospectively and compared with those of patients who did not have runs. Both groups were similar with respect to age, sex and preexisting coronary risk factors. However, patients with runs had higher peak serum enzyme levels and a higher prevalence of congestive heart failure, cardiomegaly and left ventricular hypertrophy. They also had more frequent atrial premature complexes, premature ventricular complexes at a rate of 6/minute or more, and ventricular conduction defects during the acute infarction. The presence of runs within 3 months after the MI was predictive of the presence of runs during the period 4-12 months after MI. Using a multivariate logistic analysis patients could be divided into quartiles of risk for posthospital runs on the basis of features noted during the acute phase. The prevalence of runs ranged from 4% in the lowest quartile to 49% in the highest one. Although the rate of sudden death was not different in each quartile of risk of having ventricular runs, patients in the highest quartile had a significantly higher mortality rate (16.7%) than those in the lowest one (5.6%). We conclude that severe cardiac disease manifested by poor left ventricular function, high serum enzyme levels, and certain types of cardiac arrhythmias during acute MI are associated with an increased prevalence of ventricular runs during the posthospital phase. Our study suggests that the higher mortality rate in the highest quartile of risk of having ventricular runs is related to severe cardiac disease rather than to the presence of the runs.

RUNS of ventricular ectopic activity (VEA) often occur in the course of acute myocardial infarction (MI) and usually call for immediate initiation of antiarrhythmic or other therapy. However, some patients continue to have ventricular runs (three or more consecutive beats of VEA) during recovery from their MI. Several investigators have reported that the occurrence of these runs is associated with an increased risk of sudden cardiac death. However, little is known about how to identify patients who are likely to develop runs. Symptoms reported by patients cannot be used as a guide because runs are, for the most part, asymptomatic. Some studies have relied on ECG recordings of brief duration (1-6 hours) to detect the occurrence of VEA. Frequently, only a single ECG recording is obtained just before the time of discharge or in the immediate posthospital period. Patients might be free of VEA on this recording and yet have it a month later. Therapy would be more likely initiated if the physician were aware that these patients are having runs. Thus, more should be known about the prevalence of these runs and the patients who are likely to have them.

Repeat ECG monitoring at monthly intervals can be used as a research endeavor, but is not a practical way of identifying patients who will develop runs. If one could identify the patients prone to having runs during the posthospital phase from information readily attained during their hospital stay, such patients could be further investigated with ECG
recordings and receive antidysrhythmic therapy. In addition, this information could help investigators by allowing them to test new antidysrhythmic agents on patients with a high risk of ventricular runs.

We report the results of repeated 10-hour ECG recordings in survivors of MI at 2 weeks, at monthly intervals for 6 months, and then at 9 and 12 months after MI. We have related the occurrence of runs in this population to the clinical features during the acute MI and have stratified patients into quartiles of risk based upon this information.

Materials and Methods

The population for this study was recruited between November 1971 and June 1975 from a pool of patients who were admitted to the coronary care units of Jewish or Barnes Hospital within 48 hours of the clinical onset of their MI. The diagnosis of acute MI was based on the presence of at least two of the following three criteria: (1) a history compatible with acute MI; (2) diagnostic electrocardiographic changes consisting of the appearance of new Q waves and/or reduction of R-wave voltage; and (3) characteristic changes in serum enzyme levels (creatine kinase, serum glutamic oxaloacetic transaminase, and lactic dehydrogenase and its isoenzymes). Demographic, clinical and laboratory variables were determined contemporaneously and coded on special forms according to a detailed protocol. Extensive checks were performed to ensure a consistency in the data and when questions arose, the patient's chart was reviewed in detail by a senior cardiologist.

An analysis of the relationship of the in-hospital mortality to some of these clinical features has been reported previously. They were: (1) smoking at least one pack of cigarettes per day in the last 6 months before acute MI; (2) a diagnosis of previous diabetes mellitus, regardless of its severity; (3) history of hypertension, ascertained by the patient's knowledge of diagnosis by his physician; (4) type (nontransmural or transmural) and location (anterior, inferior or posterior) of MI; (5) cardiac arrhythmias and intraventricular conduction defects (IVCD) during the CCU stay, including premature ventricular complexes (PVCs) at a rate of six per minute or more, atrial premature complexes (APCs), atrioventricular (AV) blocks (first- or second-degree or complete AV block), and any IVCD (right bundle branch block, left bundle branch block, left anterior or posterior hemiblocks, and nonspecific IVCD); (6) left ventricular hypertrophy (LVH) by ECG; (7) cardiomegaly by chest x-ray; (8) congestive heart failure during the CCU admission, diagnosed by the presence of vascular redistribution or pulmonary congestion (mild or moderate) on chest x-ray with clinical findings of failure (rales and/or ventricular gallop), or marked pulmonary congestion or pulmonary edema with or without clinical findings of failure; and (9) cardiogenic shock, defined as a systolic blood pressure less than 90 mm Hg with evidence of peripheral vasoconstriction, including sweating, cold extremities, confused sensorium and low urinary output (less than 25 ml/hour).

Survivors of MI who were less than 71 years of age, and lived within 25 miles of the medical center were eligible to participate in the study. Two hundred eighty-nine patients (40% of those eligible) were successfully recruited into the study. Patients were discharged from the hospital when this was deemed appropriate by their physicians. Each patient had one or more 10-hour ECG recordings (Avionics recorders, Model 350 G) 2 weeks after admission (at a time when the patient was still hospitalized but ambulatory), and repeated at monthly intervals for 6 months, then at 9 and 12 months after MI. Although no attempt was made to systematically treat these patients, the results of ECG recordings were made known to their physicians, who placed some of the patients on antidysrhythmic drugs. However, in general, the drug levels were not obtained nor was any effort made to quantitatively assess the efficacy of this treatment. Long-term follow-up for all patients was obtained by telephone or mail contact every 6 months. If a patient died, the circumstances of the death was elicited from the next of kin according to a defined protocol. The deaths were classified by a panel of four cardiologists (without the knowledge of the results of ECG recording analysis) as sudden death, sudden death/new MI, not sudden death/new MI, not sudden death/cardiac death, and not sudden death/noncardiac death. A death within 1 hour of the onset of symptoms or an unwitnessed death was defined as sudden death. The diagnosis of new MI was based on two out of three clinical criteria mentioned earlier or on the evidence of new MI on postmortem examination.

The Argus/H computer system, which has been demonstrated to detect 91% of ventricular couplets or runs and correctly classify all tapes with these dysrhythmias, was used to detect and enumerate all PVCs. Each computer-identified PVC was examined by a trained editor who produced annotated ECG strips of relevant sections of the tape. These strips, along with computer-generated summary information, were reviewed independently by two or more cardiologists without previous knowledge of the identity of the patient, the results from any other recording, or the recording session. The result of the computer analysis and editing procedure was an annotated beat-by-beat record of the ambulatory ECG known as an Argus/H Cycle stream. These Cycle streams were processed by computer programs, which tabulated all runs and merged this information with the parameters that described the acute phase of the patient's MI.

The clinical features of patients who had at least one run during the first year after MI were compared with those of survivors who did not have this arrhythmia during the same study period. Ventricular runs found on any tapes made 2 weeks to 3 months after MI were defined as early runs, and those found 4–12 months after MI were defined as late runs. Clinical features during the acute phase of MI were
also examined for their associations with the presence of early or late runs.

We used the odds ratio (\(\omega\)) to indicate the strength of the association between clinical features and the subsequent occurrence of runs. The odds ratio is closely related to the relative risk. When a clinical feature is associated with an increased risk of an event, \(\omega\) is greater than 1; conversely, when the risk is decreased, \(\omega\) is less than 1. Observed probability levels were computed using a standard chi-square distribution or Fisher's exact test, where cell expectations fell below five. A multivariate logistic equation which was fit to the data to better define the relationships between clinical features of the acute MI and subsequent runs can be written as

\[
P(\text{run}) = \frac{1}{1 + \exp(a + b_1 * x_1 + b_2 * x_2 + \ldots + b_n * x_n)}
\]

where \(P(\text{run})\) is the probability of developing a run, \(x_1, x_2, \ldots x_n\) are clinical features, and the coefficients \(a\) and \(b_1, b_2, \ldots b_n\) are estimated from the data.

We used a maximum likelihood technique to estimate the above coefficients. Unfortunately, maximum likelihood estimation of the multivariate logistic requires an iterative technique. For selecting appropriate variables to include in the logistic equation, the results of ordinary least-squares techniques are closely parallel to those of maximum likelihood estimation techniques. Thus, we used less expensive multiple regression equations for selecting the variables for the logistic equation. We have noted the importance of interactions between clinical features in predicting subsequent VEA. Therefore, interaction terms were also examined to see if they added significance to the prediction of having runs.

To interpret the values of the coefficients of the multivariate logistic, it should be noted that the value of \(b_i\) has a close relationship to the odds ratio, used to indicate the strength of the relationship between a single variable and the presence of runs. A partial odds ratio (\(\omega'_i\)) for each variable included in the multivariate logistic (which controls for all of the other variables in the logistic) may be computed from \(\omega'_i = \exp(-b_i)\). \(\omega'_i\) can then be thought of as the odds ratio of that variable for the presence of runs, independent of the influence of other variables. Thus it is similar to a partial multiple regression coefficient.

The patients were then ranked into quartiles of risk of having ventricular runs by using the solution of the multivariate logistic analysis. We also determined the 1-year mortality rate of patients in each quartile of risk of having ventricular runs on the ambulatory ECG recording to establish the relationship of death to either the presence of these dysrhythmias or the presence of severe cardiac disease.

**Results**

We analyzed a total of 1808 tapes from 289 patients. The percentage of tapes with at least one run for each recording session is shown in figure 1. The lowest frequency of runs (3.4%) was at the 2-week recording session, while the patients were still hospitalized. During the posthospital phase, the prevalence of runs increased to 11.5% at 1 month. From 2 months to 1 year, runs were found at any recording session in about 7% of the patients. Eighteen of the 101 tapes (18%) that followed a tape with a run contained one or more runs, while only 6.5% (83 of 1270) of tapes after a run without a run showed a run (\(\omega = 3.10, p < 0.001\)). Thirty-nine percent (16 of 41) of tapes following a tape with two or more runs had a run, while only 3% (two of 60) of tapes following a tape with only one run showed one or more runs. This demonstrates that patients who have runs, particularly two or more, at a given recording session, are at greater risk of having a run on the next recording.

Figure 2 shows the percentage of patients with a run on one or more outpatient tapes (excluding the 2-week session) as a function of the number of tapes analyzed for that patient. As expected, the percentage of patients with one or more runs increased with the number of ECG recordings analyzed. Over 30% of the patients who had all eight outpatient tapes processed showed a run at some time during that period.

Eighty-eight of the 289 patients (30%) had either early or late runs. Sixty-three of the 288 patients (22%) had early runs and 49 of the 233 patients (21%) had late runs. Forty-four percent (24 of 55) of the patients with early runs and a tape in the late period had late runs as well, while only 14% of the patients (25 of 177) without early runs had late runs (\(\omega = 4.71, p < 0.001\)). Thus, the presence of runs 2 weeks to 3 months after MI was strongly associated with the
presence of runs on tapes taken 4–12 months after MI. Associations of selected demographic and clinical features with runs are shown in table 1. Age, sex and transmural MI were not associated with a significant increase in risk of having ventricular runs in the postinfarction period. Coronary risk factors (smoking, hypertension and diabetes) and previous MI were also only weakly associated with the risk. However, indicators of pump failure (e.g., congestive heart failure, cardiomegaly or LVH) or of electrical instability (APCs, PVCs at a rate greater than six per minute, AV block and any IVCD) were associated with an increased prevalence of runs from 2 weeks to 1 year after MI. The degree of association was usually greater with early than late runs. Although the prevalence of posterior MI was low in this study (5%), patients with posterior MI appeared to have a lower risk of runs.

The variables shown in table 1 were considered for inclusion in the multivariate logistic equation. By

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**Table 1. Odds Ratios (ω) for Selected Clinical Features Observed During the Acute Myocardial Infarction and Subsequent Runs**

<table>
<thead>
<tr>
<th>Clinical feature</th>
<th>% of total population having feature</th>
<th>% of any run</th>
<th>ω</th>
<th>% of early run</th>
<th>ω</th>
<th>% of late run</th>
<th>ω</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>80</td>
<td>31</td>
<td>1.19</td>
<td>24</td>
<td>1.96</td>
<td>20</td>
<td>0.81</td>
</tr>
<tr>
<td>Age &gt; 60 years</td>
<td>36</td>
<td>34</td>
<td>1.32</td>
<td>26</td>
<td>1.41</td>
<td>24</td>
<td>1.29</td>
</tr>
<tr>
<td>Hx smoking</td>
<td>51</td>
<td>32</td>
<td>1.18</td>
<td>23</td>
<td>1.31</td>
<td>23</td>
<td>1.31</td>
</tr>
<tr>
<td>Hx hypertension</td>
<td>39</td>
<td>31</td>
<td>1.06</td>
<td>23</td>
<td>1.14</td>
<td>23</td>
<td>1.16</td>
</tr>
<tr>
<td>Hx diabetes</td>
<td>18</td>
<td>33</td>
<td>1.18</td>
<td>20</td>
<td>0.85</td>
<td>23</td>
<td>1.16</td>
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<tr>
<td>Hx MI</td>
<td>21</td>
<td>37</td>
<td>1.43</td>
<td>27</td>
<td>1.44</td>
<td>27</td>
<td>1.48</td>
</tr>
<tr>
<td>Transmural MI</td>
<td>79</td>
<td>32</td>
<td>1.44</td>
<td>23</td>
<td>1.35</td>
<td>21</td>
<td>1.05</td>
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<tr>
<td>Anterior MI</td>
<td>46</td>
<td>29</td>
<td>0.91</td>
<td>20</td>
<td>0.84</td>
<td>21</td>
<td>1.03</td>
</tr>
<tr>
<td>Inferior MI</td>
<td>56</td>
<td>33</td>
<td>1.30</td>
<td>23</td>
<td>1.18</td>
<td>23</td>
<td>1.33</td>
</tr>
<tr>
<td>Posterior MI</td>
<td>5</td>
<td>7</td>
<td>0.15</td>
<td>0*</td>
<td>—</td>
<td>0</td>
<td>—</td>
</tr>
<tr>
<td>CHF</td>
<td>45</td>
<td>36</td>
<td>1.60</td>
<td>28*</td>
<td>1.86</td>
<td>27</td>
<td>1.84</td>
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<tr>
<td>CM</td>
<td>35</td>
<td>38*</td>
<td>1.74</td>
<td>32†</td>
<td>2.33</td>
<td>29</td>
<td>1.90</td>
</tr>
<tr>
<td>LVH</td>
<td>14</td>
<td>46*</td>
<td>2.24</td>
<td>39†</td>
<td>2.72</td>
<td>32</td>
<td>1.99</td>
</tr>
<tr>
<td>CHF, CM and LVH</td>
<td>7</td>
<td>57†</td>
<td>3.37</td>
<td>43*</td>
<td>2.96</td>
<td>47†</td>
<td>4.93</td>
</tr>
<tr>
<td>Any IVCD</td>
<td>20</td>
<td>42*</td>
<td>1.91</td>
<td>37†</td>
<td>2.63</td>
<td>23</td>
<td>1.17</td>
</tr>
<tr>
<td>Nonspecific IVCD</td>
<td>7</td>
<td>52*</td>
<td>2.73</td>
<td>48†</td>
<td>3.67</td>
<td>43*</td>
<td>3.07</td>
</tr>
<tr>
<td>Any AV block</td>
<td>11</td>
<td>35</td>
<td>1.29</td>
<td>29</td>
<td>1.54</td>
<td>32</td>
<td>1.92</td>
</tr>
<tr>
<td>APC</td>
<td>35</td>
<td>33</td>
<td>1.17</td>
<td>28*</td>
<td>1.70</td>
<td>21</td>
<td>0.99</td>
</tr>
<tr>
<td>Any PVC</td>
<td>92</td>
<td>32</td>
<td>2.96</td>
<td>23</td>
<td>2.98</td>
<td>22</td>
<td>5.20</td>
</tr>
<tr>
<td>PVC &gt; 6/min.</td>
<td>49</td>
<td>37*</td>
<td>1.82</td>
<td>27*</td>
<td>1.65</td>
<td>27*</td>
<td>1.96</td>
</tr>
<tr>
<td>Ventricular tachycardia</td>
<td>40</td>
<td>33</td>
<td>1.20</td>
<td>25</td>
<td>1.35</td>
<td>22</td>
<td>1.11</td>
</tr>
<tr>
<td>SGOT &gt; 240</td>
<td>30</td>
<td>40*</td>
<td>1.89</td>
<td>35†</td>
<td>2.74</td>
<td>28</td>
<td>1.80</td>
</tr>
<tr>
<td>LDH &gt; 660</td>
<td>42</td>
<td>40*</td>
<td>2.20</td>
<td>33†</td>
<td>3.09</td>
<td>26</td>
<td>1.72</td>
</tr>
<tr>
<td>Overall</td>
<td>100</td>
<td>30</td>
<td>22</td>
<td>22</td>
<td>21</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p < 0.05.
†p < 0.01.

Abbreviations: APC = atrial premature complex; CHF = congestive heart failure; CM = cardiomegaly; Hx = history of; IVCD = intraventricular conduction defect; LDH = lactic dehydrogenase; LVH = left ventricular hypertrophy; MI = myocardial infarction; PVC = premature ventricular complex; SGOT = serum glutamic oxaloacetic transaminase.
using a special multiple regression technique\textsuperscript{21} in which all combinations of variables were evaluated, we reduced the number of variables to a set in which each variable contributed in a meaningful manner. We used the maximum likelihood estimates of the multivariate logistic\textsuperscript{20} to make final refinements of the model. Table 2 shows the variables finally selected, along with the associated partial odds ratios and asymptotic 95\% confidence intervals on the partial odds ratio. For the continuous variable logarithm of peak lactic dehydrogenase (LDH), the odds ratio is that associated with a doubling of the peak LDH. A doubling of the peak LDH produced more than a doubling of the risk. The slope of this function was greater for patients with a history of MI. Cardiomegaly for males, LVH for patients with their initial MI and IVCD for patients with nonanterior MIs were the combinations of clinical features that independently contributed to the risk of having runs with partial odds ratio over 2.

Using the solution shown in table 2, the patients were ranked by the predicted probability of having runs. The 25\% of patients at highest risk were grouped into quartile 1, the next 25\% into quartile 2, and so on. The average predicted risk for the early as well as the late runs from the model along with their observed prevalence for each quartile is shown in table 3. The close correspondence demonstrates the good fit of the model. Those at high risk of early runs were also at increased risk for late runs. Although the model was not intended to predict late runs, it nevertheless predicted them reasonably well.

Twenty-six patients (9\%) died within 1 year of follow-up. Twelve of these 26 (46.2\%) had ventricular runs, whereas four (30.8\%) of the 13 sudden deaths had these dysrhythmias. The rate of sudden death was not different in patients who were included in the highest or lowest quartile of risk of having ventricular runs (table 3). However, patients who were in the highest quartile had a significantly higher overall mortality rate than those in the lower quartile ($p < 0.039$). The overall mortality rate was 16.7\% in the highest quartile and 5.6\% in the lowest one.

**Discussion**

Our study has demonstrated several interesting features of ventricular runs after MI. The prevalence of runs increased from 3\% at 2 weeks after MI, to 11\% at 1 month. From 2 months to 1 year, runs were found in about 7\% of patients at any particular time. The decreased frequency of runs at the 2-week recording session is consistent with the lower average PVC rate reported previously for this recording time.\textsuperscript{22} On repeated monitoring, more than 30\% of our patients had one or more runs. This is higher than other reports,\textsuperscript{4, 6, 22} and is probably because of more frequent recording sessions on each patient in our study (average 6.3 tapes per patient). Anderson et al.\textsuperscript{4} obtained a 6-hour recording at 4-month intervals with an average of 5.5 recordings per patient and found runs in only 7\% of their patients. A higher prevalence of congestive heart failure in our patients, and the inclusion of runs with rates under 100 per minute, may have had some influence on the high prevalence of runs in our

<table>
<thead>
<tr>
<th>Quartile</th>
<th>No.</th>
<th>Average predicted risk of early run % (range)</th>
<th>Observed prevalence of early run (%)</th>
<th>Observed prevalence of late run (%)</th>
<th>Observed 1-year mortality Overall No. (%)</th>
<th>Sudden No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>72</td>
<td>49.0 (29.5-90.4)</td>
<td>49.3</td>
<td>29.6</td>
<td>12 (16.7)</td>
<td>3 (4.2)</td>
</tr>
<tr>
<td>2</td>
<td>72</td>
<td>21.8 (16.5-29.1)</td>
<td>20.8</td>
<td>22.6</td>
<td>7 (9.7)</td>
<td>5 (6.9)</td>
</tr>
<tr>
<td>3</td>
<td>73</td>
<td>12.5 (8.7-16.2)</td>
<td>13.7</td>
<td>18.6</td>
<td>3 (4.1)</td>
<td>2 (2.7)</td>
</tr>
<tr>
<td>4</td>
<td>72</td>
<td>5.0 (0.1-8.6)</td>
<td>4.2</td>
<td>13.8</td>
<td>4 (5.6)</td>
<td>3 (4.2)</td>
</tr>
</tbody>
</table>

$p = 0.039$ NS
study. However, the frequent recordings of a somewhat longer duration (10 hours) and the increased sensitivity of computer detection of runs are probably the most important reasons for the increased frequency of runs seen in the present study.

Age, sex, coronary risk factors and previous MI did not appear to have an important influence on the development of runs. The location of MI appeared to play only a minor role, except that patients with a posterior MI had a reduced incidence of runs. Similar to others,4 we found that the prevalence of runs during the posthospital phase of MI was greater in patients with significant ventricular dysfunction. Patients who had either congestive failure, cardiomegaly, high serum enzyme levels, or ECG evidence of LVH, APCs, PVCs (more than than six per minute) or IVCD during their acute MI, had an increased risk of runs in the posthospital period. The multivariate logistic model showed that the height of the peak LDH is an important independent predictor of the probability of having runs. Furthermore, combinations of clinical features, including cardiomegaly for males, LVH for patients with their initial MI, and IVCD for patients with nonanterior MIs independently predicted the risk of having runs.

Clinical features recorded during the acute MI also influence the risk of developing late runs, but the effect is less than on early runs. Furthermore, the best predictor of runs during the late period is the presence of early runs. Using an appropriate logistic model, the patients can be divided into quartiles of risk that can predict the observed prevalence of both early and late runs. The lowest quartile has an observed risk of 4% for early runs and 14% for late runs, whereas the highest quartile has risks of 49% and 30%, respectively.

In our study, the predicted risk of ventricular runs was related to an increased mortality in the first year. This was mainly the result of an increased incidence of nonsudden death. However, no difference in sudden death rate was observed in those who were in the lowest or highest quartile. The presence of ventricular runs in our patients seemed to be a marker of severe cardiac disease rather than an independent factor for increased incidence of sudden death. This finding is consistent with previous studies.

This study did not include patients with other forms of cardiac diseases, so our findings may not be applicable to any cardiac patients except for survivors of MI. Furthermore, although ventricular runs were related to various clinical features during acute MI, we did not examine the probability of an independent contribution of the presence of runs to the risk of death. The number of deaths in our study was too small to allow a meaningful analysis of this relationship.

In conclusion, repeated monitoring in the first year after MI demonstrated that nearly one-third of the patients showed runs on one or more recording sessions. The risk of runs was significantly related to clinical features measured during the acute MI. Of particular importance were indications of left ventricular dysfunction, high serum enzyme values, and certain ventricular and atrial dysrhythmias during the acute MI. Late runs were most likely to occur in patients who showed early runs. This study demonstrates that patients may be stratified into subgroups at substantially different risks of having runs in the first year after infarction. This type of stratification may be useful in choosing populations for more frequent monitoring and suitable antidyssrhythmic therapy.

Acknowledgment

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Failure of Antiarrhythmic Drugs to Prevent Experimental Reperfusion Ventricular Fibrillation

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SUMMARY Ninety-nine adult mongrel dogs underwent acute ligation of the proximal left anterior descending coronary artery. Thirty minutes later, the occlusion was released to evaluate the effectiveness of five antiarrhythmic protocols in eliminating reperfusion ventricular fibrillation. The five protocols included: protocol 1—i.v. lidocaine, preligation and prerelease (n = 19); protocol 2—i.v. lidocaine, prereperfusion only (n = 22); protocol 3—chronic, oral, daily amiodarone for 2 weeks preligation (n = 19); protocol 4—i.v. procainamide, preligation and prereperfusion (n = 21); and protocol 5—i.v. verapamil, prereperfusion (n = 18). Each regimen was evaluated with respect to the incidence of reperfusion ventricular fibrillation in dogs that survived to reperfusion, and the results were compared to 77 control dogs that underwent identical coronary artery occlusion and release procedures without drug therapy. The incidence of reperfusion ventricular fibrillation was as follows: protocol 1—seven of 15 dogs (47%); protocol 2—six of 18 (33%); protocol 3—11 of 16 dogs (69%); protocol 4—eight of 17 dogs (47%); and protocol 5—10 of 17 dogs (59%), compared with 36 of 60 (60%) in control dogs.

Using chi-square analysis, protocol 2 was beneficial (p < 0.05). The dogs were then stratified into high- and low-risk subgroups based on the arrhythmic events of the antecedent coronary artery ligation periods, and predictive risk indices for the occurrence of reperfusion ventricular fibrillation were developed. The Mantel-Haenszel method of statistical analysis revealed that none of these protocols resulted in a statistically significant reduction in the incidence of reperfusion ventricular fibrillation. Thus, use of these predictive indices plus appropriate statistical methods has revealed, unexpectedly, limitations in the efficacy of a spectrum of antiarrhythmic agents in preventing reperfusion ventricular fibrillation.

CANINE coronary artery occlusion and reperfusion models have been studied extensively as a means for understanding the life-threatening ventricular arrhythmias that occur after myocardial ischemia and infarction. However, as useful as these canine models have been in revealing electrophysiologic mechanisms, their use as models for evaluating antiarrhythmic drug interventions has led to equivocal and contradictory results. Other studies, using either coronary artery ligation or reperfusion models, have also suggested that a large and variable number of animals do not develop ventricular fibrillation, even without prior antiarrhythmic therapy (approximately 60% and 30%, respectively). Previous studies in this laboratory, however, indicate that the risk for developing ventricular fibrillation on reperfusion might be predicted for individual animals based on the incidence, time course and severity of arrhythmias occurring during the antecedent period of acute coronary artery ligation. This was predicated on the observation that different animals subjected to acute one-stage ligation of the proximal left anterior descending coronary artery developed either immediate (occurring 2–12 minutes...
Relationship between clinical features of acute myocardial infarction and ventricular runs 2 weeks to 1 year after infarction.
R E Kleiger, J P Miller, S Thanavaro, M A Province, T F Martin and G C Oliver

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