Counter Measures against Death from Arrhythmias in Acute Myocardial Infarction: Mortality of the Disease in a Hospital at Different Periods with Changing Care Systems. Factors of Delay in the Pre-hospital Phase

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The results of treatment of 400 patients with established acute myocardial infarction in a hospital at different periods with changing care systems are described.

Significant reduction of death from arrhythmias could be obtained only when an organization with immediate availability of well-trained medical personnel and reliable actual continuous monitoring of electrocardiograms had been established.

Components of delay in the pre-hospital phase of acute myocardial infarction were also studied. There were two significant factors in delay: one was delay due to ignorance of patients about the disease, second was the delay after consultation of family doctors until arrival at the CCU. Time is consumed in the latter factor mainly in making of definite diagnosis.

The implication of these data in the management of patients with a diagnosis of acute myocardial infarction are discussed.

It has been recognized that the commonest cause of early death after acute myocardial infarction is life threatening arrhythmias. Modern anti-arrhythmic therapy including lidocaine, DC defibrillation, artificial pacemaker, and others could correct and prevent such catastrophic events. This led to the creation of the coronary care unit (CCU) where continuous reliable monitoring of the electrocardiogram and immediate treatment by trained personnel are available.

On the other hand, epidemiologic studies of coronary heart disease have consistently demonstrated that approximately more than 60 per cent of deaths occur outside the hospital and are sudden, occurring particularly within 1 to 2 hours after the onset of symptoms. In order to reduce early coronary deaths which occur mainly due to life threatening arrhythmias, establishment of a well functioning CCU and early care as soon as possible after the onset of the symptoms are essential. As a basic study for that purpose mortality of acute myocardial infarction in a hospital at different periods with changing care systems and components of delay in the pre-hospital phase of the disease were studied.

METHODS

Three groups of 400 consecutive patients with established acute myocardial infarction at different periods since 1966 to 1980 were reviewed to assess whether the outcome in such patients had improved over the 14 years in accordance with

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CCU
Hospital mortality
Pre-hospital care

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### TABLE 1 HOSPITAL MORTALITY RATE AND CAUSE OF DEATHS OF PATIENTS WITH ACUTE MYOCARDIAL INFARCTION

<table>
<thead>
<tr>
<th>Group</th>
<th>No. of hospital deaths</th>
<th>mortality rate</th>
<th>No. and rate of each cause of death</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of patients</td>
<td></td>
<td>primary arrhythmia</td>
</tr>
<tr>
<td>A</td>
<td>24/116</td>
<td>20.7</td>
<td>12 (50.0%)</td>
</tr>
<tr>
<td>B</td>
<td>22/151</td>
<td>14.6</td>
<td>13 (59.0%)</td>
</tr>
<tr>
<td>C</td>
<td>17/133</td>
<td>12.8</td>
<td>3 (17.6%)</td>
</tr>
</tbody>
</table>

A total of 116 patients in group A was admitted over 6 years from January 1966 to the regular medical wards without continuous monitoring of the electrocardiogram.

A total of 151 patients in group B was managed in the regular medical wards over 5 years from September 1972, and their electrocardiograms were displayed on a central oscilloscope in the nurses’ station, but actual monitoring was performed not continuously but intermittently.

In group C a total of 133 patients was treated in the CCU, from November 1977 to February 1980, where actual continuous monitoring of electrocardiograms was accomplished.

**Physicians** In groups A and B 4 medical residents are present in the ward during the day, but physicians are not always available at night because only one night-call doctor has to take care other medical wards simultaneously. In group C at least one cardiologist and 2 medical residents are present in the CCU during the day and at least one member of the pavilion house staff, consisting of 4 cardiologists and 8 well trained medical residents, is present at night.

**The nursing staff** In groups A and B the nursing staffs were not specially trained as coronary nurses and monitoring of the electrocardiograms was not continuously performed. In group C 6 specially trained registered nurses during the day and at least 2 at night are present in the unit at all times. Each nurse has completed a special training course consisting in recognition and treatment of arrhythmias, pump failure and cardiac arrest.

Ninety patients from a defined population with established acute myocardial infarction were questioned about their activities before their hospital arrival. Patients were interviewed after moving to their regular rooms from the CCU. Questions concerned the time interval between the onset of acute symptoms to the time the patient arrived at the CCU, cardinal acute symptoms, and prior knowledge about acute myocardial infarction, symptoms, importance of prevention of early death, and emergency facilities including the CCU.

The time intervals were defined as follows. Primary care period: the period between the onset of acute symptoms until they entered primary care which is mainly provided by a family physician. Secondary care period: the interval between the start of primary care and arrival at the CCU.

**RESULTS**

*Mortality of acute myocardial infarction of*
Diagnostic and Therapeutic Procedures in Acute Myocardial Infarction

TABLE II COMPARISON OF HOSPITAL MORTALITY IN TWO GROUPS OF PATIENTS BEFORE AND AFTER CERTAIN CHANGES IN POLICY OF MANAGEMENT

<table>
<thead>
<tr>
<th>Group</th>
<th>1. no pump failure</th>
<th>2. mild heart failure</th>
<th>3. severe heart failure</th>
<th>4. cardiogenic shock</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>8/110</td>
<td>5/22</td>
<td>3/13</td>
<td>3/3</td>
</tr>
<tr>
<td></td>
<td>13/132 (9.8%)</td>
<td>6/16 (37.5%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>2/82</td>
<td>1/20</td>
<td>4/21</td>
<td>8/8</td>
</tr>
<tr>
<td></td>
<td>3/102 (2.9%)</td>
<td>12/29 (41.4%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Numerator and denominator of the fraction represents No. of deaths and patients respectively.

TABLE III COMPARISON OF MORTALITY DURING ACTUAL CONTINUOUS MONITORING IN TWO GROUPS OF PATIENTS

<table>
<thead>
<tr>
<th>Group</th>
<th>1. no pump failure</th>
<th>2. mild heart failure</th>
<th>3. severe heart failure</th>
<th>4. cardiogenic shock</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>7/110</td>
<td>3/22</td>
<td>3/13</td>
<td>3/3</td>
</tr>
<tr>
<td></td>
<td>10/132 (7.5%)</td>
<td>(23.1%)</td>
<td>(100%)</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>0/82</td>
<td>0/20</td>
<td>4/21</td>
<td>8/8</td>
</tr>
<tr>
<td></td>
<td>0/102 (0%)</td>
<td>(19.1%)</td>
<td>(100%)</td>
<td></td>
</tr>
</tbody>
</table>

Numerator and denominator of the fraction represents No. of deaths and patients respectively.

different periods with changing care systems

Causes of deaths were primary arrhythmia, pump failure, left ventricular failure and/or cardiogenic shock, rupture of the heart, cerebral embolism and others. Death from primary arrhythmia was defined as death that occurred suddenly due to life threatening arrhythmia in a case without or even with mild heart failure and the patient might have been able to survive if the arrhythmia had not occurred.

Over-all hospital mortality in groups A, B and C was 20.7 per cent, 14.6 per cent and 12.8 per cent respectively. Incidences of each cause of death in each group are shown on Table I. The incidence of death from primary arrhythmia in the first two groups was essentially similar: 50 percent for group A and 59 per cent for group B. But it was significantly reduced to 17.6 per cent in group C.

Each patient was classified into one of the following groups according to the severity of the left ventricular dysfunction.

1. No heart failure
2. Presence of heart failure, but of mild to moderate degree, i.e., diagnostic criteria included S3 gallop and rales but no pulmonary edema.
3. Severe heart failure, i.e., frank pulmonary edema.
4. Cardiogenic shock or shock with left ventricular failure.

In groups B and C, hospital mortality in each of the sub-groups 1, 2, 3 and 4 are summarized on Table II.

In patients without severe heart failure and/or shock, i.e., in groups 1 and 2, hospital mortality was 9.8 percent in group B and 2.9 per cent in group C. In the same groups deaths during actual continuous monitoring of electrocardiograms was also evaluated. Mortality rate was 7.5 per cent (10 deaths out of 132 patients) in group B and 0 per cent (no deaths out of 102 patients) in group C. Thus the significant reduction in mortality in the CCU (group C) was gratifying among the patients without severe left ventricular dysfunction, but the mortality in patients complicated by severe left ventricular failure and/or shock remained high (Tables II and III).

Delayed components in the pre-hospital phase

Thirty-two per cent of the patients arrived at the CCU within 2 hours after the onset, but 43 per cent took more than 12 hours after the onset of the disease.

There were four major delay components. Delay due to ignorance of the patients and their families about the disease was found in 33 cases. They had no foreknowledge about acute myo-

cardiac infarction and they had been thinking the patient surely did not have such a disease. A second important cause of delay was found in 31 patients, that is, delay after consultation with family doctors in travel to the hospital. The time was consumed mainly in making a definite diagnosis by the doctor. In 21 patients the time was mainly spent in seeking medical consultation.

In another 5 cases the time was wasted in finding a CCU to send the patient.

Previous knowledge about acute myocardial infarction was questioned in 90 patients. Among 90 patients, only 20 have had a knowledge about the symptoms suggesting acute myocardial infarction such as severe anterior chest pain with importance of medical care for prevention of early death immediately after onset of the disease. Only 10 patients had known the term CCU and its meaning. Only 9 patients had been familiar with all three of the items.

Patients who had had prior knowledge about the disease arrived at the CCU with less delay compared with those without previous knowledge. Some of them, however, consumed a significant amount of time before arriving at the CCU despite their previous knowledge. In these patients symptoms were not severe enough to consider the disease.

Here on Figure 1 the main symptoms the patients complained about at the onset are summarized.

DISCUSSION

Overall hospital mortality in each group of our series seems to improve gradually. However, we could not conclude that stepwise improvement of the care system reflected upon mortality of the disease in the hospital. Grace emphasized many of the pitfalls in evaluation of mortality rates of acute myocardial infarction. The variability in overall mortality rate reflects the importance of age and pre-existing complicating disease. Even in the same CCU, mortality rates can vary from 10 to 44 per cent when it is evaluated in a small series, and 16 to 35 percent in a large series. If it is evaluated in multiple different hospitals there are wide variations in mortality in each CCU. The effect of CCU on mortality ranged from –40 to +1 percent among the 5 hospitals. These differences may be due to different study designs, statistical analysis, and to inconsistent definitions and inclusion criteria.

Incidence of death from arrhythmia are not essentially changed between groups A and B. In group C, however, incidence of arrhythmia deaths was significantly reduced compared with the former. This is statistically significant. Particularly it has to be emphasized that all 3 of the deaths from arrhythmia in group C died after being discharged from the CCU. In the series during actual continuous monitoring of electrocardiograms, mortality rate of arrhythmia was 7.5 per cent in group B, but 0 percent in group C. The effect of CCU on mortality is significant at least in prevention of death from arrhythmia. Our data strongly suggest that prompt detection and immediate treatment of arrhythmia can prevent death from arrhythmias.

Recently, CCUs have been increased in number, but the standard for each CCU and ways to assess its own function have not been clarified in this country. Wherever there is a CCU, well-trained and immediately available medical staff should be prepared, rather than just monitoring equipment. It has to be emphasized that reliable continuous monitoring of arrhythmias and immediate availability of well-trained medical personnel always are essential for efficient functional activity of a CCU.

The community mortality rate from acute myocardial infarction has not, however, been reduced only by the wide spread development of CCUs. This led to the creation of prehospital care including the mobile CCU, hospital based teams, and public training in cardiopulmonary resuscitation. Mass education about the disease is also important. In our series prior knowledge of the public about acute myocardial infarction was very poor. The second important factor is delayed after consultation of the family doctors until arrival at the hospital. The time is mainly consumed in making a definite diagnosis. Education about the proper understanding of the disease both for patients and doctors seems to be important. The other two delay factors were either in seeking medical consultation or in searching for a CCU to send the patient. These were due to lack of an emergency system in the community. These definitely make significant delays in arrival at the CCU.

In order to improve the situation other than in the establishment of a CCU in the hospital, (1) patients should be informed more adequately about the disease, (2) physicians should be educated in the use of emergency facilities as soon as possible, and (3) a mobile coronary care system should be established for safe and prompt
REFERENCES