Mobile Coronary Care*

J. F. Pantridge, M.D.

Conventional coronary care units have a minimal effect on the overall mortality from coronary thrombosis in the community. The majority of the patients, when they reach a hospital coronary care unit, are either convalescent or moribund. The pre-hospital coronary care scheme allows coronary care to reach patients soon after the onset of symptoms at a time at which risk is greatest. The median time between the onset of symptoms and the initiation of coronary care has been reduced from more than eight hours to one hour 40 minutes. Pre-hospital coronary care reduces mortality by making possible the prevention or correction of ventricular fibrillation outside hospital. The early initiation of coronary care reduces the hospital mortality from shock and pump failure by the prevention or immediate correction of dysrhythmias.

It is generally agreed that hospital coronary care units will reduce the mortality from acute myocardial infarction among patients who survive long enough to reach such units. Unfortunately, the majority of deaths from acute myocardial infarction occur before hospital admission. The limited impact of the conventional hospital coronary care unit is appreciated if the time at which deaths occur in relation to the onset of symptoms is contrasted with the time at which patients are likely to reach a hospital ward (Fig. 1). When all ages are considered (Fig. 1, curve A1) 40 percent of the deaths from acute myocardial infarction occur within one hour of the onset of symptoms.1 Among men of middle-age and younger, 63 percent of the deaths occur within one hour of the onset of symptoms.2 However, only 16 percent of patients reach hospital within four hours (Fig 1, curve B)3 and the median time between the onset of symptoms and admission is more than eight hours.1

Since the majority of deaths occur before hospital admission, an attempt has been made to initiate coronary care in the pre-hospital phase. A mobile coronary care unit (MCCU) was started in Belfast in January 1966.4-5 The objective was to deliver intensive care to the patient at the home or at the place where infarction occurred as soon as possible after the onset of symptoms. A system has been arranged that enables a junior physician and a nurse who have experience of coronary care to reach the patient quickly. The median interval between the receipt of a signal from the family doctor or lay individual and the arrival of the hospital personnel to the patient is ten minutes. The team carries the usual equipment found in the coronary care unit, ie monitoring apparatus, drugs, intravenous solutions and a portable defibrillator (Fig 2). Junior medical personnel are adequate since the equipment includes telemetering apparatus and the team is in contact with the hospital coronary care unit by two-way radio telephone. Monitoring and therapy are initiated at the site of attack. Pain is relieved and a stable rhythm established before the patient is moved. Monitoring is continued during transport.

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The major objective of mobile coronary care, as of coronary care in hospital is the prevention of death from rhythm disturbances since it is likely that the majority of early deaths result from ventricular fibrillation.

A mobile unit removes the risk of dysrhythmic death during transport. There has been no death in
transit in the four-year period. In this period (1966 to 1969) 2,741 patients were managed by the unit (Table 1). Forty-three percent had indubitable acute infarction. The criteria for the diagnosis of infarction have been previously defined. An additional 33 percent had acute coronary insufficiency. The emergency in 10 percent of patients was not related to acute coronary disease. Unjustified calls amounted to 6 percent of the total.

There has been a progressive increase in the number of patients coming under intensive care early (Fig 5). The interval between the onset of symptoms and the initiation of intensive care has been considerably reduced. The median delay in 1965 was more than eight hours. In 1969, the median delay was 1 hour 40 minutes. The reduction has resulted from shortening of the administrative delay. Unfortunately, there has been little change in the delay between onset of symptoms and the patient’s signal for medical aid (Fig 6). Among 447 patients with acute myocardial infarction managed by the mobile unit in 1969, 27 percent came under intensive care within one hour.

When a mobile unit is available, the correction of ventricular fibrillation outside the hospital becomes a practical proposition. In the four-year period, 193 patients with cardiac arrest outside hospital were encountered (Table 2). The median interval between onset of symptoms and cardiac arrest in these 193 patients was ten minutes. In the absence of efficient resuscitation within four minutes, the majority had asystole, while among those in whom efficient resuscitation was initiated within four minutes, the majority had ventricular fibrillation. This suggests that the usual mechanism of sudden death is ventricular fibrillation and that in the absence of immediate resuscitation this dysrhythmia is followed by asystole. There were 55 temporary survivors. Thirty-eight of the 55 patients in whom resuscitation was successful survived to leave the hospital (Table 3). Only one of these 38 has residual cerebral dysfunction. Further success in the correction of cardiac arrest outside hospital will be achieved when more attention is given to the training in resuscitative methods of family doctors, nurses, medical students, and first-aid workers in industrial establishments and large stores.

It is of interest that the hospital mortality of patients managed by the mobile unit is lower than that recorded among patients admitted to coronary care units in the usual way. The mean hospital mortality recorded from coronary care units is 22.6 percent (Table 4). Lawrie et al. record a mortality rate of 17.5 percent in patients less than 70 years (Table 4). It has been stated that the mortality is unlikely to be reduced below this level. However, when patients are managed by a mobile coronary care unit, the mortality can be reduced to 12.3 percent, and among patients 70 years and less, to 10.5 percent (Table 4). Among those seen within one hour aged 70 years and less, the mortality was 8.6 percent, the incidence of shock 3.4 percent (Table 5). This reduction in mortality results from

### Table 1—Data Concerning Patients Managed by the MCCU in The 4-year Period 1966-69

<table>
<thead>
<tr>
<th>Myocardial Infarction</th>
<th>Ischemic Pain</th>
<th>Non Coronary Emergency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abnormal ECG</td>
<td>Normal ECG</td>
<td>Cardiovascular</td>
</tr>
<tr>
<td>1183 (T33)</td>
<td>793 (29%)</td>
<td>120 (4%)</td>
</tr>
</tbody>
</table>

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a reduced incidence of shock and pump failure. Occlusion of a coronary vessel is usually associated with an area of inevitable infarction. Surrounding this is an area of myocardium which may suffer infarction if the blood supply through the collateral vessels is reduced. Such a reduction in collateral supply may result from rhythm disturbances which are frequent immediately after coronary occlusion. The fall in cardiac output, blood pressure and coronary perfusion associated with uncorrected rhythm disturbances may lead to extension of the initial area of infarction and conversely the prevention or rapid correction of such dysrhythmias may limit the area of infarction.

Rhythm disturbances are common in the first two hours after myocardial infarction at a time when patients are seldom under intensive coronary care. Bradycardiacs are frequent among patients seen early. Thus, among patients with posterior infarction seen within one hour of the onset of symptoms, 61 percent showed sinus bradycardia, nodal brady-cardia or AV block, second degree or complete. It has been shown that in some cases, early complete AV block may result from excessive vagal discharge and may respond to atropine. There has been some difference of opinion regarding the significance of sinus bradycardia occurring immediately after coronary occlusion. However, since the damaged myo-

![Figure 5](http://journal.publications.chestnet.org/pdfaccess.ashx?url=/data/journals/chest/21500/)

**Figure 5.** Solid bar: seen within one hour; shaded bar: seen within two hours; open bar: seen within four hours.

![Figure 6](http://journal.publications.chestnet.org/pdfaccess.ashx?url=/data/journals/chest/21500/)

**Figure 6.** Open bar: patient delay; shaded bar: administrative delay.
cardiogram cannot compensate for reduction in rate by increase in stroke volume there is reason to believe that the ideal heart rate after acute infarction is in the region of 90. Furthermore, it has been shown that the threshold for ventricular fibrillation is lower at slow heart rates. Braydarrhythmia and ventricular dysrhythmia are both most frequent immediately after the onset of coronary occlusion.

It is of interest that our experience differs from that of others who have noted a higher hospital mortality among patients who were admitted to coronary care units soon after the onset of symptoms (Table 6). Thus, among patients less than 70 years admitted within four hours, a mortality of 19 percent has been recorded. The comparable hospital mortality among patients managed by a mobile coronary care unit was 9.3 percent. Among patients admitted to a coronary care unit within three hours, a mortality rate of 23.7 percent was recorded. A comparable mortality among patients managed by a mobile unit was 9.7 percent (Table 6). This difference is presumably related to the different method of management. The lower mortality among patients managed by a mobile unit results from correction of rhythm disturbances before transport, prevention or immediate correction of rhythm disturbances that occur during transport and immediate admission to the hospital coronary care unit, bypassing the casualty department or admitting areas.

The likely impact of the addition of a mobile coronary care unit to a conventional hospital coronary care unit is indicated in Table 7. Two hundred and twenty-five hypothetical patients with acute myocardial infarction are considered. Since the overall mortality from myocardial infarction in the community is of the order of 40 percent, 90 deaths are to be expected. Two-thirds of the deaths occur outside hospital. Thus, 30 of the 90 deaths will occur in hospital. The usual hospital mortality rate in the absence of a coronary care unit is 30 percent. Therefore, 100 of the 225 hypothetical patients are likely to be admitted. It is claimed that the hospital coronary care unit will reduce the hospital mortality by one-third. Reduction in hospital deaths from 30 to 20 will reduce the total deaths to 50. Thus, even if all hospitalized patients are admitted to a coronary care unit, the overall reduction in mortality will not be greater than 0.45 percent.
Table 7—Effect of Addition of MCCU to Hospital CCU on Community Case Fatality from Coronary Thrombosis

<table>
<thead>
<tr>
<th>225 with MI</th>
<th>Deaths</th>
<th>100 (Ad)</th>
</tr>
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<tbody>
<tr>
<td>4.5%</td>
<td>40 %</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td>35.5%</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>31.5%</td>
<td>74</td>
</tr>
<tr>
<td>9.7%</td>
<td>29 %</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>25.8%</td>
<td>58</td>
</tr>
<tr>
<td>14.2%</td>
<td></td>
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Additional reduction in the mortality rate from the operation of a mobile coronary care unit results from: (a) prevention or correction of ventricular fibrillation outside hospital prior to transport; (b) elimination of death during transport and in casualty departments; (c) diminution of the hospital mortality by reduction in the incidence of shock and pump failure. In 1969, among 447 patients with acute myocardial infarction managed by the mobile unit, ventricular fibrillation was corrected outside hospital and before transport in 14 (3 percent). There is no doubt that this fatal dysrhythmia was prevented in at least a similar number of patients by the immediate correction of frequent and multifocal ventricular extrasystoles, ventricular tachycardia or ventricular extrasystoles of the R on T type. Thus, six patients are saved for each 100 managed, reducing the total deaths to 74 and the overall mortality rate 31.5 percent (Table 7).

The elimination of death during transport will save nine patients for each 100 managed, since at least 10 percent of acute coronary deaths occur during transport or in casualty departments. Thus, the total number of deaths will be reduced to 65 and the overall mortality rate to 29 percent.

The hospital mortality rate among all patients managed by the mobile coronary care unit is less than 13 percent, a reduction of 7 percent when compared with the mortality among patients admitted to coronary care units in the usual way (Tables 4 and 5). Thus, the total deaths are reduced to 58 and the overall mortality to 25.8 percent.

The addition of a mobile coronary care unit to a hospital coronary care unit will therefore result in a further reduction in the mortality of 9.7 percent. Combination of a mobile coronary care unit and a hospital coronary care unit should result in a 14.2 percent reduction in the overall mortality from acute myocardial infarction.

REFERENCES


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EPILOGUE

As a research fellow in 1948-49, I had the honor of working with Dr. Burch and the late Dr. F. N. Wilson. It was these distinguished cardiologists who stimulated my interest in the problems connected with coronary artery disease.