Mobile coronary care and mortality from ischaemic heart disease in a predominantly rural community

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SUMMARY
The mobile coronary care unit based at Coleraine Hospital was called to 155 patients in the community during a six-monthly period, 74 of whom had sustained a myocardial infarction. Over the same period, 25 of 49 patients admitted via the ordinary ambulance with suspected ischaemic heart disease had sustained a myocardial infarction and received medical care significantly later than those seen by the mobile unit. A further 12 patients out of 39 with suspected ischaemic heart disease admitted by other means (the accident and emergency department or other hospital units) brought the total number of patients admitted to hospital with myocardial infarction during the study period to 111.

Overall mortality from myocardial infarction was 19.8% and was significantly higher in those ≥ 70 years of age. Nine patients with myocardial infarction seen by the mobile coronary care unit required early defibrillation (four outside hospital) and eight of these survived to be discharged. No patients admitted by other means required emergency defibrillation. Although no significant difference in mortality was demonstrated between those seen before or after three hours from the onset of symptoms or between patients admitted by the mobile unit or by the ordinary ambulance, a subgroup of patients below 70 years of age and seen by the mobile unit less than three hours after the onset of symptoms had the lowest mortality of 6.7%. Estimated overall mortality from ischaemic heart disease in this community over the study period was in excess of those deaths accounted for in this survey, implying a high mortality in those not admitted to hospital.

INTRODUCTION
An “intensive care” ambulance first came into operation at Coleraine Hospital in June 1977. It was staffed by an ambulance driver and a trained intensive care nurse until June 1978 when medical staffing levels permitted a senior house officer to join the team. At present the ambulance covers a mixed urban-rural area of 400 square kilometres in north Antrim and northeast Londonderry, and serves a population of 86,500 people (42,600 males, 43,900 females). In the
tenth year of its operation the present prospective survey was conducted over a six-month period to assess the use of the ambulance by this community and the effect of mobile coronary care on hospital survival following admission with ischaemic heart disease.

PATIENTS AND METHODS

All admissions between 1 October 1986 and 31 March 1987 for ischaemic heart disease (including myocardial infarction) were followed for the duration of their hospital stay. They were classified in three groups. 1. All patients seen in the community by the mobile coronary care unit. 2. All patients admitted directly to a general medical ward via an ordinary ambulance or from the accident and emergency or other hospital departments, with suspected ischaemic heart disease or myocardial infarction. 3. All in-patients subsequently proven to have sustained an unsuspected myocardial infarction irrespective of the source of admission or reason for referral.

A diagnosis of myocardial infarction was accepted when at least two of the following criteria were present: typical history of chest pain; characteristic and evolving electrocardiographic features; significant rises in cardiac enzymes in serial blood samples. For each patient the mode of admission was determined, the time from onset of symptoms to hospital conditions or arrival of the mobile unit, complications ensuing before and after two hours from the provision of hospital or mobile unit care, the length of hospital stay, outcome and the final diagnosis.

The mobile care unit is continuously on stand-by, and requests are transferred from ambulance control to the hospital telephone switchboard whilst the ambulance is being mobilised. The duty senior house officer and staff nurse are alerted and join the ambulance at the accident and emergency entrance. Calls are not usually vetted by medical staff. All patients transported by the mobile unit are admitted to the intensive care ward. Admissions by ordinary ambulance are arranged between the general practitioner and the house physician on duty, and these patients are brought to one of the general medical wards, where seven beds are equipped with a monitoring facility. Admissions from the accident and emergency ward are arranged with the duty senior house officer and can be directed either to intensive care or a general ward.

The time of receiving a call for the mobile unit and its arrival at the destination is recorded to the nearest minute and logged at ambulance control.

Data were analysed using Student's t- and chi-square tests. Statistical significance was accepted when \( p < 0.05 \).

RESULTS

There were 243 patients in this study group over the six-month study period, of whom 155 were seen by the mobile coronary care unit in the community, 49 were admitted by ordinary ambulance, 33 via the accident and emergency department, and six from other sources (non-medical hospital wards and out-patient clinics).

Of the 155 patients seen by the mobile unit, 74 (47.7%) had sustained a myocardial infarct (56 male, 18 female, mean age 66.2 yrs). An additional 30 patients were considered to have acute coronary insufficiency and 10 had arrhythmias without infarction, three of whom had ventricular tachycardia at presentation (Table I). Only one patient refused admission to hospital.
Table 1

Final diagnoses of 155 patients seen in the community by the mobile coronary care unit over a six-month period

| Final diagnosis                                                                 | Number |
|---------------------------------------------------------------------------------|--------|
| Myocardial infarction                                                           | 74     |
| Acute coronary insufficiency                                                    | 30     |
| Left ventricular failure:                                                       |        |
| chronic cardiac ischaemia                                                      | 6      |
| aortic valve disease                                                            | 2      |
| cardiomyopathy                                                                  | 2      |
| Dead on arrival                                                                 | 6      |
| Resistant ventricular fibrillation                                              | 2      |
| Arrhythmias:                                                                    |        |
| atrial fibrillation                                                             | 5      |
| ventricular tachycardia                                                         | 3      |
| supraventricular tachycardia                                                    | 2      |
| Syncope                                                                         | 4      |
| No diagnosis at discharge                                                       | 4      |
| Cholecystitis                                                                   | 2      |
| Musculoskeletal pain                                                            | 2      |
| Hiatus hernia                                                                   | 2      |
| Asthma                                                                          | 2      |
| Pulmonary embolus, intracerebral haemorrhage, duodenal ulcer                    |        |
| hypertension, anaemia, anxiety neurosis, drunk                                  | 1 each |

In 17 cases (11%) the mobile unit was requested by a lay person and in one case by an ambulance crew. In all other cases the patient was first seen and assessed by a general practitioner. The median time taken from call to arrival of the ambulance was 12.0 min (mean 16.2 ± 8.8 min). The median time from onset of symptoms to arrival of the ambulance was 2.0 hr (mean 3.0 ± 3.2 hr) for all patients and 2.0 hr (mean 3.1 ± 3.2 hr) for the 71 patients with myocardial infarction for whom time of onset of symptoms was available. Of these 71 patients, 20 (28%) were seen within one hour and 50 (70%) within three hours.

Of the 74 patients with myocardial infarction admitted by the mobile unit, nine required emergency defibrillation (ventricular tachycardia or fibrillation) within two hours of being seen in the community, mean 2.1 hr following onset of symptoms, mean age 64.3 yr. One was successfully defibrillated at home and three in transit. Eight of these nine patients survived to leave hospital. Three patients presenting with ventricular tachycardia without infarction were defibrillated at a mean of 1.3 hr following the onset of symptoms, and all survived to discharge. Two patients had refractory ventricular fibrillation when seen in the community, and a further six were dead on arrival of the mobile unit.

Of 49 patients admitted by ordinary ambulance, 25 (51%) had suffered a myocardial infarction (14 male, 11 female, mean age 70.4 yr). An additional 12 patients had acute coronary insufficiency and one had ventricular tachycardia without infarction. No patient with myocardial infarction admitted by the ordinary ambulance required subsequent emergency defibrillation. The median time from
onset of symptoms to arrival in hospital was 4·0 hr (mean 8·9 ± 8·4 hr) for all patients and 4·2 hr (mean 7·3 ± 6·5 hr) for those with myocardial infarction. This was a significantly longer time than that taken by myocardial infarction patients transported by the mobile coronary care unit (p < 0·005). Although patients with myocardial infarction transported by ordinary ambulance were slightly older than those transported by the mobile unit, this was not statistically significant.

Out of the further 39 patients admitted from the accident and emergency and other hospital departments, 12 had proven myocardial infarction and 15 had acute coronary insufficiency. The median time from onset of symptoms to presentation at hospital was 2·5 hr (mean 4·5 ± 4·9 hr) for all patients in this category and 2·0 hr (mean 4·5 ± 4·3 hr) for those with myocardial infarction. A total of 111 patients (45·5% of the study group) had a definite myocardial infarct (78 male, 33 female, mean age 66·6 ± 12·3 yr). Sixty-seven percent were admitted by the mobile unit. Overall in-hospital mortality was 22 (19·8%). Mortality amongst mobile unit admissions with myocardial infarction was 20% (15/74 patients) and although lower than the 28% of ordinary ambulance admissions (7/25 patients), this difference was not statistically significant (p > 0·25).

For patients aged 70 years or more, mortality was significantly higher, 32% (16/50) compared to 9·8% (6/61) in those aged less than 70 yr (p < 0·01). When those admitted via the mobile coronary care unit were analysed separately, statistical significance was lost (Table II).

| Mobile coronary care unit | Ordinary ambulance | Other admissions | Total |
|--------------------------|--------------------|-----------------|-------|
| Age yr | No | Deaths (%) | No | Deaths (%) | No | Deaths (%) | No | Deaths (%) |
| <70 | 42 | 5 (11·9%) | 10 | 1 (10%) | 9 | 0 (0%) | 61 | 6 (9·8%)* |
| ≥70 | 32 | 10 (31·3%) | 15 | 6 (40%) | 3 | 0 (0%) | 50 | 16 (32%)* |
| All | 74 | 15 (20·3%) | 25 | 7 (28%) | 12 | 0 (0%) | 111 | 22 (19·8%) |

Mortality amongst females with myocardial infarction was significantly higher than males (p < 0·01), 36% of females (12/33) died in hospital compared with 13% of males (10/78). Again statistical significance was lost if only admissions via the mobile coronary care unit were analysed. This higher female mortality doubtless reflects the greater mean age of the female patients (74 yr compared to 64 yr).

In 105 of 111 cases of proven myocardial infarction, the time from onset of symptoms to the provision of hospital care or arrival of the mobile unit was established to the nearest 15 minutes, allowing comparison of mortality between patients seen before and after three hours. Considering all 105 patients, 10/61 (16·4%) of those seen at three hours or less died, which is not significantly different from 7/44 (15·9%) of those seen after three hours. For patients seen by
the mobile unit considered separately, 9/50 (18%) of those seen at three hours or less died, not significantly less than 4/21 (19%) seen after three hours of the onset of symptoms (Table III). A subgroup of patients aged less than 70 yr seen by the mobile unit by three hours or less had a mortality of 6·7% (2/30 patients). Only two out of 10 patients aged less than 70 yr admitted by ordinary ambulance reached medical care within three hours, so no meaningful comparison is possible. For ordinary ambulance patients analysed separately, 1/6 (16·7%) died when admitted three hours or less after onset of symptoms, not significantly less than 3/16 (18·8%) admitted more than three hours after onset.

### TABLE III

**Distribution of 105 patients with myocardial infarction by time from onset of symptoms to medical attention, and mode of admission**

| Mobile coronary care unit | Ordinary ambulance | Other admissions | Total |
|---------------------------|--------------------|-----------------|-------|
| Time hr                   | No    | Deaths (%) | No    | Deaths (%) | No    | Deaths (%) | No    | Deaths (%) |
| ≤3                        | 50    | 9 (18%)    | 6     | 1 (16·7%)  | 5     | 0 (0%)      | 61    | 10 (16·4%)  |
| >3                        | 21    | 4 (19·1%)  | 16    | 3 (18·8%)  | 7     | 0 (0%)      | 44    | 7 (15·9%)   |
| All                       | 71    | 13 (18·3%) | 22    | 4 (18·2%)  | 12    | 0 (0%)      | 105   | 17 (16%)    |

All five patients aged less than 70 and 9/10 patients over 70 who died from myocardial infarction following admission by the mobile unit, had called a general practitioner (93%). The mean length of hospital stay amongst survivors admitted by the mobile unit was 13·7 ± 5·6 days, not significantly shorter than 15·8 ± 4·8 days for all other myocardial infarction patients. There were no deaths amongst any patients with acute coronary insufficiency.

**DISCUSSION**

Since the introduction of mobile coronary care in Belfast in 1966, several other units have been established in this province and worldwide. Improved survival was clearly demonstrated for patients with myocardial infarction seen by a mobile unit within three hours of onset of symptoms. Seventy percent of our patients receiving coronary care outside hospital did so within this time limit, the median being two hours. Our figures for "total delay" for both mobile coronary care and ordinary ambulances are comparable to other units serving a mixed urban-rural population in Northern Ireland.

The high mortality of our patients aged over 70 is an expected finding. The mortality of 11·9% for those aged less than 70 seen by the mobile unit is of the same order as that previously reported. Although the reduction in hospital mortality in our mobile care group failed to reach statistical significance, we feel that this reflects the relatively higher numbers of elderly patients (with higher mortality) present in both groups, and the smaller number of patients admitted by ordinary ambulance overall. The reduction in mortality seen in patients admitted earlier than three hours from onset of symptoms was small, but again may be an effect of the relatively higher numbers of elderly in this study, since the mortality in the subgroup aged less than 70 and seen earlier than three hours was reassuringly low at 6·7%.

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Using the mortality rates for ischaemic heart disease derived by McIlwaine et al.\(^7\) from a study in Belfast (4.4/1000 for males, 3.1/1000 for females), an estimated 160 deaths from ischaemic heart disease might have occurred in our community during the study. We accounted for 22 following hospital admission and at least another 2 outside hospital, leaving a possible 135 deaths in the community from ischaemic heart disease unaccounted for. Would it be possible to further reduce this apparently high mortality outside hospital? A high percentage of these deaths are caused by primary rhythm disturbance\(^7\) and may be preventable with early defibrillation. One strategy which has been adopted for reducing early mortality in an urban-rural community operating mobile coronary care has been to provide defibrillators to all general practitioners in the region.\(^8\) This might be reasonable in our community since 88\% of our patients with myocardial infarction had called a general practitioner as first line of aid, and only 7\% of our mobile unit admissions who subsequently died of ischaemic heart disease received mobile coronary care as the first line of aid. McIlwaine et al\(^7\) reported that 26\% of patients aged less than 70, dying in Belfast from ischaemic heart disease, summoned mobile coronary care as first line of aid. Other strategies which must be considered include the earlier administration of thrombolytic therapy,\(^9\) and an attempt to reduce delay time between onset of symptoms and the provision of coronary care. Most delay is accounted for by the patient,\(^3,10\) and delays attributed to the general practitioner mediating between the cardiac patient and the arrival of coronary care range from 15 minutes in an urban environment\(^7\) to 45 minutes in an urban-rural environment.\(^10\) Reducing these delays involves both patient education and the facilitation of direct access of the public to the mobile coronary care unit, with medical staff vetting public calls. Although this would increase the workload of the coronary care unit, the facility would appear to be underused by the public at present.

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