PAPERS AND ORIGINALS

Comparison of mortality of patients with heart attacks admitted to a coronary care unit and an ordinary medical ward

J D HILL, G HOLDSTOCK, J R HAMPTON

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Summary

During a 32-month period 2047 patients suspected of having heart attacks were admitted to hospital and were followed up prospectively. Out of 1480 eventually found to have definite or probable myocardial infarction, 483 had initially been admitted to an ordinary medical ward because of the shortage of coronary care unit (CCU) beds. More patients aged over 65 had been admitted to a ward than to a CCU, and more patients aged 65 or less had been admitted initially to a CCU. Within each age group, however, patients admitted initially to a CCU were clinically similar to those admitted initially to a ward. There was a higher proportion of successful resuscitations among patients admitted to a CCU, but there was no significant difference in mortality in either age group between patients admitted to a CCU and a ward.

Introduction

It has been claimed that when patients with heart attacks were admitted to a coronary care unit (CCU) rather than to an ordinary medical ward the mortality was 17% instead of 35%.¹ The Joint Working Party of the Royal College of Physicians and the British Cardiac Society² came to "the unanimous opinion . . . that some form of specialised accommodation for the care of patients after cardiac infarction is essential." In the past decade CCUs have become widespread in Britain, yet there has been no

reduction in the overall mortality from heart attacks, the observed fall in hospital mortality possibly resulting from an increase in admissions of low-risk cases rather than from the efficacy of CCUs.³

No randomised trial of the efficacy of CCUs as opposed to ordinary wards has been described. Evidence used in support of CCUs has been derived from a comparison of mortality rates between patients admitted to a CCU and those admitted to ordinary wards on the basis of bed availability,^{1 4 5} a comparison of mortality between hospitals with and without CCUs,^{6 7} a comparison of mortality rates in hospitals before and after the provision of a CCU,⁸ or simply from analyses of mortalities of patients in CCUs without any comparison with patients treated elsewhere.⁹⁻¹⁷ Although in some of these studies great care was taken to ensure that the patients treated in the CCUs were initially comparable to those treated in ordinary wards, none of the studies was conducted on a basis of prospective random allocation. Furthermore, most of them were done nearly 10 years ago and probably related to a different pattern of hospital admission from that which obtains today.

In Nottingham a shortage of CCU beds has meant that many patients referred to hospital with heart attacks have had to be admitted to an ordinary medical ward. During a 32-month period data on all patients admitted with suspected heart attacks were collected prospectively, and we have used these to compare the effects of admission to a CCU or an ordinary ward resulting from "bed availability." We have tried to make our study as similar as possible to the best of the previous studies of this type.^{1 4 5}

Patients and methods

All patients with emergency medical problems in Nottingham and its surroundings are referred to the two teaching hospitals. Each has a fully equipped CCU, but as the two units together have only 10 beds for a population of some half a million it is inevitable that many patients with heart attacks must be admitted to an ordinary medical ward. The two units have a common operational policy: when possible, any patient suspected of having had a heart attack in the preceding 24 hours is admitted direct to a CCU. If only one bed is available and two

Department of Medicine, General Hospital, Nottingham NG1 6HA

J D HILL, MB, MRCP, lecturer

G HOLDSTOCK, MB, MRCP, senior house officer (now registrar in medicine, Royal South Hants Hospital)

J R HAMPTON, DM, FRCP, consultant physician and reader in medicine

or more patients require admission, the junior medical staff use their discretion to select the patient for the CCU. Though ample bedside electrocardiogram (ECG) monitors and defibrillators are available for patients admitted to the medical wards, only the CCU nurses are trained to recognise dysrhythmias, and nurses in ordinary wards are not allowed to use defibrillators. Throughout their hospital stay all patients remain under the care of the physician on emergency duty the day they were admitted, and his junior staff look after patients both in the CCU and in the ordinary wards. All the physicians in both hospitals treat their patients according to an agreed policy, and no drug trials were in progress at the time of this study.

During the 32-month period data were collected daily by a non-medical graduate research assistant on all patients referred to hospital with suspected heart attacks. Patients were identified from ambulance and hospital admission records and were followed up until they died or were discharged. This study concerns only those patients who were admitted to a CCU or ward, those who died in the ambulance or in the accident and emergency department being excluded.

After a patient's death or discharge the data collected, together with copies of all ECGs and the discharge summary or necropsy report, were inspected by a physician (JRH) and the patient was either excluded from the study if he or she had been found to have some disease other than a heart attack or placed in one of the following five categories.

(1) *Definite myocardial infarction*—Patients with a convincing clinical history together with unequivocal ECG (Q-wave and sequential S-T-segment) changes and a pronounced rise in cardiac enzyme values (serum aspartate transaminase or hydroxybutyrate dehydrogenase) or necropsy evidence of definite recent myocardial infarction.

(2) *Probable myocardial infarction*—Patients with a convincing clinical history together with either unequivocal ECG changes or a pronounced rise in serum enzyme values or necropsy evidence of coronary artery disease if the patient died soon after admission and no other cause of death could be found.

(3) *Possible myocardial infarction*—Patients with a convincing clinical history together with either an abnormal ECG that was not typical of recent myocardial infarction or a marginal rise in serum enzymes.

(4) *Ischaemic heart disease*—Patients with a clear history of a previous myocardial infarction or angina together with an abnormal ECG but normal serum enzyme values.

(5) *Chest pain of uncertain cause*—Patients for whom no adequate diagnosis could be made.

Categories (1) and (2) correspond approximately to the WHO definition of definite myocardial infarction.

The data were transferred to 80-column cards and analysed by computer.

Results and comment

During the study period 2047 patients suspected of having heart attacks were admitted to hospital, 1315 to a CCU and 732 to a medical ward (table I). Patients aged 65 or less admitted to a CCU or ward were similar in sex distribution, but more women aged over 65 were admitted to a medical ward. In both age groups there was a higher proportion of patients with definite or probable myocardial infarction among those admitted to the CCUs. There was a significantly ($P < 0.001$) higher mortality among the older patients whether they were admitted to a CCU or ward, but within each age group there was no significant difference in mortality between patients admitted to a CCU or ward.

Because of the differences in sex distribution and ultimate diagnosis between the groups admitted to a CCU and a ward, and because of the differences in mortality between patients aged 65 or less and 66 and

over, the remainder of our data are confined to the 1480 patients ultimately diagnosed as having definite or probable infarction and are presented separately for the two age groups. Of the 567 patients with possible myocardial infarction or ischaemic heart disease 15 died, but permission for necropsy was refused and the diagnosis was not confirmed.

Table II shows that the groups of patients aged 65 or less who were admitted to a CCU or ward were similar in age and sex distribution, in the proportions for whom the ambulance had been summoned by a general practitioner rather than a member of the public, in the proportions whose attacks occurred while they were at home, and in the proportions known to have call times—that is, the duration of symptoms before the ambulance was summoned, which was known in 81 % of cases—of less than 30 minutes and less than 150 minutes.

TABLE II—Sex distribution of patients aged 65 or less with definite or probable myocardial infarction admitted to CCU or ward, and source of ambulance call and duration of symptoms before call

	CCU (n = 797; mean age 54)	Ward (n = 186; mean age 56)
No (%) of men	662 (83)	150 (81)
Ambulance called by GP (% of ambulance calls)	515 (70)	126 (73)
Ambulance call from home (% of ambulance calls)	635 (86)	150 (87)
Duration of symptoms before ambulance call:		
<30 minutes (% of known times)	104 (16)	20 (14)
<150 minutes (% of known times)	391 (60)	80 (57)

These groups were also similar in symptoms and physical signs recorded on admission, except that a higher proportion of patients admitted to a CCU had chest pain, and more in this group were observed to have dysrhythmias in the first 24 hours (table III). More patients admitted to the CCU were given antidysrhythmic drugs, while significantly fewer were given diuretics; similar proportions were given digoxin. The prehospital and hospital data for the patients aged 66 or more were similar to the data for younger patients, and the same differences in treatment pattern were present.

TABLE III—Symptoms and signs recorded on admission to CCU or ward of patients aged 65 or less with definite or probable myocardial infarction, and treatment given. Data expressed as No (%) of patients

	CCU (n = 797)	Ward (n = 186)	P
Clinical state:			
Chest pain ..	775 (97)	168 (90)	<0.001
Blood pressure <100 mm Hg systolic ..	69 (9)	14 (8)	NS
Dyspnoea ..	309 (39)	74 (40)	NS
Crepitations ..	417 (52)	99 (53)	NS
Recorded dysrhythmias in first 24 hours ..	293 (37)	45 (24)	<0.01
Treatment:			
Digoxin ..	264 (33)	67 (36)	NS
Diuretics ..	365 (46)	106 (57)	<0.01
Antidysrhythmic drugs ..	293 (37)	40 (22)	<0.001

NS = Not significant.

Table IV shows the mortality among the different groups of patients. In those aged 66 or more the mortality was almost the same whether they were admitted initially to a CCU or a ward (31 % and 32 %), and although among the younger patients there was a lower mortality in the group admitted to a CCU (15 % compared with 18 %), the difference was not significant. Similar proportions of deaths occurred in the first 24 hours.

Information on patients on whom resuscitation was attempted at any time during their hospital stay was known for a period of only 22 months, during which 1452 patients were admitted, of whom 1000 were found to have definite or probable myocardial infarction.

Table V shows the number of resuscitation attempts and successes, success being recorded if the patient left hospital alive. There was no significant difference in the total number of attempts between patients

TABLE I—Details of all patients suspected of having heart attacks admitted to CCU or ward

	CCU		Ward		Total (n = 2047)
	Age ≤ 65 (n = 1083)	Age > 66 (n = 232)	Age ≤ 65 (n = 328)	Age > 66 (n = 404)	
No (%) of men	880 (81)	168 (72)	249 (76)	224 (55)	1521 (74)
No (%) with definite or probable myocardial infarction	797 (74)	200 (86)	186 (57)	297 (74)	1480 (72)
No (%) dying in hospital	123 (11)	64 (28)	38 (12)	99 (25)	324 (16)

TABLE IV—Hospital mortality among all patients with definite or probable myocardial infarction admitted to CCU or ward

	CCU		Ward		Total (n = 1480)
	Age ≤ 65 (n = 797)	Age ≥ 66 (n = 200)	Age ≤ 65 (n = 186)	Age ≥ 66 (n = 297)	
No of deaths in first 24 hours	58	31	17	38	144
Total No (%) of deaths	119 (15)	62 (31)	34 (18)	94 (32)	309 (21)

TABLE V—Details of resuscitation attempts in 1000 cases of definite or probable myocardial infarction admitted to CCU or ward. Data expressed as No (%) of cases

	CCU		Ward		Total (n = 1000)
	Age ≤ 65 (n = 517)	Age ≥ 66 (n = 144)	Age ≤ 65 (n = 125)	Age ≥ 66 (n = 214)	
Attempts in first 24 hours	51 (10)	22 (15)	9 (7)	16 (7)	98 (10)
Attempts at any time	89 (17)	42 (29)	20 (16)	31 (14)	182 (18)
Success at any time	27 (5)	13 (9)	4 (3)	6 (3)	50 (5)

initially admitted to a CCU or a ward, although there were significantly ($P < 0.01$) more attempts on patients over the age of 65 admitted to a CCU than on those over 65 admitted to a general ward. There was a similar proportion of attempts during the first 24 hours in hospital in all groups.

When considered as a proportion of the number of attempts, there was no significant difference in the number of successes between the CCU and ward groups. Only when the number of successes was considered in relation to the number of patients admitted with definite or probable infarction did the advantage of the CCU over the general ward achieve significance ($P < 0.05$), and this was entirely due to the results in the older age group ($P < 0.02$).

Discussion

These patients were selected for admission to a CCU or ward according to bed availability, and all the data were collected prospectively: in these respects, and so far as possible in all other respects, our study was similar to those that have been claimed to show benefit from admitting patients with heart attacks to CCUs.¹⁻⁵ Like the previous studies, ours was not a randomised trial, and despite the admission policy of the CCUs there was clear evidence of selection of patients for admission to a CCU or ward. A higher proportion of patients with definite or probable infarction were admitted to a CCU, suggesting that the junior staff were reasonably good at identifying these patients at the time of admission. There was also a natural tendency to admit older patients to a ward.

There were more patients with recorded dysrhythmias among those admitted to a CCU, and more patients in a CCU received antidysrhythmic treatment. It is not clear whether this was the result of patients with dysrhythmias when first seen being selected for admission to a CCU or whether admission to a CCU led to dysrhythmias being noticed. Patients admitted to hospital primarily because of heart failure were excluded from this study, and the reason for the excess of patients treated with diuretics in the ward group is not clear.

Comparison of the mortality in our series with those in other reports is difficult because of differences in the patients studied, but our figures of 16% for all heart attacks and 21% for definite and probable myocardial infarction at all ages are similar to those of Hofvendahl¹ (26% for definite infarctions).

Although the mortality among patients admitted to the CCUs might have been higher had they been admitted to ordinary wards, our findings suggest that the CCUs have not had much effect on mortality. While changes in the pattern of referral of patients to hospital³ may well partly account for the similarity of our overall mortality to that previously claimed for CCUs, it is possible that the relatively low mortality in the patients admitted to ordinary wards results from a much more widespread dissemination of equipment and expertise than was usual 10 years ago.

It is not clear whether the greater number of attempted resuscitations in the group aged over 65 admitted to a CCU reflects an increased rate of diagnosis of a cardiac arrest by CCU staff compared with ward staff, or whether it reflects a difference in the type of patient who was admitted to a CCU rather than a ward. Similarly the higher success rate when resuscitation was attempted in a CCU rather than a ward may have been the result either of more efficient management by CCU staff or of the patients in the CCU being more easily resuscitated: the increased use of diuretics in the ward groups suggests that more of these patients may have been in heart failure and therefore perhaps more difficult to resuscitate. In any case successful resuscitation may clearly be accomplished in both a CCU and a ward, and any difference in results between a CCU and a ward is not enough to influence overall mortality.

Some patients with heart attacks will always need intensive care, and CCUs will always be convenient places to concentrate highly trained nurses and expensive complex equipment for such procedures as cardioversion and pacemaker insertion. CCUs also provide a valuable training ground for junior staff and nurses, for most dysrhythmias probably pass unnoticed in ordinary wards. Before sufficient resources are allocated to enable all patients with suspected heart attacks to be admitted to CCUs, however, further studies are required: our data suggest that a randomised trial of admission to a CCU or a ward is both ethical and desirable.

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Requests for reprints should be sent to Dr J R Hampton.

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