PAPERS AND ORIGINALS

Myocardial infarction: a comparison between home and hospital care for patients

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Summary

To compare the results of home and hospital treatment in men aged under 70 years who had suffered acute myocardial infarction within 48 hours 1895 patients were considered for study in four centres in south-west England. Four-hundred-and-fifty patients were randomly allocated to receive care either at home by their family doctor or in hospital, initially in an intensive care unit. The randomised treatment groups were similar in age, history of cardiovascular disease, and incidence of hypotension when first examined. They were followed up for up to a year after onset. The mortality rate at 28 days was 12% for the random home group and 14% for the random hospital group; the corresponding figures at 330 days were 20% and 27%. On average, older patients and those without initial hypotension fared rather better under home care. The patients who underwent randomisation were similar to those whose place of care was not randomised, except that the non-randomised group contained a higher proportion of initially hypotensive patients, whose prognosis was poor wherever treated.

These results confirm and extend our preliminary findings. Home care is a proper form of treatment for many patients with acute myocardial infarction, particularly those over 60 years and those with an uncomplicated attack seen by general practitioners.

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Introduction

Because of the increase in the number of deaths from coronary heart disease, improvement in the treatment of this condition is a matter of urgent concern. The recent changes in hospital management, notably the introduction of coronary care units,[1] have been associated with a fall in the hospital mortality rate.[2] Nevertheless, many patients continue to be treated at home. According to some authorities,[3 4] the mortality of the latter group appears to be similar to or lower than that of patients treated in hospital. As selection of patients might account for these findings, we planned a randomised controlled trial to compare the fate of patients treated in hospitals, initially in an intensive care unit, with that of patients treated at home.

The trial was carried out in four centres in south-west England and preliminary results were given by Mather *et al.*[5] This report deals mainly with the extended series of 450 patients who were randomly allocated to a place of treatment during the trial and followed up for a year.

Structure of trial

The plan of the trial has been described.[5] Entry was confined to men under 70 years of age who had suffered an infarction within the previous 48 hours. Women were excluded because home care for most would be difficult for social reasons. The trial was started in Bristol in October 1966, in Exeter in July 1967, in Torbay in January 1968, and in Plymouth in April 1968. Local practitioners were contacted and over half agreed to participate (a total of 458). Patients were offered and admitted to the trial when myocardial infarction was suspected on clinical examination by the participating doctor. Those not fulfilling the diagnostic criteria were subsequently excluded. Diagnostic criteria were based on the electrocardiographic (ECG)

changes suggested by the World Health Organisation.[6] These are the development of either direct injury currents, or typical Q and T wave changes in association with increases in appropriate serum enzyme levels. Patients were also accepted if subsequent necropsy showed evidence of recent myocardial infarction or coronary occlusion. Only a few patients were admitted to the trial because of necropsy evidence and the proportions in both home and hospital groups were similar. Any patient admitted to the trial who died before the ECG diagnosis could be made had a necropsy, usually performed by the coroner's pathologist.

In each of the four centres patients were allocated at random by the visiting general practitioner, who decided whether a patient entered the trial. Allocation to random treatment groups was made at provisional diagnosis by opening a sealed envelope which stipulated home or hospital care.

We accepted that random selection would not be possible in all cases and that certain groups of patients would be excluded: (*a*) those who opted strongly for either home or hospital care; (*b*) those who were visitors or living alone or had inadequate care at home; (*c*) those whose first medical contact was in the street, factory, or hospital or with a locum doctor who was unaware of the trial; (*d*) those who were considered by their doctor to have medical conditions, which might or might not be associated with the infarction, that precluded random allocation.

These excluded patients fell into three groups. Those in the "mandatory" hospital group entered the trial under circumstances which allowed no choice in the place of treatment. Those in the elective hospital or elective home groups might have been randomly allocated to treatment either at home or in hospital, but the general practitioner was inhibited by various considerations. The number of patients in these three groups are given for comparison, but the trial proper considered only those patients in the random home or random hospital groups.

Patients treated at home could be transferred to hospital if the family doctor thought it advisable, but in the analysis they were retained in their original groups. The usual reasons for transfer from home to hospital were problems in management, such as persistent cardiac pain, heart failure, deep vein thrombosis, and urinary retention, rather than sudden life-threatening conditions, such as serious dysrhythmias or evidence of further infarction.

The diagnosis in the hospital groups was confirmed by investigation in hospital and in the home groups by visits of a research fellow to the home, where at least three serial ECGs and two blood samples for serum enzyme tests were taken. The first ECG and blood test were made shortly after admission to the trial. The initial blood pressure of patients transferred to hospital was sometimes first recorded only on arrival and was thus subject to a variable delay. All the patients randomised to receive hospital treatment were admitted directly to a coronary care unit for a minimum of 48 hours before transfer to the adjacent medical ward. Management was similar to that in other coronary care units throughout the country and was standardised between the four centres. Treatment included constant monitoring by trained staff and the administration of anti-dysrhythmic agents. Trained nursing staff were encouraged to use the defibrillator for ventricular fibrillation. Facilities for pacemaking were available.

In contrast to that of patients in the random trial, treatment of those sent electively or mandatorily to hospital was not always standardised. Some of these patients were treated in hospitals without intensive care facilities.

As a minimum requirement for all cases, examinations were performed every one, two, four, and seven days after admission to the trial and thereafter at one, six, and 12 months after onset. We followed up all except 12 patients for about one year. Results are reported as 300 days survival or death, rather than a year, because of the variable time of final examination.

Results

The numbers in the five treatment groups in each centre and in total are given in table I. Of the 1895 confirmed episodes studied, a choice of treatment was possible in 1438 and 31% of these were in the random treatment groups. The randomised treatment groups were comparable in terms of crude classification by age and history (table II). The categories of history of angina or infarction were pooled because of the strong association between these features in the trial cases and the similar mortality risks when they occur singly or together. Similarly, patients with a history of hypertension (blood pressure known to be over 160/100 mm Hg or on treatment with hypotensive agents) or diabetes were pooled because of their small total number and similar prognosis during the trial. Apart from the 6% of cases in which initial blood pressure was not recorded (see table IX), the proportions of patients with initial hypotension (systolic blood pressure <100 mm Hg at first medical examination) were almost equal (8% at home; 7% in hospital).

The interval between the onset of the attack and the time of the

TABLE I—*Composition of treatment groups. Randomisation rate expresses total number of cases in random groups as percentage of total number in random and elective groups. Number in mandatory hospital group is expressed as percentage of grand total*

Centre	Random home	Random hospital	Total random group	Elective home	Elective hospital	Total of elective and random groups	Randomisation rate	Mandatory hospital	Grand total
Bristol	72 (14%)	78 (15%)	150	86 (17%)	271 (53%)	507	30%	101 (17%)	608
Exeter	45 (20%)	41 (18%)	86	20 (9%)	122 (54%)	228	38%	130 (36%)	358
Plymouth	37 (13%)	44 (15%)	81	20 (7%)	187 (65%)	288	28%	89 (24%)	377
Torbay	72 (19%)	61 (15%)	133	25 (6%)	257 (62%)	415	32%	137 (25%)	522
Total	226 (16%)	224 (16%)	450	151 (11%)	837 (58%)	1438	31%	457 (24%)	1895

TABLE II—*Composition of random treatment groups according to age and history. Results are numbers (percentages)*

Treatment group	Age (years)		History							
	<60	$\geqslant 60$	None	Any past history	Angina and/or infarction	Hypertension and/or diabetes	(Angina and/or infarction) and (hypertension and/or diabetes)	Total	Unknown	Grand total
Random home	118 (52)	108 (48)	93 (45)	112 (55)	69 (34)	18 (9)	25 (12)	205	21 (9)	226
Random hospital	109 (49)	115 (51)	86 (44)	111 (56)	67 (34)	20 (10)	24 (12)	197	27 (12)	224
Total	227	223	179 (45)	223 (56)	136 (34)	38 (9)	49 (12)	402	48 (11)	450

TABLE III—*Interval from onset until the first receipt of medical care for randomised cases. Results are numbers (percentages)*

Time t (hours):	$0<t<3$	$3\leqslant t<6$	$6\leqslant t<12$	$12<t\leqslant 48$	Total under 6 h	Total under 12 h	Total known	Unknown	Grand total
Random home	64 (44)	30 (21)	24 (16)	28 (19)	94 (64)	118 (81)	146	80 (35)	226
Random hospital	71 (49)	18 (13)	25 (17)	30 (21)	89 (62)	114 (79)	144	80 (36)	224
Total	135 (47)	48 (17)	49 (17)	58 (20)	183 (63)	232 (80)	290	160 (36)	450

TABLE IV—*Mortality rates in patients seen within three hours of onset of symptoms. Unknown cases are excluded from calculation of mortality rates*

Internal from onset:	<1 h		⩾1 and <2 h		⩾2 and <3 h		Total <3 h		
Group:	Random home	Random hospital	Random home	Random hospital	Random home	Random hospital	Random home	Random hospital	Total
No (%) dying in ⩽330 days	9 (41)	7 (29)	2 (10)	7 (25)	3 (16)	7 (41)	14 (23)	21 (30)	35 (27)
No (%) surviving >330 days	13 (59)	17 (71)	19 (90)	21 (75)	16 (84)	10 (59)	48 (77)	48 (70)	96 (73)
No unknown	1	0	1	2	0	0	2	2	4
Total	23	24	22	30	19	17	64	71	135

TABLE V—*Mortality rates for randomised cases. Results are numbers (percentages)*

Time of death (t) (days):	0<t⩽1	1<t⩽7	7<t⩽28	28<t⩽330	Total ⩽7	Total ⩽28	Total ⩽330	Survival>330	Unknown	Grnad total
Random home	1 (0·5)	7	18	18	8 (4)	26 (12)	44 (20)	176	6	226
Random hospital	4 (2)	11	16	27	15 (7)	31 (14)	58 (27)	160	6	224
Total	5 (1)	18	34	45	23 (5)	57 (13)	102 (23)	336	12	450

TABLE VI—*Mortality rates in different age groups. Unknown cases are excluded from all calculations of mortality rates*

Age (years):	<60			⩾60			Total		
Time (days):	No (%) dying in ⩽330 days	No (%) surviving ⩾330 days	No unknown	No (%) dying in ⩽330 days	No (%) surviving >330 days	No unknown	No (%) dying in ⩽330 days	No (%) surviving >330 days	No unknown
Random home	20 (17)	97 (83)	1	24 (23)	79 (77)	5	44 (20)	176 (80)	6
Random hospital	19 (18)	87 (82)	3	39 (35)	73 (65)	3	58 (27)	160 (73)	6
Total	39 (17)	184 (83)	4	63 (29)	152 (71)	8	102 (23)	336 (77)	12
χ^2 (DF = 1)	0·03; NS			3·44*; NS			2·67; NS		

*This value is significant at 10% level. NS = Not significant.

first medical examination (when the decision on randomisation was usually made) was known for only 290 patients (64%) as this information was not sought at three of the centres in the earlier stages of the trial. Altogether 135 (47%) of these patients were seen within three hours (table III). Indefinite times of onset made some uncertainty inevitable, but there was no reason to suppose that patients with unknown times differed in any essential respect from the rest. The distribution for all patients was similar to the total of known times reported from Bristol alone, where a record was made from the beginning of the trial.

The fate of patients seen within three hours of onset is shown in table IV: mortality rates at 330 days were 23% at home and 30% in hospital. These rates only fractionally exceeded the corresponding rates for all random home (20%) and random hospital (27%) patients. There was a differential in favour of home treatment, although it was not statistically significant.* The variability in the contrasts between the treatment groups in different hours was probably because of the small numbers. At first it might be thought that many seen within an hour at home were dying suddenly and early of primary ventricular fibrillation, but, early deaths at home were less common than in hospital (table V). For patients seen at known later times (>3 to 48 hours after onset) mortality rates at 330 days were 17% in the random home group, 21% in the random hospital group, and 19% overall; and for patients seen at unknown times the rates were 21% (random home), 28% (random hospital), and 25% overall. The small difference between patients seen at known, as opposed to unknown times, was not significant. The overall mortality rates (table V) were similar in the two random groups both at 28 days (12% home; 14% hospital) and at 330 days (20% home; 27% hospital), the slightly lower home rate being not significantly different.

There was the expected higher death rate in those aged 60 years or over, and this was most pronounced among those treated in hospital (table VI). Twenty-four patients (23%) treated at home survived only 330 days or less compared with 39 patients (35%) treated in hospital. There was a significant difference in favour of home treatment for patients aged 60 years and over without initial hypotension (table VII). Random home patients who were later transferred to hospital fared similarly to the main group of hospital patients.

Patients with a history of angina or myocardial infarction fared almost equally badly wherever they were treated, their mortality rate being doubled at 330 days (table VIII). Of the 38 patients with diabetes of hypertension one (6%) treated at home and seven (37%) treated in hospital had died at 330 days. The mortality rate of those who had an initial systolic blood pressure of 100 mm Hg or above when first examined, with or without signs of heart failure, was lower in patients treated at home (table IX).

TABLE VII—*Mortality rates in patients aged 60 years and over and without hypotension (⩾ 100 mm Hg) when first examined*

	No dying in ⩽330 days	No surviving in >330 days	No unknown	Total
Random home	15	71	5	91
Random hospital	32	69	3	104
Total	47	140	8	195

χ^2 (DF = 1) (excluding unknown cases) = 5·01, which was significant at 5% level.

*Judgments of statistical significance were made at the conventional 5% level unless the contrary is indicated.

TABLE VIII—*Mortality rates of patients classified according to history of cardiovascular disease. Unknown cases are excluded from all calculations of mortality rates*

History:	None			Angina and/or infarction			Hypertension and or diabetes (no angina or infarction)			Unknown			Total		
Time of death (days):	No (%) dying in ⩽330	No (%) surviving >330	No unknown	No (%) dying in ⩽330	No (%) surviving >330	No unknown	No (%) dying in ⩽330	No (%) surviving >330	No unknown	No (%) dying in ⩽330	No (%) surviving >330	No unknown	No (%) dying in ⩽330	No (%) surviving >330	No unknown
Random home	11 (12)	80 (88)	2	26 (29)	64 (71)	4	1 (6)	17 (94)	0	6 (29)	15 (71)	0	44 (20)	176 (80)	6
Random hospital	15 (18)	69 (82)	2	30 (34)	58 (66)	3	7 (37)	12 (63)	1	6 (22)	21 (78)	0	58 (27)	160 (73)	7
Total	26 (15)	149 (85)	4	56 (31)	122 (69)	7	8 (22)	29 (78)	1	12 (25)	36 (75)	0	102 (23)	336 (77)	12

TABLE IX—*Mortality rates of patients according to presence or absence of hypotension (<100 mm Hg) when first examined. Unknown cases are excluded from all calculations of mortality rates*

Initial hypotension:	Absent			Present			Unknown			Total		
Time of death (days):	No (%) dying in ≤330	No (%) surviving >330	No unknown	No (%) dying in ≤330	No (%) surviving >330	No unknown	No (%) dying in ≤330	No (%) surviving >330	No unknown	No (%) dying in ≤330	No (%) surviving >330	No unknown
Random home	30 (16)	160 (84)	6	9 (56)	7 (44)	0	5 (36)	9 (64)	0	44 (20)	176 (80)	6
Random hospital	48 (25)	144 (75)	6	6 (43)	8 (57)	0	4 (33)	8 (67)	0	58 (27)	160 (73)	6
Total	78 (20)	304 (80)	12	15 (50)	15 (50)	0	9 (34)	17 (66)	0	102 (23)	336 (77)	12

An analysis of the patients treated at each of the four centres showed that the mortality rates and the characteristics of the randomised patients were similar in each.

Discussion

The essence of this report is a comparison of two groups of patients allocated at random to home or hospital care. The two groups were similarly constituted in age, history of cardiovascular disease, delay to first medical care, and the presence of a defined degree of hypotension at first examination. Of these factors the chances of dying were related most strongly to age, a history of angina or a previous infarction, and initial hypotension, and comparisons of treatment on subgroups of cases distinguished by these factors are important.

The mortality rate overall compared favourably with that reported from other centres.[7] Comparison of the two groups for survival to 330 days slightly favoured home care. While this contrast was not statistically significant, it may be stated with 95% confidence that the true difference between the percentage mortalities at 330 days in the two random groups in the circumstances of the trial lay between 14·5% in favour of home and 1·3% in favour of hospital treatment. The patients who do particularly well at home are those aged 60 years or over with initial blood pressures of 100 mg Hg or above (significant at the 5% level).

In 1965, when our trial was formulated, it was considered that treatment in coronary care units for the first 48 hours might significantly lower the mortality by preventing and treating dysrhythmias. Since then it has been shown that the period of extremely high risk is within the first hour or two from onset.[8] Even though our numbers were small, for the 135 patients seen and admitted to the trial before three hours there was no significant difference between home and hospital care when judged by survival to 330 days. Furthermore, their mortality (27%) was only slightly higher than that of those who first saw a doctor later after their infarct (23%). Our study had insufficient patients (99) seen within two hours of onset to decide whether their admission to hospital offers significant benefits. Further randomised trials of such patients seem both necessary and ethical.

Although several studies[9,10] covering the psychological reaction of patients admitted to coronary care units indicate that they may be reassured by such units, we think that stress associated with transfer to hospital[11] might contribute to anxiety and lead to irremediable dysrhythmias and pump failure. In contrast, a continuing peaceful and secure home atmosphere might prevent the development of some of the complications. We did not attempt to compare the effect of treatment in a coronary care unit with that in a general medical ward. We accepted that if patients were admitted to hospital they should be treated initially in a coronary care unit.

The conclusions on survival to 330 days are, of course, based only on the 31% of patients who were randomised to place of treatment. As reported previously,[5] however, these patients were broadly typical of the non-randomly treated patients, apart from the slightly greater proportion of younger patients in the elective and mandatory hospital groups and a higher proportion of those with signs of heart failure or initial hypotension: patients with these characteristics do poorly wherever they are treated. The treatment of patients both in hospital and at home was modelled as closely as possible on current clinical practice. There was also no clear difference in the length of the interval from onset to first medical examination between the randomised groups and the remainder, and the timings were comparable with those in other reports[12,13] that refer to the time interval from onset to admission to hospital.

These facts suggest that the comparisons made on the randomised cases justify home care of many patients with acute myocardial infarction presenting in general practice. Extension of the analysis to an enlarged series of patients confirms this observation with particular emphasis when the patient is aged over 60 years and is without initial hypotention (as defined).

SUGGESTIONS ON MANAGEMENT

Our opinions on management concern those patients who suffer a myocardial infarction at home and for whom a general practitioner is called. They agree broadly with those of Colling[14] and the Council of the Royal College of General Practitioners.[15] Treatment at home is to be favoured if: (*a*) the patient is elderly, especially if there is no hypotension, heart failure, or persistence of pain; (*b*) the attack is uncomplicated and the patient is seen some hours after the presumed onset; (*c*) the patient wants home care; and (*d*) the home is some distance from a hospital, especially if this has no intensive care facilities.

Medical, as distinct from social, factors that might influence the doctor towards hospital admission will be: (*a*) persistent dysrhythmias, particularly ventricular ones. Multiple ventricular ectopic beats may presage more serious rhythms, but the possibility that these may develop later on as a result of transfer to hospital cannot be excluded; and (*b*) bradycardia (<55/min) which has not responded to atropine. The desirability of hospital treatment in these circumstances will be affected by the proximity of a coronary care unit.

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Emergency arteriography in acute gastrointestinal bleeding

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Emergency arteriography was carried out on 35 patients with acute gastrointestinal bleeding, in 31 of them within two hours of active bleeding (a haematemesis; a diagnostic change in central venous pressure, pulse rate, or blood pressure; or gastric aspiration of fresh blood). A definite site of bleeding was identified in 27 patients (77%)—this being a small-intestinal vascular abnormality in three—and a probable site in three. Confirmation of the bleeding site was obtained in 20 out of 23 patients treated surgically. An intra-arterial vasoconstrictor infusion was given as a temporary measure before surgery in seven patients, only one of whom showed active bleeding at operation. An intra-arterial vasoconstrictor infusion was tried as definitive treatment in an additional 10 patients, but in four out of seven with a chronic ulcer bleeding recurred after 5-68 hours and was therefore treated surgically.

We recommend the diagnostic use of arteriography in patients with reliable evidence of active bleeding if its site cannot be determined by endoscopy. We do not recommend its therapeutic use in those with a chronic ulcer, except to facilitate resuscitation before surgery; further studies are needed to define its role in those with an acute lesion.

Introduction

After the finding in animals[1] that contrast medium leaking into the lumen of the gastrointestinal tract at 0·5 ml/min may be identified by selective arteriography, Baum *et al*[2] introduced arteriography in the investigation of patients with active gastrointestinal bleeding. They defined "active" as the presence at the time of study of melaena, haematemesis, or hypotension or a continued fall in haemoglobin and packed cell volume. They detected the bleeding site in four of the first eight patients studied. Subsequently Reuter and Bookstein[3] identified the site of bleeding in 11 out of 16 patients thought clinically to have active bleeding, although they did not define their criteria for assessing activity. Frey *et al*[4] detected a bleeding site in 25 out of 45 patients with active bleeding as indicated by haematemesis or melaena or a continuing drop in packed cell volume. Stanley and Wise[5] detected a bleeding site in 35 out of 68 patients with acute gastrointestinal bleeding; it was detected in 17 out of 22 patients who were clinically shocked, and in 17 out of 20 patients who had received five or more units of blood over the previous 24 hours.

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Some of the above criteria are unreliable or insensitive indicators of active bleeding. Melaena stools continue long after bleeding had stopped, and haemoglobin and packed cell volume do not fall till haemodilution has occurred. Only about half of the patients have a haematemesis at the time of an episode of recurrent haemorrhage,[6] and central venous pressure is a more sensitive index of recurrent haemorrhage than pulse rate and blood pressure.[7] Our main aim was to determine the diagnostic yield from arteriography carried out during active bleeding, making use of sensitive and reliable indicators of recurrent haemorrhage. Thus patients with acute gastrointestinal bleeding were routinely admitted to an intensive care ward and central venous pressure was measured hourly in addition to other forms of monitoring.

An additional objective was to carry out a pilot study of the potential therapeutic value of intra-arterial infusion of vasoconstrictors, as judged by the same sensitive and reliable indicators of recurrent haemorrhage. After the introduction of this form of treatment,[8] Rosch *et al*[9] clearly showed, by repeating arteriography immediately after intra-arterial adrenaline infusion, that it results in arterial vasoconstriction and the immediate stopping of haemorrhage from arteries in the upper gastrointestinal tract. It is not clear, however, what risk there is of recurrent haemorrhage over a longer period once the infusion has been stopped.

Patients and methods

Patients with acute gastrointestinal bleeding were admitted to an intensive care ward and selected for emergency arteriography if they fulfilled one or more of the following criteria: (1) haematemesis; (2) a fall in central venous pressure over two hours or less from 1 cm water above the manubriosternal joint to 4 cm water below the manubriosternal joint; (3) a rise in pulse rate of 20 beats/min over less than two hours; (4) a fall in systolic blood pressure of 20 mm Hg over two hours or less; (5) gastric aspiration of fresh blood.

Diagnostic studies—Emergency arteriography was carried out within two hours of the patient fulfilling the above criteria. The coeliac artery, and in some cases the superior mesenteric artery, was catheterised from the femoral artery by the Seldinger technique. When evidence of bleeding was equivocal selective catheterisation of the left gastric or gastroduodenal artery was carried out as indicated.

Therapeutic studies—In the latter part of the study, when arteriography showed definite evidence of a bleeding site it was followed immediately by intra-arterial infusion of adrenaline or vasopressin. If immediate surgery was planned the infusion was given down the same catheter, but if not, then, to prevent clotting in the catheter tip, the original catheter, which had an end hole and a side hole, was changed for one having an end hole only, which was left in situ for 24-72 hours. For infusion of the coeliac axis adrenaline was given at a rate of 15-20 μg/min for 20-60 minutes using a Fenwal pressure infusor. For infusion of the superior mesenteric artery vasopressin was given at a rate of 0·2 unit/min for 10 minutes, followed by 0·3 unit/min for 20 minutes.[10] After either infusion heparin was given slowly intravenously to keep the catheter patent. If further haemorrhage occurred the patient underwent emergency surgery preceded by a further infusion of adrenaline or vasopressin to prevent further preoperative blood loss.