PAPERS AND ORIGINALS

Course of patients discharged early after myocardial infarction

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British Medical Journal, 1976, 1, 1555-1558

Summary

Two hundred and seventy-one (76%) out of 358 survivors of infarction were discharged by the eighth hospital day, and 251 (93%) of them survived to six weeks after discharge. Six of the 20 patients who died between discharge and six weeks did so after readmission and 14 died as outpatients. All these patients who died at home had transmural infarction and four had diabetes. In inpatients successful resuscitation occurred mainly within the first 48 hours, with only three successful long-term results from all the patients who suffered arrest later. This suggests that more prolonged inpatient care would not have reduced the late mortality. These figures justify continuing with an early discharge policy for most patients, but coronary care should probably be more prolonged for patients with diabetes.

Introduction

Early mobilisation and discharge of patients with myocardial infarction have several important advantages, which include freeing beds for patients during the early vulnerable hours. Anxiety, depression, and undue delay in return to work, common complications after infarction, may be reduced by early discharge.^{1,2} Despite previous fears,³ early mobilisation and discharge do not seem to lead to increased ventricular rupture or aneurysm formation^{1,4,5} but may lead to several outpatient

deaths that may be prevented by a more prolonged period of inpatient treatment. A progressively shorter period of inpatient treatment for myocardial infarction has been recommended in recent years. A multicentre controlled trial¹ has suggested that patients discharged on the 15th day do as well as those discharged on the 28th day. Another controlled study,⁶ which compared the results of a two-week hospital stay with those of a three-week stay, showed that there seemed to be no additional benefit in a three-week stay. In 1973 we published results⁷ in which 89% of patients surviving infarction were discharged by the 10th day. Subsequent prospective trials^{8,9} have shown that it is safe to send selected patients home after less than 10 days in hospital. We describe here our experience with an even earlier less selective discharge policy than has previously been described and our study of the subsequent outpatient course.

Patients and methods

The male coronary care unit consists of 20 beds, six of which are equipped for continuous monitoring. Patients are monitored for 72 hours and restricted to bed for the first 24 hours. After 24 hours those who are free from significant chest pain or hypotension are allowed to sit in a chair. After the monitored period patients move down the ward but remain in the unit throughout their stay in hospital. They are restricted to sitting in a chair until the sixth day, when they are encouraged to walk around the ward if free from heart failure or other obvious contraindications. On the seventh and eighth days most are discharged home. Patients who are kept in beyond the eighth day have persistent heart failure, recurrent arrhythmias, infarct extension, pulmonary embolism, other existing complications of infarction, or inadequate home conditions. After discharge all patients are instructed to remain in their homes for one month. A month after discharge they are encouraged to start taking short walks. Six weeks after discharge they are reviewed in the outpatient clinic.

Four hundred and five men were admitted with myocardial infarction between June 1974 and June 1975. Proof of infarction was based on the clinical history together with electrocardiographic evidence of either transmural or non-transmural infarction or an increase in serum aspartate aminotransferase or lactic dehydrogenase levels, or both. The men were aged 28 to 80 with a mean of 56.9 years. Altogether 312 patients (77%) had suffered from predominantly transmural infarction while 85 (21%) suffered non-transmural infarction. In the remaining eight (2%) the presence of left bundle-branch block made assessment of the type of infarction impossible.

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Results

INPATIENT DEATHS

Fifty-nine (15%) of the 405 patients died as inpatients, and table I shows the time of death after admission as well as the number of successful resuscitations in patients who survived to leave hospital. Three hundred and fifty-eight patients survived to the eighth hospital day. Twelve patients died as inpatients after the eighth hospital day; all had been kept in because of existing complications of infarction. None of the late deaths occurred in the group kept in after the eighth day for social or unrecorded reasons.

PATIENTS DISCHARGED BY THE EIGHTH DAY

Two hundred and seventy-one (76%) of the 358 patients who had survived were discharged by the eighth hospital day; 191 had had a transmural infarct, 76 had had a non-transmural infarct, and in four cases left bundle-branch block obscured the extent of the infarct. Eighteen of this group had been admitted more than 24 hours after the onset of acute symptoms and 49 had had a previous infarct. These patients discharged by the eighth day included five who had been resuscitated from ventricular fibrillation; 11 who had been treated for ventricular tachycardia; eight who had been in complete heart block which had not required pacing; six who had been in second degree block; and 12 in whom sinus tachycardia had been recorded during the first 72 hours of admission.

READMISSION OF PATIENTS DISCHARGED BY THE EIGHTH DAY

Patients readmitted with further infarction—Twelve (4%) of the patients who were discharged by the eighth hospital day were re-

admitted within six weeks with a second infarct; four of these patients died. The mean interval between discharge and second admission was nine days (range 1-23 days). Eight readmissions occurred within a week of discharge.

Patients readmitted with late complications of infarction—Eleven patients were readmitted for reasons other than infarction; in five the reason for readmission was cardiac pain without subsequent evidence of reinfarction. Two had the postinfarction syndrome; three were admitted with cerebrovascular accidents; two were in left ventricular failure; and one patient was admitted with acute pancreatitis. One of the three patients with cerebrovascular accidents and the patient with acute pancreatitis died.

Hence there were six deaths after readmission. Table II shows the number of days after initial discharge that these deaths following readmission occurred, as well as describing the time and number of deaths occurring in outpatients.

OUTPATIENT DEATHS IN PATIENTS DISCHARGED HOME BY EIGHTH DAY

Patients who died within the first week at home—Table II outlines the number of days after discharge that the outpatient deaths occurred in those discharged by the eighth day. Eight outpatient deaths occurred within the first week, and table III describes the ages, site of infarction, significant history, and some details of the inpatient course of these eight patients. In each case the infarct was transmural. All of these patients had been admitted within 24 hours of the acute onset of symptoms; three were known diabetics, and in each case the diabetes was mild and controlled by diet alone. One of the patients with anterolateral infarction developed left bundle-branch block during the first 72 hours of admission. Another patient had frequent atrial extrasystoles recorded during the first 72 hours, and another developed

TABLE I—Time and number of deaths after admission and time and number of successful resuscitations in patients who survived to leave hospital

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	33
No of deaths after admission	23	11	6	1	1	1	3	1	2	3	1		1	2		1					1			1
No of successful resuscitations	13	6			1			1					1											

TABLE II—Time and number of deaths among patients discharged by eighth day

No of days after discharge:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	38
No of outpatient deaths	1	3	1	1	1	1				1		2		2						1												
No readmitted:																																
Who died after further infarction ..							1																									1
Who died of late complications ..								1									1									1						

TABLE III—Details of patients who died after being discharged from hospital by eighth day

Case No	Age	Site	Previous infarct	Diabetes	History	Previous angina	Left ventricular failure	Arrhythmia or conduction abnormality	Days after discharge to death
<i>Patients who died within a week of discharge</i>									
1	54	Anterolateral	No	No	None	1 week	Yes	LBBB	1
2	62	Antero/inferolateral	No	No	Cerebral vascular accident, hypertension	1 month	No	Sinus tachycardia	2
3	47	Inferolateral	No	No	Epileptic	No	Yes	Wenckebach	2
4	50	Inferior	No	No	No	No	No	No	2
5	43	Inferior	No	Yes, steroid induced, diet controlled	Asthma, obesity	No	No	No	3
6	53	Inferior	Yes	Yes, diet controlled	No	3 years	No	No	4
7	73	Inferolateral	Yes	No	Depression	10 years	No	Atrial extrasystoles	5
8	74	Inferior	No	Yes, diet controlled	Atrial fibrillation	No	No	Stayed in atrial fibrillation	6
<i>Patients who died over a week after discharge</i>									
9	75	Inferior	No	No	Pernicious anaemia	3 years	No	6 hours of sinus bradycardia	10
10	66	Anterolateral	No	No	Obesity	1 year	Yes	No	14
11	71	Anterior	No	No	No	3 months	No	Junctional extrasystoles	14
12	66	Inferior	No	Yes, diet and phenformin	No	No	Yes	No	12
13	60	Anterolateral	No	No	Peripheral vascular disease	No	No	No	12
14	63	Inferoposterior	No	No	No	No	No	1 hour of sinus bradycardia	21

sinus tachycardia (rate greater than 110/min), which developed during the first 72 hours and was still present at the time of discharge. Another patient with an inferior infarct developed Wenckebach atrioventricular block, which started 48 hours after admission and persisted for 72 hours.

Four of this group had been free from both left ventricular failure and a significant arrhythmia or conduction abnormality and none had suffered ventricular fibrillation or ventricular tachycardia. Three of these four patients were the mild diabetics mentioned above and two had had a previous infarct. Details of the circumstances of death were obtained from the patients' general practitioners. Death had either not been witnessed or was sudden in five cases. Two patients complained of pain for a few minutes before death, while one patient died after a night of prolonged pain.

Patients who died after a week at home—Table III describes also the six patients who died 10 days to three weeks after discharge. All had transmural infarctions and five had apparently convalesced uneventfully. Four of these deaths were either unwitnessed or sudden. The fifth patient died before arrival of the ambulance after prolonged pain. We have no knowledge about the course and mode of death of the sixth. No consistent pattern emerges from this analysis, though one of the group was a diabetic controlled on diet and phenformin.

PATIENTS WITH PREVIOUSLY DIAGNOSED DIABETES

Thirteen of the original 405 patients (3%) had known diabetes, and only three of these patients survived to six weeks after discharge. Three died within the first 72 hours with intractable failure and a further two died on the fifth and 14 day for the same reason. Thus eight patients with previously known diabetes survived to be discharged. Five of these were discharged by the eighth day and only one of these patients survived at six weeks. Three remained in hospital beyond the eighth day because of persisting heart failure in two and the need to stabilise the diabetes of the third. Two of these patients survived to six weeks and the third died six days after discharge.

PATIENTS WHO STAYED IN HOSPITAL AFTER THE EIGHTH DAY

Eighty-seven patients were kept in after the eighth day and 75 survived to leave hospital. Patients were often kept in for more than one reason, the major reason being persistent heart failure in 31, recurrent arrhythmias in 17 (nine of this group had complete heart block requiring pacing), an extension of the original infarct in 12, pulmonary emboli in six, and systemic emboli in seven. One patient required stabilisation of diabetes. Eight remained for social and five for unrecorded reasons and none of these died. Six of those kept in beyond the eighth day subsequently died as outpatients, and 12 were readmitted with further infarcts.

PATIENTS WHO SUFFERED CARDIAC ARREST AND SURVIVED TO LEAVE HOSPITAL

Table I shows the total number of cardiac arrests after admission with the numbers of resuscitations from which the patient survived to leave hospital. These were largely confined to the first 48 hours; only three patients who had an arrest after 48 hours survived to leave hospital.

Eight patients had ventricular tachycardia not associated with arrest but requiring treatment with lignocaine. In each case it occurred within 24 hours of admission.

Discussion

Although 251 (93%) of the 271 patients discharged by the eighth hospital day survived to six weeks after discharge, eight patients died within a week of discharge, and some of these might possibly have been resuscitated if they had stayed in hospital longer. Restieaux *et al*¹⁰ established that ventricular fibrillation may be a late complication occurring a week or more after infarction. Thompson and Sloman¹¹ recommended more extended coronary care for selected patients. Grace and Yarovite¹² investigated the value of extending the usual acute facilities into a period of intermediate coronary care. They thought that this policy resulted in a reduction in the expected number of deaths.

Reynell,¹³ however, has questioned the value of intermediate coronary care because of the apparent rarity of primary ventricular fibrillation occurring after discharge from the coronary care unit.

As expected, our figures indicate that successful resuscitation after cardiac arrest occurred mainly during the first 48 hours in hospital. Most patients kept in the ward beyond the eighth day had continuing complications of infarction and thus had a worse prognosis than those discharged early. None the less, only one of the 13 patients who suffered cardiac arrest after the eighth day survived to leave hospital, which suggests that a more prolonged hospital stay would not have reduced the late death rate appreciably.

Chaturvedi *et al*⁹ selected a group of patients seven days after infarction by the absence of certain risk factors. Forty per cent of all their patients who survived to six days had none of these risk factors and all of this group survived to three months. Applying these risk factors to our eight patients who died within the first week of discharge we would have kept in three for longer. Applying these factors to all patients, however, would have meant keeping many more in hospital. Chaturvedi *et al*⁹ discharged only 49% of the survivors by the eighth day in contrast to our 76%.

Hayes *et al*⁸ found that 71% (189) of all patients surviving to 48 hours in a coronary care unit were free from persistent cardiac pain, heart failure, or significant arrhythmias. These patients were allocated to an early group discharged on the ninth day and a late group discharged on the 16th day. There was no subsequent difference between the two groups in numbers of further infarctions, readmissions, or deaths.

Soler *et al*¹⁴ have confirmed reports^{15,16} that patients with diabetes mellitus have a worse prognosis after myocardial infarction, emphasising their liability to late cardiac arrest. Harrower and Clarke¹⁷ showed a slightly significantly worse prognosis for patients with diabetes after infarction. Only three of our 13 patients with previously known diabetes survived to six weeks after infarction. Five died as inpatients and five died after discharge. Three of the eight deaths that occurred within a week of discharge occurred in diabetics. In each case the diabetes was mild and controlled by diet alone.

This analysis of the inpatient course of those patients who died after discharge has not provided any means of identifying all of them in advance. All the outpatient deaths occurred in patients with transmural infarction, so it would seem that it is safe to discharge patients with non-transmural infarction early. Our results confirm a report¹¹ that indicates that diabetics are especially liable to late arrest and that they should probably be kept in hospital for longer, although the reported results of late resuscitation on a general medical ward are poor in this group.¹⁷ A trial of prolonged coronary care for patients with diabetes is required, and we now keep patients with diabetes in our coronary care unit for a longer period.

An early discharge policy inevitably leads to a few unexpected outpatient deaths. Successful long-term results from resuscitating patients who underwent cardiac arrest were confined almost solely to those who suffered arrest within the first 48 hours. We recorded successful long-term results in only three of those who suffered arrest after this time. This suggests that a longer hospital stay would not have appreciably reduced our late mortality rate. An early discharge policy frees more beds for patients during the early vulnerable hours after infarction, when resuscitation is particularly likely to be successful. It probably also leads to a quicker return to work, with less anxiety and depression.

We thank Mr W Deaville, Mr J Silk, and all the nursing staff on the coronary care unit for their co-operation and the senior house officers and registrars who have rotated through cardiology during these investigations for all the help that they gave us. We thank the Department of Health and Social Security for financial support for three of the authors (AG, HT, and RP).

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Nitrazepam: lastingly effective but trouble on withdrawal

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British Medical Journal, 1976, **1**, 1558-1560

Summary

The sleep of 10 volunteers with an average age of 57 years was recorded electrophysiologically before, during, and after nitrazepam 5 mg nightly for 10 weeks. Sleep was longer and less broken on the drug and no tolerance was obvious after two months' use. Withdrawal of the drug, however, caused sleep to be temporarily worse than before the drug had been taken. Slow-wave sleep was reduced by nitrazepam, but the accompanying secretion of growth hormone was not impaired.

Introduction

We recently described how a placebo had no effect on sleep¹; here, using the same 10 middle-aged volunteers, we report on the actions of nitrazepam 5 mg. We also looked for any influence on the nocturnal secretion of growth hormone (GH).

All-night electrophysiological recording makes precise measurement of the amount of time a person is asleep possible. It also shows two different kinds of sleep that alternate through the night. One is rapid eye movement (REM) or paradoxical sleep, the other is non-REM or orthodox sleep. The latter is subdivided into stages 1, 2, 3, and 4. Stages 3 and 4 are known as slow-wave sleep (SWS) and during these stages the large nocturnal secretion of GH occurs. In the undrugged condition the secretion depends on the presence of stages 3 and 4 and does not take place if these stages are not allowed to develop.^{2,3} Growth hormone is thought to be important for sleep's restorative function, and since many benzodiazepines will reduce SWS, it seemed important to find out whether nitrazepam would impair GH secretion. In clinical practice drugs are taken for long periods, and so we conducted a study over many weeks.

Methods

Ten volunteers, with the agreement of their general practitioners, took part in this study of nitrazepam 5 mg nightly. There were six women and four men aged 41-62 (mean 57) years. They had taken no drugs in the preceding months and were asked not to take any drugs other than those given by us and to consume no alcohol. Subjects attended the laboratory, to sleep in quiet and comfortable bedrooms according to the experimental design:

Weeks 1 and 2 ..	.. 2 Adaptation nights, 6 baseline nights
Weeks 5 and 6 ..	.. 1 Adaptation night, 6 early drug nights
Weeks 7 to 10 ..	.. Drug continued at home
Weeks 11 and 12 ..	.. 1 Adaptation night, 6 late drug nights
Weeks 13 and 14 ..	.. Drug continued at home
Weeks 15 and 16 ..	.. 1 Adaptation night, 6 withdrawal nights

The drug was taken 30 minutes before lights-out (about 2230 to 0715). On all nights the electroencephalogram, eye movements, and submental muscle tone were recorded.

Seven of the volunteers attended the laboratory for six additional nights, when blood was sampled through a catheter without disturbing the sleeper.⁴ The six nights represented one adaptation night followed by one recording and blood sampling night during the baseline period and similarly one adaptation and one measurement night in the early drug phase and one adaptation and one measurement night in the late drug period. The blood samples were taken every 30 minutes, and the plasma was separated and stored deep-frozen until assayed.

The GH concentration in each sample was assayed "blind" as to the experimental condition by the MRC Radioimmunoassay Team in Edinburgh using the method of Hunter.⁵ The GH results were expressed as mU/l (in terms of human growth hormone international reference preparation 66/217) concentration at the clock time when the blood sample was taken. These clock times were then converted, for each night, into time in minutes after the first onset of sleep. Graphs were plotted, and the area under the GH curve, from sleep onset to six hours later, was measured by a planimeter in cm². The vertical scale was 1 cm/2 mU/l and the horizontal scale was 2 cm/hour.

The electrophysiological recordings were coded and categorised "blind" into the different stages of sleep and wakefulness.⁶ The time it took subjects to fall asleep, the total amount of time they slept, and the hourly distribution and total number of minutes after the onset of sleep that they were awake and in each of the sleep stages were calculated.

STATISTICS—Friedman's analysis of variance was used to test the overall significance of the results,⁷ and *t* tests for paired observations were used to compare the different periods of the experiment.⁸

Results

The volunteers slept longer while taking the drug. This improvement in sleep was maintained throughout the drug period, but on withdrawal from the drug the time spent asleep was significantly shorter than before the drug had been taken (table I).

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