

The Course of Acute Myocardial Infarction

Feasibility of Early Discharge of the Uncomplicated Patient

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SUMMARY

This report represents our experience with 522 consecutive patients with acute myocardial infarction admitted directly to the Duke Coronary Care Unit. Fifty items of information were used to characterize the patients, their hospital course and follow-up. Serious complications included death, ventricular tachycardia or fibrillation, second- or third-degree heart block, pulmonary edema, cardiogenic shock, persistent sinus tachycardia or hypotension, atrial flutter or fibrillation, and extension of infarction. Forty-nine percent of the patients (252 of 522) experienced a serious complication. All patients who experienced any serious complications had at least one of the above during the first four days of hospitalization. Patients who survived through day 4 were subgrouped on the basis of the occurrence (complicated) or lack of occurrence (uncomplicated) of the above on day 5. Complicated patients had a subsequent hospital mortality of 14% and an incidence of late serious complications of 51%. Patients who were uncomplicated through day 4 had a subsequent hospital mortality of zero and an incidence of late serious complications of zero. These data suggest that it would be feasible and ethically justified to conduct a prospective clinical trial of early discharge (7th day) in patients who meet the above criteria for uncomplicated. The potential economic savings through earlier discharge in uncomplicated patients are of major significance.

Additional Indexing Words:

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Shock

Computer

IN 1952, Levine and Lown¹ first offered evidence to seriously challenge the view that prolonged bed rest and hospitalization were necessary in the management of patients with acute myocardial infarction. Their studies demonstrated that patients could be advanced from bed rest to chair two to seven days after infarction and discharged at four weeks with no apparent increase in mortality or morbidity. In 1969, Lown and Sidel² stated that in their view patients who did not exhibit complications during the first week after infarction derived no special benefit from remaining in the hospital after the tenth or twelfth day. Wenger et al.³ subsequently published an extensive nationwide survey of the approach to management of over 70,000 patients treated during

1970 and revealed a median hospital stay of 21 days. Subsequent studies by Hutter et al.,⁴ Harpur et al.,⁵ Groden et al.⁶ and others^{7, 8, 9} supported the view that even earlier discharge (14–21 days) could be advocated with safety in patients with uncomplicated infarction. The major purpose of this report is to provide additional evidence regarding the “benign” hospital course of initially uncomplicated patients with acute infarction and to define more precisely the characteristics which identify the patient who will follow such a course. Our data also suggest that it would be feasible and ethically justified to conduct a study of even earlier discharge (7 days) and that nearly 50% of patients admitted directly to a coronary care unit with established infarction might be candidates for such a study.

Methods

The data bank used in this analysis consisted of 50 items of information on 522 consecutive patients admitted directly through the emergency room or outpatient facility to the Duke Coronary Care Unit (CCU) for acute myocardial infarction between 1965 and 1973. An additional 239 patients admitted by intra-ward or intra-hospital transfer were not included in the analysis because of the presence of complications which necessitated the transfer or of another disease which otherwise precluded consideration of early discharge.

Acute myocardial infarction was defined by the presence

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of at least two of the following three factors: (1) a clinical history of chest pain which suggested acute myocardial infarction; (2) new Q waves or typical evolutionary ST-T changes on the electrocardiogram; and (3) characteristic changes of the serum enzymes. The enzyme changes included an elevated lactic dehydrogenase and/or creatine phosphokinase without abnormal serum glutamicpyruvate transaminase and, more recently, an elevation of the isoenzymes of creatine phosphokinase and lactic dehydrogenase. Ninety-five percent of the patients in the study had enzyme changes considered diagnostic of infarction, i.e., transiently elevated values which subsequently fell to normal in the absence of other possible causes for the elevation.

Since January 1967, all data used in this analysis have been recorded daily on flow sheets by a resident house officer and/or cardiology fellow. Data on patients evaluated prior to January 1967 were recorded retrospectively on the same standardized forms. All items of information were reviewed and verified by at least one senior cardiologist. Follow-up data on life-death status were obtained at six-month intervals after hospital admission. These data were obtained by a staff cardiologist during a clinic visit or by a research associate over the telephone. The follow-up data were 100% complete. Analyses were performed using an interactive data analysis system.^{10, 11}

The 522 patients were reviewed to determine the presence and time of occurrence of serious complication. The complications considered serious were death, ventricular tachycardia (4 premature ventricular contractions in a row) or fibrillation, second- or third-degree heart block, pulmonary edema, cardiogenic shock, persistent sinus tachycardia (> 100 beats/min), persistent hypotension (SBP < 90 mm Hg), rapid atrial arrhythmias or extension of infarction. The presence of other complications considered unserious (i.e., transient hypotension, new intraventricular conduction disturbances, first-degree heart block, a ventricular gallop and/or basilar rales, and the presence of greater than six premature ventricular beats/minute) was also determined. The ECG monitoring system on our CCU includes continuous central monitoring: a tape memory loop and a 24-hour/day "monitor watcher" who records regular

strips every two hours, any observed disturbances of rhythm, and any rhythm which exceeds rate limits and thus activates the recording system automatically.

Results

Serious complications occurred in 257 (49%) of our 522 patients. It was of interest, however, that all patients who suffered a serious complication had at least one of these complications prior to the fifth day of hospitalization. Since death at any time during hospitalization was regarded as a serious complication, it follows that all patients who died, early or late, fell into the group who had at least one serious complication during the first four days. An important corollary of this method of subgrouping was that hospital mortality was zero in those patients who were free of any serious complication during the first four days of hospitalization. There were 102 deaths in 522 patients. Seventy-six of the deaths occurred during the first four days and 26 occurred after day 4. All 26 late deaths occurred in patients who had suffered a serious nonfatal complication during the first four days. Thus, hospital mortality subsequent to subgrouping on day 4 was zero in the uncomplicated group and 14% in the complicated group.

As noted above, all patients who had any serious complications in the hospital had at least one by day 4. Those patients who survived four days without serious complications not only had a zero percent mortality; they also had no late serious complications (fig. 1). In contrast, patients who survived four days despite a serious early complication had a high incidence (51%) of late serious complications. The prevalence of serious complications before and subsequent to the fifth day in the high risk subgroup is shown in table 1.

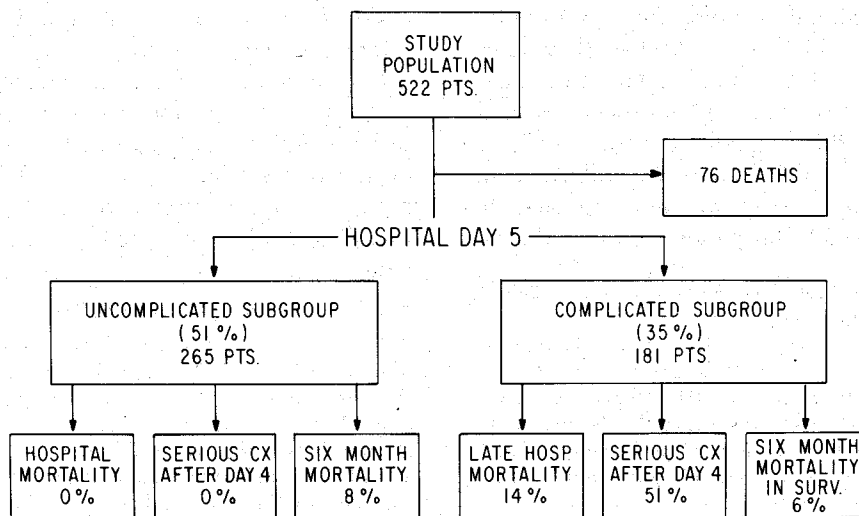


Figure 1

Prevalence of mortality and complications in the study population.

Table 1

Prevalence (%) of Serious Complications in High-risk Subgroup

	Day 1 - 4	Day 5 - discharge
Cardiac asystole	3	1
Ventricular tachycardia	34	7
Ventricular fibrillation	31	2
Second-degree heart block I	28	4
Second-degree heart block II	8	2
Third-degree heart block	22	4
Pulmonary edema	35	5
Cardiogenic shock	24	6
Extension of infarction	29	5
Persistent sinus tachycardia	44	23
Persistent hypotension	21	10
Atrial fibrillation	15	3
Atrial flutter	8	2
Paroxysmal atrial tachycardia	4	2

The prevalence of unserious complications in the low- and high-risk groups is shown in table 2. Many patients in the low-risk subgroup had initial sinus tachycardia or sinus bradycardia; frequent PVCs despite lidocaine therapy, or an S_3 indicating mild heart failure. The prevalence of these findings was reduced significantly after day 4. In the high-risk subgroup, the prevalence of first-degree A-V block, initial sinus tachycardia, intraventricular conduction disturbances, frequent PVCs despite lidocaine, and an S_3 was higher during the first four days and persisted subsequently in a greater percent of patients than in the low-risk subgroup.

Nine of the 265 patients in the low-risk subgroup had a temporary electrode catheter inserted either because of initial sinus bradycardia, high-grade first-degree A-V block or an intraventricular conduction delay. The electrode catheter was not used in any of these nine patients and was removed prior to day 7. Some, but not all, of the patients with PVCs despite

lidocaine after day 4 were treated with quinidine and some, but not all, of the patients with an S_3 after day 4 were digitalized. In summary, in the low-risk subgroup unserious complications after day 4 were infrequent and even when they occurred were seldom the basis for a specific intervention. In the high-risk subgroup, an S_3 persisted after day 4 in 25% of patients and was the basis for treatment with digitalis and/or diuretics in a majority of instances.

The average hospital stay for the 265 uncomplicated patients was 17 days. The average hospital stay for 155 survivors in the complicated subgroup was 20 days. This difference was not statistically significant. The mortality rate between hospital discharge and the six-month follow-up was 8% in the uncomplicated patients. Twelve of these deaths were sudden, nine were secondary to heart failure, and one was due to a cerebrovascular accident. The mortality in the complicated subgroup after hospital discharge was 6%. This difference in mortality subsequent to hospital discharge was not statistically significant.

Discussion

These data indicate that 265 (51%) of 522 patients with acute myocardial infarction who were admitted directly to our CCU had a benign hospital course. All patients who died or who had a serious complication in the hospital had at least one serious complication prior to the fifth hospital day. Despite certain limitations inherent in any retrospective study, our observations suggest that patients who are characterized by the absence of: a) ventricular tachycardia or fibrillation, b) second- or third-degree A-V block, c) pulmonary edema or cardiogenic shock, d) persistent sinus tachycardia or hypotension, e) atrial flutter or atrial fibrillation, and f) extension of infarction during the first four days of hospitalization will survive. Furthermore, patients characterized by the absence of

Table 2

Prevalence (%) of Unserious Complications

	Low-risk subgroup		High-risk subgroup	
	Day 1 - 4	Day 5 - discharge	Day 1 - 4	Day 5 - discharge
Transient hypotension	12	5	11	5
First-degree heart block	4	2	24	10
Initial sinus tachycardia	14	—	19	—
Sinus bradycardia	18	6	20	9
Conduction disturbances:				
LBBB	2	1	6	3
LA hemiblock	4	2	5	6
LP hemiblock	1	—	4	1
RBBB	1	1	6	2
PVCs greater than 6/min	11	5	35	13
Ventricular gallop	19	8	43	25

these complications did not develop serious complications late during hospitalization; the incidence of unserious complications was exceedingly low; and they did not appear to derive any added benefit from extended hospitalization.

In our total group of 522 patients, 257 experienced at least one of the serious complications noted above by the fourth hospital day and, of these patients, 102 died in the hospital. Although 76 of the 102 deaths occurred by day 4, the hospital mortality subsequent to day 4 (26 of 181) and the high incidence of serious nonfatal complications subsequent to day 4 (51%) certainly seem to justify continued hospitalization and efforts to reduce the likelihood of fatal and morbid events.

Our studies are consistent with the view held by many^{8, 12} that late hospital deaths and serious complications are most likely to occur in patients with life-threatening arrhythmias, cardiac arrest or severe left ventricular failure early in the course of acute myocardial infarction. While patients with these early serious complications may do well subsequently, the risk of late complications and death seems to justify longer monitoring, a longer period of hospitalization and in general a "conservative" approach. Our data also support the view that a "liberal" approach, including early mobilization and early discharge, is feasible in the patient who has no serious complications by day 4. The data available in the literature documenting the safety of discharge 10 to 15 days after uncomplicated infarction,^{4, 5} coupled with our own observations reported here, form a reasonable basis for a prospective trial of discharge one week after uncomplicated infarction. Candidates for such a trial should of course have adequate preparation prior to discharge⁴ and the home environment should be conducive to continued care and support. Techniques which would allow valid comparisons of cardiac rhythm, other events and physiological and psychological recovery in patients discharged early and in those kept in the hospital for 14 to 21 days would enhance the value of such a prospective trial.

Patients who recover from a myocardial infarction are at an increased risk of cardiac death in subsequent months and years. While there is no evidence that early mobilization or early discharge of otherwise uncomplicated patients contributes to an increased

relative risk of death, this must be established with each major deviation from past patterns of therapy and is a legitimate requirement for a proposed study of discharge at one week. Even if such a study fails to show any benefit from early discharge, the economic factors are of major proportion. A reduction in the duration of hospitalization at our institution from 17 to seven days for a patient with acute infarction could save from \$2,000 to \$3,500. If our estimate that 50% of patients with acute myocardial infarction might be safely discharged by the seventh day is correct, the potential for financial savings on a national scale are clearly of major importance.

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