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Feasibility of Direct Discharge From the Coronary/Intermediate Care Unit After Acute Myocardial Infarction

Manohara P. J. Senaratne, FRCPC, FACC, PHD, Marleen E. Irwin, RRT, Selma Shaben, Jo Griffiths, BSCN, Jayan Nagendran, Leslie Kasza, MD, FRCPC, FACC, Sajad Gulamhusein, MD, FRCPC, FACC, Maureen Haughian, BSCN

Edmonton, Alberta, Canada

OBJECTIVES This investigation was designed to determine the feasibility and cost-effectiveness of direct discharge from the coronary/intermediate care unit (CICU) in 497 consecutive patients with an acute myocardial infarction (AMI).

BACKGROUND Although patients with an AMI are traditionally treated in the CICU followed by a period on the medical ward, the latter phase can likely be incorporated within the CICU.

METHODS All patients were considered for direct discharge from the CICU with appropriate patient education. The 6-week postdischarge course was evaluated using a structured questionnaire by a telephone interview.

RESULTS There were 497 patients (men = 353; women = 144; age 63.5 ± 0.6 years) in the study, with 29 in-hospital deaths and a further 11 deaths occurring within 6 weeks of discharge. The mode length of CICU stay was 4.0 days (mean 5.1 ± 0.2 days): 1 to 2 (12%), 3 (19%), 4 (21%), 5 (14%), 6 to 7 (19%) and ≥7 (15%) days, respectively with 87.2% discharged home directly. Of the 425 patients surveyed, 119 (28.0%) indicated that they had made unscheduled return visits (URV) to a hospital or physician's office: 10.6% to an emergency room, 9.4% to a physician's office and 8.0% readmitted to a hospital. Of these URV, only 14.3% occurred within 48 h of discharge. Compared to historical controls, the present management strategy resulted in a cost savings of Cdn. $4,044.01 per patient.

CONCLUSIONS Direct discharge from CICU is a feasible and safe strategy for the majority of patients that results in considerable savings. (J Am Coll Cardiol 1999;33:1040–6) © 1999 by the American College of Cardiology

Acute myocardial infarction (AMI) remains a significant event in the natural history of coronary artery disease. The occurrence of an AMI results in significant early as well as late morbidity and mortality (1,2). In addition to these clinical consequences, the in-hospital care required for an AMI consumes a considerable portion of the health care dollars used in the management of coronary artery disease. In most centers, the in-hospital care of patients with AMI involves a period of monitored stay in a coronary/intermediate care unit (CICU) followed by a period of unmonitored stay on a medical/cardiology ward before discharge. The time spent on the medical ward involves increasing mobilization and patient education followed by an exercise test before discharge. In recent years, there has been increasing pressure to minimize the length of stay for patients with acute diseases (due to reduced health care resources). This study was planned after a decrease in the number of medical beds available at the Grey Nuns Hospital due to the government-initiated reduction in health care expenditure that occurred in the province of Alberta. The study was designed to determine the feasibility and cost-effectiveness of eliminating the period of stay on the medical ward and discharging patients directly from the CICU after AMI.

See page 1047

METHODS

The present study examined 497 consecutive patients who were admitted to the CICU at the Grey Nuns Hospital in Edmonton with a diagnosis of AMI from July 1995 to October 1997. The CICU is a 10-bed unit where each room is used for acute or intermediate care. The Grey Nuns

From the Division of Cardiac Sciences, Grey Nuns Hospital, Edmonton, Alberta, Canada.

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Abbreviations and Acronyms

AMI = acute myocardial infarction
CICU = coronary/intermediate care unit
ECG = electrocardiogram, electrocardiographic
LD = lactate dehydrogenase
URV = unscheduled return visits

Hospital is one of five acute care hospitals in Edmonton, a city with a population of 750,000. These hospitals in Edmonton also serve as referral centers for rural hospitals in central and northern Alberta, Yukon and Northwest Territories. Data from all admissions to the CICU were entered into a database incorporated within the SPSS data management system (3). During the first six months of the study, the data were collected retrospectively. However, since January 1, 1996 the data were collected prospectively, with the attending CICU physicians and nurses filling in forms that were placed on the patient's charts at the time of admission. After discharge, the data were cross-referenced with the charts by one individual (S.S.) with subsequent input to the database.

Diagnosis of an AMI was based on at least two of the three following criteria being present: 1) chest pain suggestive of myocardial ischemia lasting 30 min or longer; 2) enzymatic evidence of acute myocardial necrosis (this usually constituted a rise in the creatine kinase with the MB-fraction above 5%, although in few instances [6 patients only] with late presentation a rise of lactate dehydrogenase [LD] with LD1/LD2 ratio being greater than 1.0 was considered as evidence); and 3) new electrocardiographic (ECG) changes, which included development of Q waves and/or ST-T changes lasting 48 h or longer.

After admission to the CICU, patients were maintained on bed rest with bathroom privileges until chest pain free. Patients were then mobilized in an accelerated fashion based on their clinical condition and physical mobility. Mobilization involved walking within the confines of the private room on the day after admission followed by regular walking in the CICU corridors on telemetry 48 h after admission. All patients were considered as candidates for predischarge exercise testing except where a revascularization procedure had been carried out before exercise testing. In patients with revascularization, exercise testing was deferred to the postdischarge phase. The other group of patients who were excluded from exercise testing were those with physical limitations precluding the use of a treadmill.

All patients were seen by the Cardiac Rehabilitation Service after their initial stabilization and relief from chest pain. Education was provided regarding their clinical condition with special emphasis placed on the early discharge planning. The patients were instructed on expectations after discharge and provided with a prescribed day to day simple home exercise program to undertake when clinically feasible. Special emphasis was placed on the management of chest pain including the use of nitroglycerin together with instructions to return to an emergency department if the pain persisted. After discharge, the patients were encouraged to phone the Cardiac Rehabilitation Service with questions or concerns.

All stable patients were discharged home directly from the CICU. Some patients were discharged to other health care facilities due to their clinical situation or special needs. These included another hospital within the city for coronary artery bypass surgery, the medical ward within this institution and a rural hospital in the case of out-of-town patients where further in-hospital care was deemed necessary.

Follow-up. The postdischarge course was evaluated six weeks after discharge by a telephone interview using a structured questionnaire. The interview was conducted by one of two trained individuals (J.N. and S.S.). All attempts were made to contact the patients at home or at work.

Confirmation of readmissions during the six-week postdischarge period was obtained from discharge summaries and other relevant information. Immediate cause of death was ascertained in all instances when a death occurred within the six-week postdischarge period. Visits to the family physician/cardiologist arranged at the time of discharge were regarded as scheduled visits. All other visits to physicians together with all readmissions were categorized as unscheduled return visits (URV).

Statistical analysis. On each patient, a total of 131 variables were identified. Variables were obtained from the medical history, clinical course and complications within the CICU, investigative data and follow-up questionnaire. All continuous variables were recorded as such, whereas the discrete variables were categorized to ensure that the responses would be mutually exclusive.

All data were entered into a database formulated within the SPSS data management system with statistical analysis performed using the system (3). Comparisons between groups within continuous variables were made using an unpaired Student *t* test. In the case of discrete variables a chi-square test was used. A p value <0.05 is quoted accepting the limitation of this "standard" value in the case of multiple comparisons.

A discriminant function analysis was carried out to determine whether the individuals making URV could be identified from information available at the time of discharge. The details of the methodology have been previously described (4). In summary, all variables considered as having a possible impact on URV were entered into a step-wise discriminant function analysis program (3) to obtain the best possible discrimination between the two groups (i.e., URV vs. no URV). During the analysis the variables were entered in a step-wise manner to obtain the best possible discrimination. At each step, a single additional variable was entered into the set of discriminating variables. The variables entered were selected on the basis of minimizing the overall Wilk's lambda, a generalized distance measure. The

program calculated the canonical correlation for the discriminant function and the canonical discriminant function coefficients for each of the discriminating variables.

The program also classified each patient into one of the two groups (URV vs. no URV) using the "Jack-knife" method of Lachenbruch (5). In this method, a single patient is removed, and the discriminant function analysis is carried out on the remaining (n − 1) patients. The resulting discriminant function equation is then applied to the data from the removed patient to predict the group (URV or no URV) to which the patient belongs. This analysis was performed sequentially on each patient and the predicted group compared with the actual group in each case. This method provides a relatively unbiased estimation of the error rate of the discriminant function analysis (5).

Cost analysis. A cost analysis was carried out to determine how the present management strategy of direct discharge from the CICU (whenever feasible) affects the total cost for in-hospital management of patients with AMI. Historical controls were used for comparison, because the present study was not a randomized control trial. The cost of a CICU bed was Cdn. $1,116.20 per day, and the cost of a medical ward bed was Cdn. $700.00 per day (excluding remuneration to physicians). The mean cost per patient was estimated by adding the cost for the CICU stay and the cost for the medical ward stay.

RESULTS

A total of 497 patients were admitted to the Coronary Care Unit between July 1995 and October 1997 with a discharge diagnosis of AMI. Of the 497, 346 (70%) were admitted through the emergency room, 139 (28%) were accepted in transfer from other institutions and 12 (2%) were admitted from within the institution (e.g., medical/surgical wards among others). During their CICU stay 22 patients (4.4%) died, with a further seven patients dying after discharge from the CICU but within the same hospital admission (e.g., in the medical ward). Thus the total in-hospital mortality was 5.8% (the causes of death are tabulated in Table 1). A total of 475 patients were discharged alive from the CICU.

The demographics and other clinical and investigational data on these 497 patients are tabulated in Tables 2 and 3. There were 353 men and 144 women with a mean age of 63.5 ± 0.6 years (range 20 to 93). The mean weight was 79.1 ± 0.8 kg with a mean body mass index of 28.5 ± 0.5 with 59.8% of the patients having a body mass index of greater than 25. There were 129 patients (26.0%) with a history of previous myocardial infarction and 195 patients (39.2%) with a history of angina. There was a documented history of hypertension, dyslipidemia and diabetes mellitus in 217 (43.7%), 169 (34%) and 97 (19.5%) patients respectively. Family history of coronary artery disease (first-degree relative: men <55 years, women <65 years) was present in 196 patients (39.4%). History of smoking was present in 341 patients (68.6%) with 177 patients (35.6%) having smoked within the last year. Of the 497 patients, 241 received thrombolytic therapy (48.5%) with tissue-type plasminogen activator/reteplase given in 123 patients (51.0%) with streptokinase given in 118 patients (49.0%). Female patients were significantly more likely to have received streptokinase ($p < 0.05$). The door to needle time

Table 1. Causes of Death of the 29 Patients Who Died Within the Hospital Stay Associated With the Current Acute Myocardial Infarction*

Causes of Death	No. of Patients
Cardiogenic shock, primary	11
Cardiogenic shock after reinfarction	7
Out-of-hospital cardiac arrest at presentation	5
Intracranial hemorrhage	2
Unexpected cardiac arrest†	2
Dissection of aorta with hemopericardium	1
Stroke complicating myocardial infarction	1

*Deaths = 22 patients within the coronary/intermediate care unit, plus seven patients after transfer to medical ward/other facility. †Patient 1: collapse with pulseless electrical activity with sinus tachycardia (132 beats/min) followed quickly by a wide complex bradycardia leading to asystole. Patient 2: collapse accompanied by pulseless electrical activity with a narrow complex bradycardia, which quickly became wide complex with further slowing of rate leading to asystole.

Table 2. Demographics and Clinical Characteristics of the Patient Population (n = 497)

Variable	Male	Female
No. of patients	353 (71.0%)	144 (29.0%)
Age (yr)	61.5 ± 0.69	68.4 ± 1.1
<50	78 (22.1%)	13 (9.0%)
50 to 70	176 (50.0%)	59 (41.0%)
>70	99 (28.0%)	72 (50.0%)
Range	20 to 91	36 to 93
Weight (kg)	83.1 ± 0.9	69.4 ± 1.3
Body mass index	28.6 ± 0.6	28.2 ± 0.6
>25	72.4%	29.2%
Ethnic origin		
Caucasian	272 (77.1%)	114 (79.2%)
South Asian	32 (9.1%)	7 (4.9%)
Middle Eastern	21 (5.9%)	9 (6.3%)
East Asian	3 (0.8%)	3 (2.1%)
Other	25 (7.1%)	11 (7.6%)
Smoking		
Ever	262 (74.2%)	79 (54.9%)
Within last year	128 (36.3%)	49 (34.0%)
Diabetes	60 (17.0%)	37 (25.7%)
Hypertension	134 (38.0%)	83 (57.6%)
Known dyslipidemia	121 (34.3%)	48 (33.3%)
Prior myocardial infarction	100 (28.3%)	29 (20.1%)

Mean ± SEM or the number of patients with percentages within that group (male vs. female) in brackets are given.

Table 3. Clinical and Investigational Data of the Patient Population (n = 497)

Variable	Male	Female
No. of patients	353 (71.0%)	144 (29.0%)
Maximum CK (μmol/liter)	1,646 ± 133	1,284 ± 114
Location of AMI		
Anteroseptal	105 (29.7%)	56 (38.9%)
Inferior or posterior	192 (54.4%)	73 (50.7%)
Lateral	39 (11.1%)	12 (8.3%)
Indeterminate	17 (4.8%)	3 (2.1%)
Type of AMI		
Q wave	181 (51.3%)	72 (50.0%)
Non–Q wave	172 (48.7%)	72 (50.0%)
Thrombolytic given	175 (49.6%)	66 (45.8%)
t-PA/r-PA	97 (55.4%)	26 (39.4%)
Streptokinase	78 (44.6%)	40 (60.6%)
Complications		
Deaths	12 (3.4%)	17 (12.0%)
Recurrent AMI	3 (0.8%)	3 (2.1%)
Postinfarction angina	46 (13.0%)	18 (12.5%)
Left ventricular failure	32 (9.1%)	19 (13.2%)
VF/sustained VT	19 (5.4%)	16 (11.1%)
Predischarge exercise test		
Performed	219 (62.0%)	70 (48.6%)
Positive	64 (29.2%)	26 (37.1%)
Negative	141 (64.4%)	33 (47.1%)
Indeterminate	14 (6.4%)	11 (15.7%)
In-hospital		
Coronary angiography	104 (29.5%)	47 (32.6%)
Coronary angioplasty	34 (9.6%)	22 (15.3%)
Bypass surgery	10 (2.8%)	0 (0.0%)

Number of patients with the percentages from within that group (male vs. female) or mean ± SEM are tabulated.

AMI = acute myocardial infarction; CK = creatine kinase; r-PA = reteplase plasminogen activator; t-PA = tissue-type plasminogen activator; VF = ventricular fibrillation; VT = ventricular tachycardia.

was 41 ± 3 min (range 8 to 263 min). In those who received thrombolytic therapy, 69.3% had a door to needle time of <30 min with 83.4% having a time <45 min. The AMI was classified as being Q wave in 253 patients (50.9%) and non–Q wave in 244 patients (49.1%).

Of the 497 patients, 22 died during their CICU stay. Of the 475 patients who remained alive, 414 (87.2%) were discharged directly home. Of the remaining 61 patients, 22 patients were transferred to the medical ward, 27 to a tertiary care hospital (for coronary artery bypass surgery, neurosurgical intensive care unit, etc.) and 12 to a rural hospital. The mode length of stay in the CICU for the 497 patients was 4.0 days (mean 5.1 ± 0.2 SEM days): 1 to 2 days (12%), 3 (19%), 4 (21%), 5 (14%), 6 to 7 (19%) and greater than 7 (15%). The mean length of hospital stay including the number of days spent outside the CICU for the 497 patients was 5.6 ± 0.4 days. Of the 129 patients who had a stay of seven days or more, the predominant reason for the extended lengths of stay was due to system delays (i.e., waiting for procedures or medical ward beds). Ninety patients had loss of bed days due to delay in access to coronary angiography or angioplasty and 10 patients had loss of bed due to delays in coronary artery bypass surgery, respectively. Two hundred and ninety-five bed days were lost waiting for angiography or angioplasty and 91 bed days lost waiting for bypass surgery. A total of 522 bed days were lost due to system delays amounting to a loss of 1.05 bed days (mean) per admission. At time of discharge 374 (78.7%) were on beta-adrenergic blocking agents 113 (23.8%) on angiotensin-converting enzyme-inhibitors and only 41 (8.6%) on calcium antagonists.

Table 4. Clinical Information on the 11 Deaths of Patients Discharged Home Directly From the Coronary/Intermediate Care Unit

Causes of Death	No. of patients
Out of hospital cardiac arrest with death after admission*	4
Sudden death at home	4
Recurrent AMI*	1
Congestive cardiac failure	1
Gastrointestinal hemorrhage complicated by an AMI	1

*One patient from each group had discharged himself against medical advice during the index admission.

AMI = acute myocardial infarction.

There were 18 deaths within the six-week post-CICU discharge period, with five deaths occurring within 48 h of discharge from CICU. Three of these patients were still on the medical ward after transfer from CICU at the time of their deaths (two patients with out-of-hospital cardiac arrest and irreversible brain damage and the other with extensive brain damage associated with intracerebral hemorrhage). The other two (74 and 85 years of age) died suddenly at home within 48 h of discharge. Four other patients who died within six weeks were still in hospital at the time of their deaths. Thus only 11 deaths (2.7%) occurred within the six-week postdischarge period among patients discharged home directly from the CICU. Clinical circumstances of these 11 deaths are outlined in Table 4.

Of the 475 patients discharged alive from the CICU, 21 could not be contacted (or did not return messages left on the answering machine) with a further 14 patients declining to participate in the survey at six weeks. Thus a total of 440 patients (or next of kin in the case of patients deceased in the interim) were contacted regarding their six-week postdischarge course. Although 21 patients could not be contacted directly, information obtained from the family physicians confirmed that 20 of these were still alive at six weeks, postdischarge. No information was available on one patient who lived outside the province of Alberta, Canada.

Of the 440 patients (or next of kin) who participated in the survey, information regarding URV was available on 425 patients (no other information available on 15 of the 18 deaths). Of the 425 surveyed, 119 (28.0%) indicated that they had made URV to a hospital or physician's office within

6 weeks of discharge: 45 (10.6%) to an emergency room; 40 (9.4%) to a physician's office and, 34 (8.0%) readmitted to the hospital. Of these URV, only 17 (14.3%) occurred within 48 h; 35% from 48 h to 1 week; 34% between 1 and 3 weeks, and 16% between 3 and 6 weeks. Of the 34 patients who were readmitted, only 28% of readmissions occurred within 48 h of discharge. Thus, 86% of the URV occurred beyond 48 h of discharge. Of the 17 patients with URV within 48 h, eight were readmissions, and nine were visits to the emergency room. The mean age of these 17 patients (men = 12; women = 5) was 69.1 ± 3.0 (SEM) years with 11 (64.7%) having suffered non–Q AMIs at the time of the index admission (not the diagnosis at time of URV). The locations of the AMIs (at index admission) in the 17 patients were: anteroseptal = 7; inferior/posterior = 7; lateral = 2, and indeterminate = 1. The mean peak creatine kinase was 1,038 ± 255 μmol/liter. In-hospital complications at the time of original admission were: postinfarct angina = 29.4%; congestive cardiac failure = 11.8%. Of these 17 patients 47.1% felt that they were discharged too early.

On univariate analysis, the only variable significantly associated with presence of URV was the female gender ($p < 0.05$). Important variables not significantly associated with URV were: postinfarct angina, congestive cardiac failure and in-hospital coronary angiography and angioplasty.

Discriminant function analysis done with each variable entered in a step-wise manner revealed that female gender and the occurrence of in-hospital pneumonia were the only independent predictors of URV. The standardized canonical discriminant function coefficients for gender and pneumonia were 0.729 and 0.715 respectively. The canonical correlation coefficient for the discriminant function was 0.177. The "Jack-knife" method applied to the discriminant function analysis correctly identified 74% of those with URV.

Of the 425 patients interviewed, 420 were willing to comment on quality of care. The ratings were: outstanding—32.9%; very good—32.1%; good—26.5%; unsatisfactory—5.5%, and very poor—3.0%. Eighty-eight percent of the patients interviewed indicated that they had received enough information at the time of discharge regarding their clinical condition and follow-up. Eighteen percent of the patients felt they were discharged too early; of these, 59.0% had URV.

Cost analysis. On the basis of the CICU and medical ward bed costs given in Methods, the mean cost per patient in the present study was Cdn. $5,964.22. This was compared with historical controls. From 1989 to 1992 there were 623 admissions with AMI. The mean lengths of stay in the CICU and medical ward during this period were 4.15 and 7.68 days, respectively. The mean cost per patient based on these data was Cdn. $10,008.23. Thus, the difference in cost per patient in the present study compared with historical controls was Cdn. $4,044.01. These costs did not include remuneration to physicians.

DISCUSSION

Management of AMI has gone through a complete transformation during the preceding half century. In the late 1950s, the total duration of hospitalization was often up to six weeks (6). With the advent of coronary care units, there was a rapid decline in the length of hospital stay, although a 7 to 10 day course was still considered quite acceptable during the 1980s. During the last five years there has been increasing pressure in terms of reducing the in-hospital stay for patients with an AMI due to the reduction of global health care funding. This has not been without controversy (7,8), as many felt that the quality of clinical care may be compromised by trying to achieve very short hospital stays, as AMI is an extremely significant event in the natural history of coronary artery disease with short- and long-term consequences. Furthermore, there has been the concern of early mobilization adversely affecting remodeling with infarct expansion (9). Nonetheless, there has been continued pressure in terms of justifying each day of hospital stay for patients with acute illnesses, including an AMI with attempts at prior identification of patients suitable for early discharge (10,11).

In Canada, the reduction in health care funding for acute care facilities has resulted in a considerable decrease in the number of ward beds available for general medicine, with a lesser effect on the number of CICU beds. The protocol of management in the present study was designed to minimize the use of medical ward beds for patients admitted with an AMI without compromising the medical care provided.

The in-hospital care of AMI has traditionally been divided into two phases: 1) monitoring within a coronary and intermediate care unit; and 2) mobilization on a medical ward in an unmonitored setting, which also allowed the patient and family to gain a sense of confidence without the ECG and other close clinical monitoring done within the CICU. Traditionally, patient education was postponed to this latter phase. However, when these two phases are reviewed in terms of patient management, there seemed to be very little that was done while on the medical ward that could not be achieved in an accelerated fashion within the CICU. Furthermore, a transfer to the medical ward often included transfer of care to a different physician. This transfer of care is often associated with a period of "getting to know the patient" before exercise testing and discharge even with those patients who appeared clinically stable for discharge on the day after transfer.

Previous studies have looked at issues of early discharge following AMI. Topol et al. (12) reported a study of 80 patients with an uncomplicated AMI (no angina, heart failure or arrhythmias 72 h after admission) who were randomly assigned to early (day 3) or conventional (day 7 to 10) hospital discharge. The early discharge did not seem to

result in any excess morbidity or mortality. However, the 80 patients in the study were selected out of a group of 407 consecutive patients with AMI admitted to the hospital during the period of the study. Thus the proportion of the patients who were examined was only a small percentage of the total population, with <20% being considered for early discharge. In contrast, in the present study, 52% were discharged within four days of admission. A study by Sanz et al. (13) looked at 358 patients with AMI who had not received any thrombolytic therapy. Only 105 of the 358 patients (29.3%) who had no noted complications from the infarction were considered as candidates for early discharge on the 4th day. During the post-CICU stay within the ward, there was only one major clinical event (progressive angina). Thus, early discharge in this group of patients was considered feasible at day 4, but the authors concluded that the proportion of candidates for early discharge appeared quite small (12.6%). Furthermore, this study only entailed "mock discharge" with the patients who were considered as candidates for early discharge actually being kept on a medical ward during the study period. This mock discharge obviously underestimates the utilization of medical resources in an unscheduled manner on patients discharged home early, because the patients in a mock discharge situation are likely to feel more secure "within the confines of a hospital" and thus less likely to seek medical attention. Some studies have examined early discharge after primary angioplasty (14,15). The study by Hanlon et al. (14) described 125 patients (61.3%) who were discharged <5 days after infarction (mean 3.4 days) with a low rate of recurrent coronary events (0.8% mortality) and readmissions (1 patient = 4.0%) at a 30-day follow-up. The more recent study by Grines et al. (15) randomized 471 patients stratified as low risk after primary angioplasty (age <70 years, left ventricular ejection fraction >45%, one- or two-vessel disease, successful coronary angioplasty and no persistent arrhythmias) to accelerated care (consisting of admission to a nonintensive care unit and discharge on day 3 without noninvasive testing) or traditional care. The patients who received accelerated care had similar in-hospital as well as six-month outcomes with regard to mortality, unstable ischemia, reinfarction, stroke and congestive cardiac failure. This study seems to be the only randomized study looking at early discharge. However, only 142 of the 237 patients randomized to accelerated care were discharged on the 3rd day (59.9%), with the mean length of stay for all 237 patients being 4.2 ± 2.3 (SD), days, which is only 0.9 days shorter than the mean achieved in the present study (5.1 ± 0.19 days) on 90.4% of the patients admitted with an AMI. Nevertheless, one would anticipate that primary angioplasty is likely to result in early discharge and reduced hospital costs. However, primary angioplasty has the added advantage of characterizing the coronary anatomy and cardiologists generally feel more comfortable in discharging patients early once they "know the coronary anatomy."

The present study demonstrates that direct discharge from the CICU can be achieved in the majority of patients (87%) admitted with an AMI, with 52% of the patients being discharged within four days of admission and 68% discharged within five days. Although at first glance a median length of stay of four days seems excessive, the duration is significantly less than that observed in the Global Utilization of Streptokinase and Tissue-Type Plasminogen Activator for Occluded Coronary Arteries-I study (16). In 40,096 patients enrolled in this study, the median overall length of stay for both complicated and uncomplicated patients was nine days. The median cardiac care unit length of stay for complicated and uncomplicated patients in this study was four days and three days, respectively. Furthermore, 25% of the uncomplicated group of patients remained in the cardiac care unit for >5 days. When patients from the US were analyzed the median overall length of stay was eight days with a cardiac care unit length of stay of three days. In a separate Canadian study (17) reporting on 11,411 patients from 187 hospitals, the mean length of stay was 9.9 days.

In the present study, although 18 deaths occurred within the six week postdischarge period, only 11 (2.7%) of these mortalities were patients discharged home directly from CICU. This cannot be considered excessive for a total of 414 direct discharges from the CICU after AMI. The early clustering of deaths and other coronary events during the postdischarge period has been demonstrated in previous studies (4,18). The remaining seven deaths occurred within the same hospital admission, which was prolonged due to ongoing problems, some of which were irreversible in nature (cerebral hemorrhage and hypoxic brain damage, among others).

An equally important aspect that needs to be considered after early discharge would be the utilization of health care resources during the early postdischarge period. Of the URV, readmissions are of major concern, as they often result in more expenditure than would be expected from an additional one or two days in the hospital for the original illness. Of the 34 readmissions only 28% occurred within a 48-h postdischarge period. Thus keeping these patients in hospital for an extra 1 to 2 days would unlikely have made a major impact on these readmissions, accepting the fact that some clustering of readmissions within the first 48 h would occur irrespective of the number of days in hospital.

One hundred and nineteen patients made URV to a physician's office or emergency room within a 6-week period after discharge, with 28.6% being readmitted. It is possible that some of the visits especially to the physician's office and the emergency room may have resulted from the apprehension associated with early discharge. Although teaching was done to alleviate apprehension, there is the concern that early teaching had little effect due to poor comprehension with too much information being presented during this early phase.

The discriminant function analysis identified female gender and the occurrence of in-hospital pneumonia as inde-

pendent predictors for URV during the six-week postdischarge period. Although the "Jack-knife" method correctly classified 74.0% of those with URV, the canonical correlation coefficient for the discriminant function was relatively low (0.177), suggesting that using the analysis for future prediction may not turn out to be as accurate. This will be tested prospectively in a future group of patients, as the "Jack-knife" method still has limitations.

The cost analysis demonstrated that the present management protocol with direct discharge from the CICU whenever feasible resulted in a reduction in cost of Cdn. $4,044.01 per patient. This amounts to a total savings of Cdn. $2,009,872.90 for the 497 patients in the present study. The actual savings attained would be greater than this, because remuneration to physicians was not included in the analysis. The limitation of the cost analysis is the use of historical controls with a mean length of stay of 11.8 days from 1990 to 1992. Although the mean length of stay for AMI has gone down during the last five years, one would not have expected it to come down to 5.1 days (from 11.8 days) if the direct discharge strategy was not implemented.

The present study also clearly identifies problems within the health care system as it exists in Canada. Of the patients who had a stay of seven days or longer, a significant proportion of bed days were lost due to lack of early access to coronary angiography/coronary angioplasty or coronary artery bypass surgery. This resulted in an unnecessary and excessive expense for in-hospital care for patients with coronary artery disease in addition to the possible adverse clinical consequences related to these delays. The delay in access to these procedures also leads to loss of working days in the lives of these patients as well as their immediate family who sometimes have to take time off in association with the illness of their loved ones. The number of bed days lost was actually underestimated, as the bed days lost waiting for angiography/angioplasty or bypass surgery in patients discharged within six days was not looked at in the present study. The inherent delays in the health care provision in Canada are balanced by the equal accessibility irrespective of the socioeconomic status of the patient.

In summary, the present study demonstrates that direct discharge from the CICU is achievable in the majority of patients admitted with an AMI. This direct discharge does not appear to result in an undue increase in the morbidity and mortality during the six-week postdischarge period and also seems to result in lower costs. However, the present study is observational and has the drawback of not having a randomized control group to make a definitive conclusion because historical controls were used for this analysis. Such a randomized control study would be technically difficult to organize, at least in Canada, given the current economic environment.

Reprint requests and correspondence: Dr. M. P. J. Senaratne, Associate Clinical Professor of Medicine, University of Alberta, Director Coronary Care Unit, Grey Nuns Hospital, 1100 Youville Drive West, Edmonton, Alberta, T6L 5X8 Canada.

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