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Feasibility of early hospital discharge directly from coronary care unit after primary angioplasty for uncomplicated acute myocardial infarction

Research Article

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Abstract: Current European and American guidelines recommend early discharge for patients with uncomplicated acute myocardial infarction (AMI). However, this concept has not been widely accepted, and experience with direct discharge from the coronary care unit is limited. We aimed to investigate safety and cost effectiveness of early discharge directly from coronary care unit following successful percutaneous coronary angioplasty (PTCA) in patients with uncomplicated AMI. We included consecutive thirty-one patients with uncomplicated AMI and successful PTCA admitted to coronary care unit of a university hospital. Uncomplicated course was defined as absence of reinfarction, ischemia, VF/VT, repeated PTCA, and heart failure within first 72 hours. Incidence of death, reinfarction, VF/VT, need for revascularisation, and hospitalisation due to heart failure at 1, 6, and 12 months was compared with 56 randomly selected AMI patients with successful PTCA but longer hospitalisation. Average hospital stay was 4 days in early and 6.7 days in control group ($p<0.05$). Control group had more extensive coronary disease (54% two or more vessels vs. 28% in early discharge, $p<0,05$). During follow up, none of the early discharged patients died, the only observed event was repeat PTCA due to angina pectoris. In the control group, mortality at 12 months was 3.5% ($p<0.05$). Cumulative 12 month event free survival was 96% in early discharge group and 87% in control group, but difference was not significant ($p=0.15$, Cox-Mantel test). Cost reduction of early discharge amounted to 1100 Euro per patient. In conclusions, our study confirmed that for a selected population of patients with AMI, successful PTCA, and uncomplicated clinical course during first 72 hours, discharge as early as three days following the admission is safe.

Keywords: *Acute myocardial infarction • Early discharge • Primary angioplasty • Coronary care unit*

1. Introduction

Acute myocardial infarction (AMI) is the most important and costly event in the course of coronary disease. Despite considerable changes in the management and subsequent reduction of morbidity and mortality, it still represents an important public health and socioeconomic problem in the European countries [1,2]. Reperfusion therapy was the major breakthrough in the causative management and today primary coronary angioplasty (PTCA) represents the first choice in the management of AMI due to high reperfusion rates yielding improved prognosis with lower incidence of short and long term complications [3-6]. However, introduction of new treatment modalities was associated with significant increase in the cost of management for these patients.

In order to reduce the cost of management, shortened hospital stay was suggested for patients at low risk for complications. Several clinical studies identified these patients based on simple clinical criteria. Low-risk patients were characterized by the absence of reinfarction, ischemia, shock, heart failure, ventricular fibrillation or ventricular tachycardia, during the first 72 hours of index admission [7-10]. In these early

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studies, patients treated with thrombolysis were mainly enrolled. Early discharge was defined as discharge after 3 to 7 days post index event. This was confirmed in studies of both reperfusion strategies simultaneously or angioplasty alone, where majority of patients was discharged before fifth day of hospitalisation [11-14]. After documented safety of early discharge in the low-risk group, it was adopted and implemented especially in the United States, whereas in Europe this concept has not been widely accepted [15].

Most of the studies involved patients treated with thrombolysis and discharged from the non-intensive wards while data on patients after PTCA discharged directly from the CCU remain scarce. Therefore, in this study we wanted to investigate safety, feasibility, and cost effectiveness of early discharge directly from CCU.

2. Material and Methods

In this study, we prospectively enrolled consecutive series of 31 patients with uncomplicated AMI successfully reperfused by PTCA, which were treated at CCU of a university medical centre. University Medical Centre Ljubljana serves as a tertiary referral centre for a population of about 700,000 inhabitants.

Uncomplicated course was defined based on clinical criteria as followed: absence of death, reinfarction, ischemia, shock, heart failure, and ventricular fibrillation/ventricular tachycardia (VF/VT) during first 72 hours of index hospitalization. Ventricular fibrillation or ventricular tachycardia within the first 48 hours following AMI was not considered as adverse event. Inclusion criteria were successful PTCA, and uncomplicated course of AMI, as defined above. Exclusion criteria for early discharge were triple vessel disease and unsuccessful PTCA (TIMI flow 0 and 1). Primary end point of study was combination of death and cardiovascular events (reinfarction, unstable angina, VF/VT, repeated PTCA, heart failure). Diagnosis of AMI was based on at least two of the three criteria present: a) typical chest pain lasting at least 30 minutes; b) new electrocardiographic changes as ST segment changes or new onset of Q waves; or, c) rise in markers of cardiac necrosis such as troponin T or creatine kinase, including MB fraction [16].

For the control group, we randomly selected 56 patients that were treated at our hospital due to AMI, underwent successful PTCA, but proceeded with conventional rehabilitation protocol. Selection of the patient for early discharge, irrespective of eligibility based on clinical criteria, was left to decision of the treating physician.

Typically, all patients following PTCA were maintained to bed rest for about 12 hours. In case of uncomplicated course during those first 12 hours, their mobilization was started under supervision of the physiotherapist on the morning of the next day. If a patient was selected for early discharge based on an uneventful initial 24 hours, facilitated mobilization would continue in the CCU for another two days. If after 72 hours we did not detect any predetermined complications, patient was discharged on the morning of day four.

Major adverse events during admission and hospitalization were recorded at the time. Follow up data were collected at 30 days, 6 and 12 months by telephone contact as well as by review of the case notes. Investigators retrieved data about occurrence of predetermined adverse events, hospitalizations and other contacts with health care providers.

In addition, we wanted to assess the cost effectiveness of early discharge. Accurate calculation of costs was not possible as at the time of the study insurance covered the lump sum for every patient admitted to the CCU. However, the estimation of cost savings was based on the CCU (420 Euro/day) and ward (170 Euro/day) daily rate for the patients without the health insurance.

Continuous variables are presented as mean and standard deviation, and dichotomous variables as percentages. Two tailed Student t-test for independent samples was utilized for comparisons of continuous variables. Chi square test was used for nonparametric variables. Event free survival estimates were based on the Kaplan-Meier method. Data management and statistical analyses were performed using Statistica 7.0 software (Statsoft, Inc., 2004).

3. Results

During a 12-month study period we screened 489 patients with AMI. Median age of screened patients was 63 years, and 69% were men. For the whole group, median length of stay in the CCU was 5 days and median total stay in the hospital was 9 days. From this pool of patients, we randomly selected 56 patients that had had successful resolution of AMI by PTCA and for whom complete data on hospital course and follow up were available. These patients served as control group for purposes of further comparisons with early discharged patients.

Baseline characteristics of patients are presented in Table 1. Patients that were discharged early, left hospital on the fourth day, and in control group mean duration of hospitalization was 6.7 ± 2.9 days (p<0.05). Early discharged patients were younger, all males, had less co morbidities, and lower proportion of

Table 1. Baseline clinical and demographic characteristics of patient population. Results are presented as percentage if not stated otherwise.

	Early discharge N=31	Control N = 56	*p*
Age (years; mean ± SD)	53 ± 9	60 ± 12	< 0.05
Males	100%	73 %	< 0.05
Arterial hypertension	52%	77 %	< 0.05
Dyslipidemia	55%	80 %	< 0.05
Diabetes mellitus	13%	20 %	NS
Smoking	51%	55 %	NS
Previous MI	0%	13 %	< 0.05
Angina pectoris for more than 4 wk	16%	2 %	< 0.05
MI location			
Inferior/Posterior	58%	36 %	< 0.05
Anterior/Lateral	42%	64 %	< 0.05
STEMI	93 %	71 %	< 0.05
NSTEMI	7 %	29 %	< 0.05

STEMI: ST segment elevation acute myocardial infarction, NSTEMI: non ST segment elevation acute myocardial infarction

Table 2. Results of cardiac catheterisation. Results are presented as percentages.

	Early discharge N=31	Control N = 56	*p*
No. of diseased vessels			
One	72 %	46 %	< 0.05
Two or more	28 %	54 %	<0.05
Culprit lesion			
LAD	42 %	52 %	NS
RCA	48 %	34 %	NS
LCX	10 %	14 %	NS
Proportion stented	89 %	100 %	NS
No. stents/patient	0,93 ± 0.2	1,64 ± 1	< 0.05
No. stents/culprit vessel	0,93 ± 0.2	1,34 ± 0,7	< 0.05
Periprocedural IIb/IIIa	55%	22%	< 0.05

anterolateral location of infarction (Table 1). All patients underwent cardiac catheterisation and percutaneous revascularisation (Table 2). Higher proportion of patients in early discharge group had single vessel coronary disease, resulting in less extensive procedure (Table 2). On the other side, these patients were more aggressively treated, as reflected in higher proportion of periprocedural IIb/IIIa receptor blockade utilization. Otherwise, pharmacological treatment of the patients in both groups was comparable. All patients in both groups received thyenoperidine and aspirin. There were no differences in proportion of patients receiving angiotensin converting enzyme inhibitors (97% vs. 100%), beta blockers (97% vs. 93%), and statins (100% vs. 91%) between early discharged and control group, respectively.

In hospital course of early discharged patients was uneventful, by definition. Four patients had non-sustained VT within 24 hours following admission as the only early complication (Table 3). In the control group, one patient had a repeat PTCA due to reinfarction, and three patients had signs of left-sided heart failure, necessitating diuretic administration. Nevertheless, there were no significant differences in adverse events during hospitalisation, as control group also represented relatively low risk patients reflected in preserved left ventricular function (Table 3).

During the 12-month follow-up, early discharged patients were characterized by very low incidence of adverse events. There were no fatalities. The only event recorded was unstable angina in one patient due to stenosis on non culprit coronary artery, not treated during index procedure (Table 4). This stenosis was successfully resolved by PTCA. In the control group, two patients died, four patients had repeat PTCA due to reinfarction/unstable angina, and one patient was

Table 3. In hospital course. Results are presented as percentages and mean ± SD where appropriate.

	Early discharge N = 31	Control N = 56	*p*
Mortality	0	0	NS
VF/VT			
< 24 hrs	13%	5%	NS
> 24 hrs	0	0	
Reinfarction	0	2 %	NS
Unstable angina	0	0	NS
Repeated PTCA	0	2 %	NS
Heart failure	0	7 %	NS
Ejection fraction (%)	60 ± 3	52 ± 13	< 0.05
31 – 50%	0	11%	< 0.05
< 30%	0	4%	NS

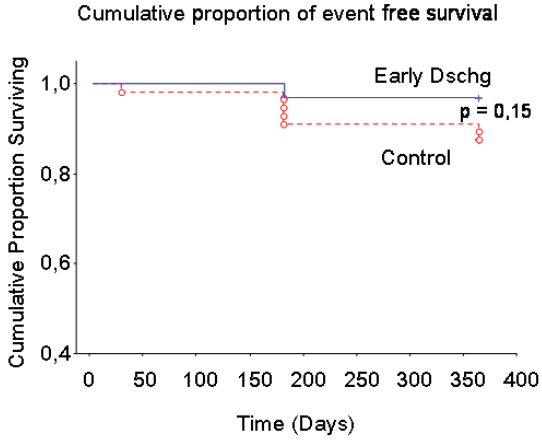
VF/VT: ventricular fibrillation or ventricular tachycardia, PTCA: percutaneous balloon angioplasty

Table 4. Mortality and major adverse events during 1 year follow up.

	30 days		6 months		12 months	
	Early (N = 31)	Control (N = 56)	Early (N = 31)	Control (N = 56)	Early (N = 31)	Control (N = 55)
Mortality	0	0	0	2 %	0	2%
VF/VT	0	0	0	0	0	0
Reinfarction or UAP	0	2 %	3 %	5 %	0	2 %
Repeated PTCA/CABG	0	2 %	3 %	5 %	0	2 %
Heart failure with hospitalisation	0	0	0	0	0	2 %

VF/VT: ventricular fibrillation or ventricular tachycardia; UAP: unstable angina pectoris; PTCA: percutaneous balloon angioplasty; CABG: coronary artery by-pass graft operation

Figure 1. Kaplan-Meier analysis of composite event-free survival for early discharged patients and patients with conventional duration of hospitalization. Composite end point included: death, reinfarction or unstable angina pectoris, need for repeated revascularisation, and heart failure necessitating hospitalization.



hospitalized due to left-sided heart failure (Table 4). Very low risk for adverse events in early discharged patients with uncomplicated hospital course was confirmed by Kaplan-Meier analysis (Figure 1). One year event-free survival for these patients was 96,7%, and 87,5% for control group (p=0,15, Cox-Mantel test).

The estimated total saved from cost due to early discharge directly from the CCU reached 34100 Euro. This means a saving of 1100 Euro per patient with uncomplicated course of acute myocardial infarction.

4. Discussion

Our study evaluated consecutive series of patients, admitted due to acute myocardial infarction that were successfully treated by PTCA and were characterized by uncomplicated early clinical course. Results in this decidedly low risk subgroup of patients support the safety, feasibility and cost effectiveness of early discharge directly from CCU, provided uncomplicated early post procedural clinical course of AMI was observed.

Combination of angiography results and simple clinical criteria including absence of predefined complications (death, reinfarction, ischemia, shock, heart failure, and VF/VT) within the first 72 hours of hospitalization was extremely helpful in identifying the low-risk patients, eligible for direct discharge from CCU on the fourth day of the index hospitalisation.

Previous reports have determined that based on relatively simple clinical criteria, typically including absence of major adverse events such as death, heart failure, recurrent ischemia, ventricular arrhythmias, low risk patients with small probability of subsequent complications can be identified [10,14,17]. These reports included mixed population of patients, only partially treated by primary PTCA. Nevertheless, patients with uncomplicated clinical course had very low incidence of complications after discharge, as well as mortality. In these studies, patients were mostly discharged between day 5 and 7 after the index event. In our study, we aimed at even earlier discharge on day 4, based on additional information gained by invasive treatment procedure.

In our typical male cohort the non-sustained VT was the only in-hospital complication, presenting early (<24 hours) in the course of the hospitalisation. In other reports of early discharge that cited angiography results the in-hospital mortality ranged from 0.7% to 3.4% while patients experienced complications in up to 11.6% [8,12]. Another study, in which the angiography in combination with the clinical parameters was utilized for identification of eligible patients for early discharge, reported results comparable to our study [11]. They reported in hospital mortality of 0.4% and complication rate of 10%. Based on these data we can speculate that angiography provides important additional information for the risk stratification and identification of candidates for very early discharge following primary PTCA.

The post discharge period was uneventful, except for one patient with unstable angina that required repeated PTCA. This proves that uneventful early course in combination with successful early reperfusion and aggressive secondary prevention identifies patients with very low complication rate on the long term. It is difficult to determine at which time risk decreases to an acceptably low level for safe discharge, as small proportion of patients will experience adverse events. However, for selected patients, based on results from our and other similar studies, successful reperfusion techniques and aggressive medical treatment decrease the risk of complications to a level that enables safe early discharge after three days [9,12,13].

The risks of early discharge have to be balanced against potential benefits. Shortened hospitalization coupled with early rehabilitation and return to home may have physical and psychological benefits. In addition, economic implications may be substantial [18]. We were able to reduce the costs for 1100 Euro/patient, which is still lower than current costs of the primary PTCA.

We are aware of important limitations of our study. Firstly, number of included patients was low; therefore we could underestimate both mortality and the complication rate in our cohort. In addition, patients included in this study represent only fraction of low risk subpopulation, and not all of patients that would be eligible for early discharge. However, the decision regarding early discharge was left under the treating physician, and majority of eligible patients were discharged later than on day four. Similar results were found in Italian AMI-Florence Registry [19]. From 751 STEMI patients they identified 59% eligible for early discharge. However, among these patients, only 33% patients younger than 75 years were discharged early, and only 26% were actually discharged within 4 days.

In conclusion, our study demonstrated that combination of successful PTCA for acute myocardial infarction and uncomplicated clinical course during first 72 hours identifies low risk male patients that can be safely discharged as early as three days following the admission.

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