

Improved Treatment of Coronary Heart Disease by Implementation of a Cardiac Hospitalization Atherosclerosis Management Program (CHAMP)

Gregg C. Fonarow, MD, Anna Gawlinski, DNSc, Samira Moughrabi, MN, and Jan H. Tillisch, MD

Despite scientific evidence that secondary prevention medical therapies reduce mortality in patients with established coronary artery disease, these therapies continue to be underutilized in patients receiving conventional care. To address this issue, a Cardiac Hospitalization Atherosclerosis Management Program (CHAMP) focused on initiation of aspirin, cholesterol-lowering medication (hydroxymethylglutaryl coenzyme A [HMG CoA] reductase inhibitor titrated to achieve low-density lipoprotein [LDL] cholesterol ≤ 100 mg/dl), β blocker, and angiotensin-converting enzyme (ACE) inhibitor therapy in conjunction with diet and exercise counseling before hospital discharge in patients with established coronary artery disease. Treatment rates and clinical outcome were compared in patients discharged after myocardial infarction in the 2-year period before (1992 to 1993) and the 2-year period after (1994 to 1995) CHAMP was implemented. In the pre- and post-CHAMP

patient groups, aspirin use at discharge improved from 68% to 92% ($p < 0.01$), β blocker use improved from 12% to 62% ($p < 0.01$), ACE inhibitor use increased from 6% to 58% ($p < 0.01$), and statin use increased from 6% to 86% ($p < 0.01$). This increased use of treatment persisted during subsequent follow-up. There was also a significant increase in patients achieving a LDL cholesterol ≤ 100 mg/dl (6% vs 58%, $p < 0.001$) and a reduction in recurrent myocardial infarction and 1-year mortality. Compared with conventional guidelines and care, CHAMP was associated with a significant increase in use of medications that have been previously demonstrated to reduce mortality; more patients achieved an LDL cholesterol ≤ 100 mg/dl, and there were improved clinical outcomes in patients after hospitalization for acute myocardial infarction. ©2001 by Excerpta Medica, Inc.

(Am J Cardiol 2001;87:819–822)

A number of studies have documented that secondary prevention medical therapies are underutilized in patients with established coronary artery disease who are receiving standard medical care.^{1–4} We hypothesized that a simplified treatment algorithm that focused on initiating secondary protection measures before hospital discharge could be a more effective way of initiating treatment. With the aim of improving treatment utilization, a Cardiac Hospitalization Atherosclerosis Management Program (CHAMP) was developed and implemented at a university-affiliated teaching hospital. The program focused on initiation of aspirin, cholesterol-lowering medication (titrated to low-density lipoprotein [LDL] ≤ 100 mg/dl), β blocker, and angiotensin-converting enzyme (ACE) inhibitor therapy in conjunction with dietary and exercise counseling in patients with established coronary artery disease before hospital discharge. This study was undertaken to assess the impact of this program on secondary prevention medication utilization, to

demonstrate the feasibility and safety of initiating cholesterol-lowering medications before hospital discharge, and to determine the impact on clinical outcome.

METHODS

The setting for this study was a university-associated teaching hospital. Full-time cardiology and medicine faculty as well as private clinical faculty serve as attending physicians supervising internal or family medicine housestaff. Before 1994, no specific treatment algorithms or management pathways were in place. Care was guided by individual physician decision and individual awareness and adherence to national clinical guidelines, such as the American College of Cardiology/American Heart Association Treatment Guideline for Acute Myocardial Infarction and the National Cholesterol Education Program's Adult Treatment Panels I and II.^{5–7} Under an ongoing medical enterprise quality improvement collaboration, a quality improvement program was developed, targeting patients hospitalized for coronary artery disease. The resulting program, CHAMP, focused on implementing secondary prevention medical treatment and providing comprehensive risk reduction counseling for patients with demonstrated coronary artery disease in the hospital setting. Patients with documented coronary artery disease were targeted for inclusion, including those patients hospitalized with unstable an-

From the Ahmanson–UCLA Cardiomyopathy Center, Division of Cardiology, and Department of Medicine, UCLA; and UCLA Medical Center, Los Angeles, California. This study was supported by the Ahmanson Foundation, Los Angeles, California. Manuscript received August 9, 2000; revised manuscript received and accepted October 18, 2000.

Address for reprints: Gregg C. Fonarow, MD, Ahmanson–UCLA Cardiomyopathy Center, UCLA Division of Cardiology, 47-123 CHS, 10833 Le Conte Avenue, Los Angeles, California 90095-1679. E-mail: gfonarow@mednet.ucla.edu.

gina, acute myocardial infarction, ischemic heart failure, and those who underwent cardiac procedures, including cardiac catheterization, angioplasty and/or stenting, and coronary bypass.

The treatment algorithm consisted of obtaining a baseline complete lipid panel upon admission in all patients with known or suspected coronary heart disease. Aspirin 325 mg was recommended at the time of initial presentation with a maintenance dose of 81 or 325 mg in all patients without contraindications. Beta-blocker therapy was begun or continued upon initial presentation in all patients with acute myocardial infarction or unstable angina, and was recommended preferentially to manage anginal symptoms, arrhythmias, and blood pressure in other patients, unless contraindicated. ACE inhibitor therapy was initiated in all patients with myocardial infarction 12 to 24 hours after admission, in all patients with heart failure or asymptomatic left ventricular dysfunction, and preferentially to manage blood pressure in other patients, unless contraindicated. Hydroxymethylglutaryl coenzyme A (HMG CoA) reductase inhibitor therapy was initiated in all patients with LDL cholesterol ≥ 100 mg/dl during hospitalization. In patients in whom a baseline lipid panel was not obtained or was obtained >12 hours after myocardial infarction symptom onset, HMG CoA reductase inhibitors were initiated and dosed empirically. Counseling regarding smoking cessation, diet, and exercise was provided during hospitalization by the individual physicians and cardiac nurses with detailed patient education materials provided. The algorithm recommended obtaining a fasting lipid panel and liver function tests on an outpatient basis at 6 weeks and if LDL cholesterol remained >100 mg/dl, the HMG CoA reductase inhibitor dose was adjusted, or if already maximized, lipid-lowering therapy of niacin, binding resin, or fibrate was added to the medication regimen. Repeat lipid testing and follow-up visits at 6 and 12 months to encourage compliance were also recommended in the treatment algorithm. The methods employed to facilitate implementation and utilization of the program have been previously described.⁸ Although treatment was strongly encouraged in the guidelines and treatment algorithm, the final decision to initiate therapy and which agent and dose to use was decided by the individual treating physicians. CHAMP was implemented in January 1994 and is still currently being used.

To assess the impact of the program, sequential patient cohorts were assessed before and after implementation of the program. Of the total group of patients hospitalized with coronary artery disease during the study period, patients diagnosed with acute myocardial infarction were selected for inclusion in this study. Medical record review was approved by the Medical Institutional Review Board. Consecutive patients discharged from the hospital with primary or secondary diagnosis of acute myocardial infarction identified by International Codes for Diagnosis-9 codes and confirmed by detailed chart review as part

of National Registry of Myocardial Infarction I and II participation were included.

Patients with acute myocardial infarction discharged in the 2-year period before CHAMP was implemented (January 1992 to December 1993) were compared with patients discharged in the 2-year period after CHAMP was implemented (January 1994 to December 1995). Patient clinical variables and treatment variables as documented in the medical record were recorded. Medications as documented in the inpatient medical record, discharge summaries, and outpatient clinic notes were recorded. Treatment rates are reported for all potential patients, without excluding patients with specific contraindication to the individual medical therapies, because chart documentation may be incomplete and subject to interpretation. LDL cholesterol levels as documented in medical records were recorded. Plasma LDL cholesterol was calculated by the Friedewald method. One-year follow-up medication use and laboratory values were recorded if a documented visit took place and/or laboratories were obtained and reported in the 6 to 18 months after hospital discharge, utilizing the values obtained closest to 12 months.

Patients remained in their original groups throughout the study. Descriptive and analytic statistics were used in the analysis of these data. For categorical variables, basic descriptive statistics are reported as numbers and percentages. Categorization of lipid levels were based on National Cholesterol Education Program guidelines.³ For continuous data, the descriptive statistics include mean and standard deviations. All confidence intervals are 95%.

RESULTS

From January 1992 to December 1995, 558 consecutive men and women were hospitalized for acute myocardial infarction and met the eligibility criteria, 256 in pre-CHAMP period of 1992 to 1993 and 302 in period after the implementation of CHAMP, 1994 to 1995. Demographic and clinical characteristics for the study groups are shown in Table 1. The 2 groups were similar with regard to a variety of baseline characteristics. Although the proportion of patients undergoing reperfusion therapy were similar, more patients received direct angioplasty in the post-CHAMP group.

Lipid panels were obtained on admission or within 12 hours of symptom onset in 10 pre-CHAMP patients (5%) and in 168 patients (68%) after implementation of the management algorithm. Initial mean LDL cholesterol was 142 ± 28 mg/dl in the post-CHAMP patient group. Medical therapy at the time of hospital discharge changed substantially after the implementation of CHAMP, as shown in Table 2. The utilization of lipid-lowering medications at time of hospital discharge increased from 6% in the pre-CHAMP patient group to 86% in the post-CHAMP group ($p < 0.01$).

The medical regimens at discharge were well tolerated. There were no documented increases in liver function tests >3 times control or cases of rhabdomyolysis. The medical regimens that patients were discharged home with were maintained during subse-

Variable	Pre-CHAMP (1992-1993) (n = 256)	Post-CHAMP (1994-1995) (n = 302)
Age (yrs)	70 ± 11	69 ± 11
Women	43%	41%
Diabetes mellitus	20%	18%
Smoker (current)	27%	24%
Prior AMI	18%	20%
Q-wave AMI	48%	50%
AMI location (anterior)	32%	34%
Chest pain onset to admission (median)	94 min	97 min
TIMI II low-risk category	68%	70%
Reperfusion therapy	37%	40%
Thrombolytics	18%	3%*
Direct coronary angioplasty	18%	37%*

*p < 0.01.
AMI = acute myocardial infarction; TIMI = Thrombolysis In Myocardial Infarction.

Therapy	Pre-CHAMP		Post-CHAMP	
	Discharge	1 Yr	Discharge	1 Yr
Aspirin	78%	68%	92%*	94%*
β blocker	12%	18%	61%*	57%*
Nitrates	62%	42%	34%*	18%*
Calcium blocker	68%	58%	12%*	6%*
ACE inhibitor	4%	16%	56%*	48%*
Statins	6%	10%	86%*	91%*

*p < 0.01, pre- versus post-CHAMP at discharge and at 1 year.

LDL (mg/dl)	Pre-CHAMP 1992/1993 (n = 256)	Post-CHAMP 1994/1995 (n = 302)
≤100	6%	58%
101-130	15%	16%
131-160	18%	4%
>160	14%	0%
Not documented	48%	22%

quent clinical follow-up during the 6- to 18-month period after hospital discharge as shown in Table 2. The treatment rates during follow-up were significantly increased when comparing the pre- and post-CHAMP groups for aspirin, β blockers, and ACE inhibitors. In the pre-CHAMP patients, during outpatient management, lipid-lowering medication use increased from 6% at time of discharge to only 10%. In contrast, patients in the post-CHAMP period when lipid-lowering medications were initiated before discharge in most patients, the 1-year treatment rate was 91%. The LDL cholesterol results are shown in Table 3. During the 6- to 18-month period after hospital discharge, only 10 patients (6%) were documented as having achieved a LDL cholesterol of ≤100 mg/dl in the pre-CHAMP patient group. In contrast, 58% of the

	Pre-CHAMP 1992/1993 (n = 256)	Post-CHAMP 1994/1995 (n = 302)
Recurrent myocardial infarction	20 (7.8%)	10 (3.1%)*
Heart failure	12 (4.7%)	8 (2.6%)*
Hospitalization	38 (14.8%)	23 (7.6%)*
Sudden death	3 (1.2%)	2 (0.6%)*
Cardiac mortality	13 (5.1%)	6 (2.0%)*
Noncardiac mortality	2 (0.8%)	2 (0.6%)*
Total mortality	18 (7.0%)	10 (3.3%)*

*p < 0.05.

post-CHAMP patients achieved LDL cholesterol levels of ≤100 mg/dl. Postdischarge mean LDL levels were 138 ± 36 mg/dl in the pre-CHAMP patient group versus 102 ± 26 mg/dl in the post-CHAMP patient group (p < 0.001).

The implementation of CHAMP was associated with an improvement in clinical outcomes in the year after discharge for myocardial infarction (Table 4). CHAMP was also associated with a reduction in all-cause mortality.

DISCUSSION

This study demonstrates that CHAMP was an effective means to improve treatment utilization of clinical trial evidence-based therapies. It is also the first study to address the feasibility, safety, and impact on adherence of initiating lipid-lowering medications before discharge in patients hospitalized with acute myocardial infarction.

Prior studies have assessed the impact of programs to improve risk factor modification in patients with coronary artery disease. A physician-directed, nurse-managed home-based case management system was compared with usual medical care in 585 men and women discharged after myocardial infarction in a Health Maintenance Organization.⁹ Speciality trained nurses initiated interventions for smoking cessation, exercise training, and diet counseling before hospital discharge followed by monitoring and drug therapy for hyperlipidemia on an outpatient basis. In this study, 93% of the special intervention patients required lipid-lowering medications because their LDL levels remained at >100 mg/dl 90 days after discharge despite intensive diet and exercise counseling and monitoring. The special intervention patients had greater rates of smoking cessation, improved functional capacity, and lower LDL cholesterol (107 ± 30 vs 132 ± 30 mg/dl) compared with usual care. The need to hire additional medical personnel (i.e., speciality trained nurses) may limit the application of this type system outside of Health Maintenance Organizations. Other studies have demonstrated improved treatment rates in specialty lipid clinics and cardiac rehabilitation programs, but these systems were applied to a selected patient population representing only a small proportion of the patients with coronary artery

disease being cared for in the health care delivery system from which the patients were drawn.^{10,11}

This study provides the first direct support for the American Heart Association Science Advisory "When to Start Cholesterol Lowering Therapy in Patients with Coronary Heart Disease," issued in 1997,¹² which recommended that consideration be given to instituting a cholesterol-reducing medication simultaneously with nonpharmacologic therapy at time of hospital discharge in patients with coronary heart disease and LDL \geq 130 mg/dl. The CHAMP algorithm extended treatment beyond this recommendation in that lipid-lowering medications were initiated during hospitalization and were intended for all patients with LDL \geq 100 mg/dl or in whom lipid panels were not obtained in the first 12 hours of admission. The CHAMP results lend support to the concept that lipid-lowering medications and lifestyle modification should be initiated at time of diagnosis in patients with coronary heart disease.

The design of this study does have significant limitations. Because this study was not a prospective, randomized trial with a concurrent control group, factors other than the CHAMP protocol may have influenced the treatment utilization rates and clinical outcomes. Other treatment factors such as the increased utilization of direct angioplasty may have also impacted clinical outcomes. Adherence to nonpharmacologic interventions of diet and exercise and patient satisfaction/functional capacity/quality of life parameters were not assessed in this study. The impact of hospital-based treatment protocols on these parameters remains to be determined. This study assessed the impact of CHAMP on patients hospitalized for acute myocardial infarction, although the impact on patients hospitalized for other cardiac indications would be expected to be similar, this will need to be further

assessed. The methods used to implement this program are readily available and would be expected to be able to be implemented in any hospital setting.

1. Ellerbeck EF, Jencks SF, Radford MJ, Kresowik TF, Craig AS, Gold JA, Krumholz HM, Vogel RA. Quality of care for Medicare patients with acute myocardial infarction. A four-state pilot study from the Cooperative Cardiovascular Project. *JAMA* 1995;273:1509–1514.
2. Sueta CA, Chowdhury M, Bocuzzi SJ, Smith SC Jr, Alexander CM, Londhe A, Lulla A, Simpson RJ Jr. Analysis of the degree of undertreatment of hyperlipidemia and congestive heart failure secondary to coronary artery disease. *Am J Cardiol* 1999;83:1303–1307.
3. Frolkis JP, Zyzanski SJ, Schwartz JM, Suhan PS. Physician noncompliance with the 1993 National Cholesterol Education Program (NCEP-ATPII) guidelines. *Circulation* 1998;98:851–855.
4. Miller M, Byington R, Hunninghake D, Pitt B, Furberg C. Sex bias and underutilization of lipid-lowering therapy in patients with coronary artery disease at academic medical centers in the United States and Canada. *Arch Intern Med* 2000;160:343–347.
5. Gunnar RM, Bourdillon PD, Dixon DW, Fuster V, Karp RB, Kennedy JW, Klocke FJ, Passamani ER, Pitt B, Rapaport E. ACC/AHA guidelines for the early management of patients with acute myocardial infarction. *Circulation* 1990;82:664–707.
6. Expert Panel. Report of the Expert Panel on Population Strategies for Blood Cholesterol Reduction. Executive summary. National Cholesterol Education Program. *Arch Intern Med* 1991;151:1071–1084.
7. Expert Panel. Summary of the second report of the National Cholesterol Education Program (NCEP) expert panel on detection, evaluation, and treatment of high blood cholesterol in adults (Adult Treatment Panel II). *JAMA* 1993;269:3015–3023.
8. Fonarow G, Gawlinski A. Rationale and design of the cardiac hospitalization atherosclerosis management program at the University of California Los Angeles (CHAMP). *Am J Cardiol* 2000;85:10A–17A.
9. Debusk RF, Miller NH, Superko HR, Dennis CA, Thomas RJ, Lew HT, Berger WE, Heller RS, Rompf J, Gee D. A case-management system for coronary risk factor modification after acute myocardial infarction. *Ann Intern Med* 1994;120:721–729.
10. Harris DE, Record NB, Gipson GW, Pearson TA. Lipid lowering in a multidisciplinary clinic compared with primary physician management. *Am J Cardiol* 1998;81:929–933.
11. Blair TP, Bryant FJ, Bocuzzi S. Treatment of hypercholesterolemia by a clinical nurse using a stepped-care protocol in a nonvolunteer population. *Arch Intern Med* 1988;148:1046–1048.
12. Grundy SM, Balady GJ, Criqui MH, Fletcher G, Greenland P, Hiratzka LF, Houston-Miller N, Kris-Etherton P, Krumholz HM, LaRosa J, et al. When to start cholesterol-lowering therapy in patients with coronary heart disease. *Circulation* 1997;95:1683–1685.