Impact of a Targeted Intervention on Lipid-Lowering Therapy in Patients With Coronary Artery Disease in the Hospital Setting

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Background: Although lipid-lowering therapy according to the National Cholesterol Education Program guidelines decreases mortality and morbidity in patients with coronary artery disease (CAD), significant undertreatment of hyperlipidemia continues to occur. This study was designed to determine the impact of an intervention targeted at improving the use of lipid-lowering therapy in patients with CAD in the hospital setting.

Methods: Cardiac case managers prompted physicians to obtain lipid profiles for patients with CAD who were not receiving lipid-lowering therapy on admission and initiate lipid-lowering therapy for patients with a low-density lipoprotein level of 130 mg/dL (3.37 mmol/L) or higher during hospitalization. The study population comprised 813 patients with CAD admitted for percutaneous transluminal coronary angioplasty, coronary artery bypass grafting, or myocardial infarction. A retrospective chart review of lipid testing and treatment rates was conducted in 300 patients in the preintervention period, and a prospective review of rates was conducted in 513 patients during the intervention period.

Results: The percentage of patients with CAD not receiving lipid-lowering therapy on admission who had fractionated lipid profiles obtained during hospitalization increased from 27% preintervention to 89% during intervention (odds ratio, 18.27; 95% confidence interval, 11.61-28.74; P < .001). The percentage of patients with a low-density lipoprotein level of 130 mg/dL or higher for whom lipid-lowering therapy was initiated during hospitalization increased from 17% preintervention to 82% during intervention (odds ratio, 24.50; 95% confidence interval, 7.33-81.83; P < .001).

Conclusions: The intervention provided by specialized cardiac case managers significantly increased physicians’ adherence to the National Cholesterol Education Program treatment guidelines. The results of the present study suggest that intervention programs of this nature could produce a significant positive impact on cardiovascular outcomes if implemented nationally.

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Coronary artery disease (CAD) is a leading cause of mortality in the United States, responsible for a half million deaths in 1996 and contributing to substantial morbidity. For 1999, it was estimated that 1.1 million Americans would have a new (650,000 people) or recurrent (450,000 people) myocardial infarction (MI), with one third of those events resulting in a fatality. Elevated serum cholesterol level is a known risk factor for CAD, and reducing cholesterol slows the progression of coronary artery lesions and decreases coronary event rates. Findings from recent studies have confirmed that lipid lowering in the secondary prevention of coronary disease significantly reduces coronary disease-related morbidity and mortality.

The National Cholesterol Education Program (NCEP) recommends that lipoprotein profiles be obtained for patients with CAD immediately following hospital admission and lipid-lowering therapy be initiated in conjunction with maximal nonpharmacological therapy for patients with a low-density lipoprotein (LDL) level of 130 mg/dL (3.37 mmol/L) or higher to achieve a target LDL cholesterol level of 100 mg/dL (2.59 mmol/L) or lower. Success in meeting NCEP goals for the management of cholesterol could significantly reduce morbidity and mortality associated with CAD. Despite the benefit of lipid-lowering therapy and the comprehensive scope and wide dissemination of the NCEP guidelines, many patients with CAD remain inadequately treated for elevated serum cholesterol level and fail to achieve the beneficial outcomes associated with the NCEP guidelines.

Interventions to increase adherence to the NCEP guidelines have been examined for outpatients with CAD. Implementation of an individualized intensive multifactor risk reduction program resulted in a significant improvement in LDL cholesterol levels and reductions in cardiac events and hospitalizations in patients with CAD compared with standard care.
PATIENTS AND METHODS

PATIENTS

This study included patients with CAD admitted to Robert Wood Johnson University Hospital, New Brunswick, NJ, for percutaneous transluminal coronary angioplasty (PTCA), coronary artery bypass grafting (CABG), or acute MI. The medical records of 300 patients who were admitted to the study hospital for the above indications from July 1996 through June 1997 were consecutively selected and reviewed for physicians’ diagnosis and treatment of hypercholesterolemia before implementation of the intervention (preintervention phase). During the intervention period, 513 consecutive patients who were admitted to the study hospital for the above indications from October 1997 through March 1998 were identified, and their lipid testing results and treatment were prospectively assessed (intervention phase).

DATA COLLECTION

Patient demographics and clinical variables were collected from medical records and laboratory reports. Demographic variables included age, sex, marital status, race, and health insurance type. Clinical variables included admission diagnosis, lipid profile (if obtained), and the use (or not) of lipid-lowering medication(s) on admission. Lipid risk profiles were obtained within 24 hours of onset of MI in the subset of patients with infarction. Total cholesterol and high-density lipoprotein cholesterol levels have been shown to remain at or near baseline levels during the first 24 to 48 hours after infarction.2,23,24 Information recorded for analysis included whether lipid-lowering drug therapy was initiated during hospitalization and if the patient was discharged with a prescription for such an agent.

INTERVENTION PROGRAM

Figure 1 presents the study process with points of intervention by specialized cardiac case managers. When patients were admitted for PTCA, CABG, or MI, cardiac case managers reviewed the medical records for the use of lipid-lowering therapy on admission. Patients who were receiving lipid-lowering agents prior to admission were excluded from the intervention. Physicians with patients not receiving lipid-lowering therapy were prompted by the cardiac case managers to obtain a fractionated lipid risk profile as part of the admission blood testing. For patients with an LDL level of 130 mg/dL or higher, cardiac case managers contacted the physician and recommended that lipid-lowering therapy be initiated before discharge if no contraindication existed.

DATA ANALYSIS

Data were analyzed using a stepwise procedure based on a cascade (as shown in Figure 1) to determine (1) the percentage of patients with CAD who were not receiving lipid-lowering therapy prior to admission; (2) the percentage of those patients with CAD not receiving lipid-lowering therapy who had lipid profiles obtained during admission; (3) the percentage of patients with CAD admitted with an LDL level of 130 mg/dL or higher; and (4) the percentage of admitted patients with an LDL level of 130 mg/dL or higher for whom lipid-lowering drug therapy was initiated during hospitalization.

Baseline characteristics of patients were compared to determine the significance of differences using a chi-square test for discrete variables and a t test for continuous variables.21 A Wilcoxon rank sum test was applied to determine differences in LDL levels of patients with hyperlipidemia in the preintervention and postintervention phases.26

The impact of the intervention on the outcomes of interest at each step of data analysis (eg, the percentage of patients with elevated baseline lipid profiles and the percentage of patients who received lipid-lowering therapy) was analyzed using a partitioning chi-square test.27 Odds ratios (ORs) with 95% confidence intervals (CIs) were also calculated for the probability of the occurrence of such outcomes postintervention vs preintervention. All statistical analyses were performed using SAS statistical software (SAS Institute Inc, Cary, NC).

RESULTS

PATIENT CHARACTERISTICS

The demographics of preintervention group (n = 300) and intervention group (n = 513) are presented in Table 1.

Various team and multidisciplinary approaches have been initiated in outpatient clinical settings to reduce risk of CAD including interventions by nurse and pharmacist with physician supervision,18 physician and pharmacist,19 nurse alone,20,21 or pharmacist alone.22 These programs were successful in demonstrating reductions in lipid levels. However, to our knowledge, there have been no studies analyzing the impact of intervention by cardiac case managers on lipid management in inpatients with CAD. The purpose of the present study was to determine the impact of an intervention initiated by cardiac case managers on lipid testing and treatment according to the NCEP guidelines for patients with CAD in the hospital setting.
The preintervention group comprised 100 patients admitted for MI, 100 admitted for CABG, and 100 admitted for PTCA; the intervention group comprised 134 patients admitted for MI, 96 patients admitted for CABG, and 283 patients admitted for PTCA. The mean age in both groups was 64 years, and the percentage of male patients in the preintervention and intervention phases were 72% and 70%, respectively.

The percentage of patients admitted for PTCA, CABG, and MI was significantly different between preintervention and intervention groups ($P = .001$). However, LDL levels of patients in the preintervention group were not statistically different from those of patients in the intervention group. In the subset of patients who met NCEP requirements for lipid-lowering therapy, there was also no significant difference in LDL levels when comparing preintervention and intervention phases.

### Table 1. Characteristics of Study Patients*

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Preintervention (n = 300)</th>
<th>Intervention Phase (n = 513)</th>
<th>$P$ Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y</td>
<td>64 ± 11</td>
<td>64 ± 11</td>
<td>.77</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>215 (72)</td>
<td>356 (70)</td>
<td>.52</td>
</tr>
<tr>
<td>Female</td>
<td>85 (28)</td>
<td>156 (30)</td>
<td></td>
</tr>
<tr>
<td>Reason for admission</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PTCA</td>
<td>100 (33)</td>
<td>283 (55)</td>
<td></td>
</tr>
<tr>
<td>CABG</td>
<td>100 (33)</td>
<td>96 (19)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>MI</td>
<td>100 (33)</td>
<td>134 (26)</td>
<td></td>
</tr>
<tr>
<td>Marital status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td>21 (7)</td>
<td>31 (6)</td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>211 (71)</td>
<td>373 (76)</td>
<td>.499</td>
</tr>
<tr>
<td>Divorced</td>
<td>20 (7)</td>
<td>28 (6)</td>
<td></td>
</tr>
<tr>
<td>Widowed</td>
<td>46 (15)</td>
<td>61 (12)</td>
<td></td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>252 (85)</td>
<td>438 (86)</td>
<td></td>
</tr>
<tr>
<td>African American</td>
<td>13 (4)</td>
<td>19 (4)</td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>10 (3)</td>
<td>15 (3)</td>
<td>.3</td>
</tr>
<tr>
<td>Asian</td>
<td>4 (1)</td>
<td>17 (3)</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>17 (6)</td>
<td>19 (4)</td>
<td></td>
</tr>
<tr>
<td>LDL level, mg/dL (mmol/L)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All patients</td>
<td>118 ± 36 (3.06 ± 0.93)</td>
<td>112 ± 40 (2.90 ± 1.04)</td>
<td>.18</td>
</tr>
<tr>
<td>Patients with an LDL level $\geq 130$ mg/dL†</td>
<td>156 ± 29 (4.04 ± 0.75)</td>
<td>160 ± 30 (4.14 ± 0.78)</td>
<td>.55</td>
</tr>
</tbody>
</table>

*All data represent number (percentage) of patients or mean ± SD of specified value. PTCA indicates percutaneous transluminal coronary angioplasty; CABG, coronary artery bypass grafting; MI, myocardial infarction; and LDL, low-density lipoprotein.

†Patients with coronary artery disease who meet National Cholesterol Education Program criteria ([LDL $\geq 130$ mg/dL (3.37 mmol/L)] for initiation of lipid-lowering drug therapy.

LIPID-LOWERING THERAPY

The number of patients in each category and ORs with 95% CIs are presented in Table 2. Intervention resulted in significant increases in the percentage of patients who had a fractionated lipid profile obtained during hospitalization in all subgroups of patients with CAD, with an overall increase from 27% to 89% (OR, 18.27; 95% CI, 11.61-28.74; $P < .001$).

In addition, a significant overall increase was observed in the initiation of lipid-lowering therapy in patients with LDL levels of 130 mg/dL or higher from 17% to 82% (OR, 24.50; 95% CI, 7.33-81.83; $P < .001$). The cardiac case management intervention significantly increased percentages of both lipid profile acquisition and lipid-lowering drug therapy initiation for eligible admitted patients (Figure 2).

Lipid profile acquisition and treatment initiation were evaluated according to the patients’ reason for admission. Of the patients admitted for PTCA, lipid profile acquisition increased from 40% to 88% (OR, 9.31; 95% CI, 4.60-18.86; $P < .001$), and initiation of lipid-lowering therapy for patients with LDL levels higher than 130 mg/dL increased from 27% to 72% (OR, 7.11; 95% CI, 1.61-31.35; $P = .005$).

The percentage of patients admitted for CABG who had an lipid profile obtained during hospitalization increased significantly from 29% to 90% following intervention (OR, 23.21; 95% CI, 9.10-59.21; $P < .001$). The percentage of patients in this group started on lipid-lowering therapy for an LDL level higher than 130 mg/dL increased from 10% to 89% (OR, 24.50; 95% CI, 11.61-28.73; $P < .001$).

For patients admitted with acute MI, lipid profile acquisition increased significantly from 17% to 89% of patients (OR, 32.04; 95% CI, 13.88-73.93; $P < .001$). Initiation of lipid-lowering drug therapy increased from 0% of patients who met criteria for such treatment to 100% ($P < .001$) following cardiac case manager intervention.

Regardless of the reason for admission, lipid profiles were obtained for 90% of patients admitted for PTCA, CABG, or MI during the intervention period (Figure 3). However, the largest change in adherence to lipid-lowering therapy was observed in patients admitted for MI. No patient with an LDL level higher than 130 mg/dL admitted for MI was started on a therapy with a lipid-lowering agent in the preintervention period, but treatment was initiated in 100% of such patients during the intervention period. In patients admitted for CABG and PTCA, treatment was initiated in 10% and 27%,
patients for whom lipid-lowering therapy was initiated increased from 0% to 90% (P < .001).

Effects of intervention also were evaluated by sex and race (Figure 5). In the preintervention period, lipid profiles were obtained for 32% of the men and only 13% of the women. During intervention, lipid profiles were obtained in 89% of the men and 88% of the women. Before intervention, 19% of the men and 0% of the women were receiving lipid-lowering therapy. During intervention, lipid-lowering therapy was more frequently initiated in men with elevated LDL levels (86%) than in women (73%).

About 27% of the white patients and 21% of all other study patients underwent lipid testing in the preintervention period (Figure 6). During intervention, however, 89% of the white patients and 89% of all other patients underwent lipid testing. During the preintervention period, while only 5% of the white patients who met criteria for lipid-lowering therapy had such treatment, 50%...
of all other patients received treatment with lipid-lowering agents. During the cardiac case manager intervention period, 80% of the white patients and 92% of all other study patients eligible for therapy were started on treatment with lipid-lowering agents.

This study clearly demonstrates that a targeted, cardiac case manager–based intervention significantly improves rates of lipid testing and initiation of lipid-lowering treatment in patients with CAD in the hospital setting. Cardiac case managers successfully prompted physicians to initiate lipid-lowering therapy for patients with LDL levels of 130 mg/dL (3.37 mmol/L) or higher before and during the intervention period.

The intervention increased the percentage of patients tested for hyperlipidemia from 27% to 89% and, ultimately, the use of lipid-lowering therapy from 17% to 82% of patients with elevated lipid levels. These improvements are statistically significant and clinically important. This study provides evidence that implementation of a targeted intervention can improve physicians’ treatment of hyperlipidemia in patients with CAD, thus increasing compliance with the NCEP guidelines.

For patients with both CAD and high serum lipid levels, the NCEP treatment guidelines encourage the measurement of serum cholesterol immediately following hospital admission, as well as the initiation of lipid-lowering therapy while patients are hospitalized. However, despite promulgation of the NCEP guidelines, there has been insufficient compliance in the treatment of elevated lipid levels. A notable number of eligible patients do not receive appropriate treatment, resulting in the subsequent failure to prevent secondary coronary events in patients with established coronary disease.

The benefits of lipid-lowering therapy in patients with CAD have been well demonstrated. Lipid-lowering therapy extends survival, improves quality of life, decreases the need for interventional procedures, and reduces the incidence of subsequent cardiac events in patients with CAD. Therefore, it is recommended that lipid-lowering therapy be initiated as a secondary prevention to reduce the risk of recurrent acute coronary disease events when LDL cholesterol levels are higher than 130 mg/dL.

A recent study found that of patients with CAD, fewer than half were discharged on appropriate lipid-lowering treatment, indicating that a significant proportion of high-risk inpatients continues to be undertreated. Another study also found that physicians follow guidelines for obtaining LDL levels only about 50% of the time, concluding that a significant number of eligible patients are not appropriately treated. In addition, fewer than one third of patients who require treatment for high cholesterol levels actually receive treatment, and 62% of patients with CAD who meet criteria for initiating lipid-lowering therapy receive prescriptions for cholesterol-lowering medications.

Lack of compliance with guidelines may indicate deficiencies in physician knowledge, implementation problems, lack of physicians’ consensus regarding treatment strategies, or problems with patient compliance. The successful treatment rate of lipid-lowering therapy was highest for patients admitted for MI, followed by that for CABG and then by that for PTCA. Longer inpatient hospital stay (longest for patients admitted for MI, followed by that for CABG and then by that for PTCA) provided greater opportunity for lipid-lowering therapy to be initiated.

A previous study found that patients with 2 or more cardiac risk factors were more likely to be treated, while men, blacks, persons in lower socioeconomic groups, and persons aged between 20 and 34 years were less likely to be treated. However, our study found that female patients were undertreated compared with their male counterparts. There was also a slight difference between whites
and other races in initiation of treatment during the intervention phase of this study; although, before intervention, fewer white patients were being treated for hyperlipidemia than patients of other races. Many studies have evaluated attempts to increase adherence to the NCEP guidelines using various intervention strategies in the outpatient setting. Coronary artery disease risk factors could be effectively reduced when either nurses or pharmacists, with physicians’ supervision, used a stepped-care protocol based on the NCEP guidelines. Teamwork between physicians and pharmacists has been successful in lowering total cholesterol levels and increasing the prescription rate of lipid-lowering agents according to NCEP recommendations. Other studies have found that nurses can provide safe, cost-effective, compliance-enhancing care for dyslipidemia. It has been suggested that the addition of lipid-lowering drug therapy before hospital release may be advantageous in terms of compliance.

This study demonstrated that joint efforts by physicians and cardiac case managers are effective in improving appropriate use of lipid-lowering therapy. Interventions of this nature implemented nationally can produce a significant positive impact on cardiovascular outcomes. Although this study demonstrated the positive impact of a targeted cardiac case manager intervention on lipid-lowering therapy, these data may not be representative of the whole U.S. population because the data were collected from a single institution. This study also examined only physicians’ in-hospital adherence to the NCEP guidelines for lipid testing and initiation of treatment prompted by cardiac case managers rather than long-term intervention effects on physicians’ treatment behavior and patients’ outcomes.

The findings from this study demonstrate that a targeted cardiac case manager–based intervention program can significantly improve adherence to national guidelines for lipid testing and initiation of lipid-lowering therapy in hospitalized patients with CAD. Significant improvements were observed in both frequency of lipid testing and appropriate initiation of lipid-lowering therapy. Programs of this nature implemented nationally can result in a significant positive impact on clinical and economic cardiovascular outcomes.

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