Patterns of Secondary Prevention in Older Patients Undergoing Coronary Artery Bypass Grafting During Hospitalization for Acute Myocardial Infarction

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Background—Aggressive risk factor modification decreases cardiovascular events and mortality in patients after coronary artery bypass grafting (CABG). Little is known regarding the use of secondary prevention in older patients undergoing CABG during hospitalization for acute myocardial infarction (AMI).

Methods and Results—Medical records were reviewed for a sample of 37,513 patients hospitalized with AMI in the United States between April 1998 and March 1999. Patients ≥65 years of age who underwent CABG after AMI (n=2,267 [8%]) were evaluated for the prescription of 4 therapies at discharge: aspirin, β-blockers, angiotensin-converting enzyme (ACE) inhibitors, and lipid lowering, in eligible patients without contraindications to therapy and compared with patients who did not undergo CABG (n=26,484 [92%]). Patients undergoing CABG had higher rates of aspirin than patients who did not undergo CABG (88.0% versus 83.2%, P=0.0002). However, CABG patients were less likely to receive β-blockers (61.5% versus 72.1%, P<0.0001), ACE inhibitors (55.5% versus 72.1%, P<0.0001), or lipid lowering (34.7% versus 55.7%, P<0.0001) prescriptions than patients who did not undergo CABG. After adjustment for disease severity, patients undergoing CABG were no longer more likely to receive discharge aspirin, and the magnitude of other differences in care increased.

Conclusions—Evidence-based discharge therapies are underutilized in older patients who underwent CABG during hospitalization for AMI. Although national efforts focusing on improving short-term surgical mortality have been successful, strategies should be developed to increase the utilization of therapies known to improve long-term mortality in patients undergoing CABG. (Circulation. 2003;108[suppl II]:II-24-II-28.)

Key Words: ■ heart surgery ■ risk factors ■ elderly ■ quality assessment

More than 400,000 CABG surgeries are performed annually in the United States. The majority of these are performed in patients ≥65 years of age, and the number of older patients undergoing CABG is steadily increasing. Over the past decade, patients undergoing CABG have an increasing burden of cardiac risk factors and, as such, are at increased risk for subsequent cardiac events.

Cumulative data from observational and clinical trials demonstrate that aggressive lipid-lowering, ACE inhibitors, and β-blockers reduce overall mortality, and decrease subsequent cardiovascular events in patients undergoing coronary revascularization. Based on this evidence, national guidelines from the American Heart Association and American College of Cardiology support aggressive risk factor modification to prevent recurrent cardiac events after CABG. Despite these recommendations, CABG patients enrolled in clinical trials are less likely to receive lipid-lowering therapy or β-blockers at hospital discharge than patients not undergoing CABG. Whether similar patterns are observed in a representative national cohort of older patients undergoing CABG during AMI hospitalization is not known. Accordingly, we utilized data from the Centers for Medicare and Medicaid Services (CMS) National Heart Care Project to evaluate quality of care for older patients undergoing coronary artery bypass grafting (CABG) after AMI.

Methods

Data Source and Sampling
We analyzed data abstracted from hospital medical records collected as part of the CMS National Heart Care Program. Patients hospitalized with a principal discharge diagnosis of AMI (International Classification of Diseases, Ninth Revision, Clinical Modification [ICD-9-CM] code 410, excluding 410.x2) between April 1998 and
lipid lowering were assessed using \( \chi^2 \) tests. In order to account for potential differences in clinical characteristics between patients undergoing CABG and those not, we evaluated quality indicator rates by multivariate logistic regression analysis adjusting for patient clinical characteristics. Independent variables incorporated in the model included cardiac arrest or congestive heart failure on admission, myocardial infarction (MI) location, systolic blood pressure, white blood cell count, and serum creatinine levels—predictors of 30-day mortality in the Cooperative Cardiovascular Project identified by Krumholz et al.\textsuperscript{26} The software used for these analyses was SAS version 8.1 (SAS Institute, Inc., Cary, NC).

Results

Patient Characteristics

Of the 28,780 patients in our sample, 2,296 (8\%) underwent CABG. Patients undergoing CABG during AMI were significantly younger than patients not undergoing CABG (mean age 73.7 years versus 77.7 years, \( P<0.001 \); Table 1), with few patients over the age of 85 years receiving CABG (3.6\% versus 20.8\%, \( P<0.0001 \)). In general, patients undergoing CABG had fewer comorbid conditions than patients not undergoing CABG. Other characteristics of patients by receipt of CABG are shown in Table 1.

Discharge Therapies

Patients undergoing CABG were more likely to be ideal for each of the discharge therapies studied. (Table 2) Patients undergoing CABG ideal for aspirin therapy were more likely to be treated than post-MI patients not undergoing CABG (88.0\% versus 83.2\%, \( P=0.0002 \)). However, among ideal candidates for treatment, CABG patients were less likely to receive \( \beta \)-blocker (61.5\% versus 72.1\%, \( P<0.0001 \)) or ACE inhibitor (55.5\% versus 72.1\%, \( P<0.0001 \)). In our cohort only 27.2\% of patients had LDL-c documented in the chart, and of these, mean LDL-c was 113 mg/dL and only 28\% had an LDL-c \( \geq 130 \) mg/dL. In these patients, those undergoing CABG were significantly less likely to receive lipid lowering on discharge (34.7\% versus 55.7\%, \( P<0.0001 \)) prescription at time of discharge (Table 2). After adjustment for clinical variables, patients undergoing CABG were no more likely than patients not undergoing CABG to receive aspirin prescription on discharge and remained significantly less likely to receive \( \beta \)-blockers, ACE inhibitors, and lipid lowering on discharge.

Discussion

These data from the Medicare Health Care Quality Improvement Program’s National AMI Project demonstrate that many Medicare patients undergoing CABG after AMI are not receiving high-quality evidence-based care. In general, older patients undergoing CABG are significantly less likely to receive \( \beta \)-blockers, ACE inhibitors, or lipid-lowering therapy on discharge compared with other MI patients. Despite clinical data and national guidelines supporting aggressive secondary prevention in patients undergoing revascularization, patients undergoing CABG are 50\% less likely to receive these evidence-based therapies. However, irrespective of revascularization strategy, quality of care for older patients with coronary artery disease remains low.

These results highlight the need for expanded national efforts to monitor secondary prevention for patients undergo-
ing CABG and emphasize the importance of recent efforts by the Society of Thoracic Surgery (STS) to monitor discharge therapies in patients enrolled in the STS national database. Whereas recent national quality improvement initiatives within the surgical community (CQI CABG) have demonstrated substantial success in improving rates of use of preoperative β-blockers as well as the use of internal mammary arteries on a national scale through the STS, our data highlight the need for efforts to ensure that evidence-based discharge therapies are provided to all appropriate patients. Programs such as the Cardiac Hospitalization Atherosclerosis Management Program,27 the American College of Cardiology Guidelines Applied in Practice, 28 and the American Heart Association’s Get With the Guidelines29 have demonstrated significant improvements in the rates of secondary prevention in cardiac patients including those undergoing CABG, and have underscored the importance of programmatic change as a key element in improving and sustaining quality of care. Our results highlight gaps in secondary prevention and the need to develop comprehensive quality improvement pro-

### TABLE 1. Patient Characteristics by Coronary Artery Bypass Grafting Status

<table>
<thead>
<tr>
<th>Characteristic (%)</th>
<th>CABG (n=2,267)</th>
<th>No CABG (n=26,513)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>Demographic information</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean age (years)</td>
<td>2,267</td>
<td>73.7</td>
<td>26,513</td>
</tr>
<tr>
<td>Female</td>
<td>846</td>
<td>38.7</td>
<td>13,174</td>
</tr>
<tr>
<td>White</td>
<td>2,133</td>
<td>93.3</td>
<td>24,321</td>
</tr>
<tr>
<td>Cardiac risk factors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hypertension</td>
<td>1,559</td>
<td>70.6</td>
<td>17,743</td>
</tr>
<tr>
<td>Diabetes</td>
<td>726</td>
<td>32.6</td>
<td>8,438</td>
</tr>
<tr>
<td>Current smoker</td>
<td>485</td>
<td>21.7</td>
<td>4,491</td>
</tr>
<tr>
<td>Cardiac history</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Previous Myocardial Infarction</td>
<td>773</td>
<td>33.7</td>
<td>9,429</td>
</tr>
<tr>
<td>Previous Percutaneous Coronary Intervention</td>
<td>276</td>
<td>11.0</td>
<td>3,221</td>
</tr>
<tr>
<td>Previous CABG</td>
<td>219</td>
<td>9.5</td>
<td>4,488</td>
</tr>
<tr>
<td>History of heart failure</td>
<td>315</td>
<td>15.1</td>
<td>7,196</td>
</tr>
<tr>
<td>History of stroke</td>
<td>285</td>
<td>12.8</td>
<td>4,561</td>
</tr>
<tr>
<td>Medical history/comorbidity</td>
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<td></td>
<td></td>
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<tr>
<td>Lung disease</td>
<td>427</td>
<td>20.0</td>
<td>5,976</td>
</tr>
<tr>
<td>Dementia</td>
<td>24</td>
<td>1.2</td>
<td>2,165</td>
</tr>
<tr>
<td>Transferred in from long term care</td>
<td>10</td>
<td>0.6</td>
<td>1,809</td>
</tr>
<tr>
<td>Anterior MI</td>
<td>928</td>
<td>42.2</td>
<td>9859</td>
</tr>
<tr>
<td>Troponin T (median)</td>
<td>21</td>
<td>0.8</td>
<td>287</td>
</tr>
<tr>
<td>Troponin I (median)</td>
<td>1,259</td>
<td>8.1</td>
<td>16,948</td>
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<tr>
<td>Peak CK (median)</td>
<td>1,951</td>
<td>472.0</td>
<td>24,465</td>
</tr>
<tr>
<td>Peak CK-MB&gt;5%</td>
<td>1,411</td>
<td>78.7</td>
<td>18,000</td>
</tr>
<tr>
<td>LVEF&lt;40%</td>
<td>610</td>
<td>29.7</td>
<td>6696</td>
</tr>
</tbody>
</table>

**ACE** = Angiotensin converting enzyme.

*Adjusted for cardiac arrest or congestive heart failure on admission, MI location, systolic blood pressure, white blood cell count, and serum creatinine levels.

### TABLE 2. Quality Indicator Rates by Coronary Artery Bypass Grafting Status

<table>
<thead>
<tr>
<th>Quality Indicator</th>
<th>Eligible (n (%))</th>
<th>Received (%)</th>
<th>Eligible (n (%))</th>
<th>Received (%)</th>
<th>P*</th>
<th>Odds ratio*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discharge aspirin</td>
<td>947 (41)</td>
<td>88.0</td>
<td>8932 (33)</td>
<td>83.2</td>
<td>0.288</td>
<td>1.17</td>
</tr>
<tr>
<td>Discharge β-blocker</td>
<td>399 (18)</td>
<td>61.5</td>
<td>3013 (11)</td>
<td>72.1</td>
<td>&lt;0.0001</td>
<td>0.51</td>
</tr>
<tr>
<td>Discharge ACE inhibitor</td>
<td>393 (17)</td>
<td>55.5</td>
<td>3177 (11)</td>
<td>72.1</td>
<td>&lt;0.0001</td>
<td>0.46</td>
</tr>
<tr>
<td>Discharge lipid lowering</td>
<td>193 (8)</td>
<td>34.7</td>
<td>1346 (5)</td>
<td>55.7</td>
<td>&lt;0.0001</td>
<td>0.34</td>
</tr>
</tbody>
</table>

*Adjusted for cardiac arrest or congestive heart failure on admission, MI location, systolic blood pressure, white blood cell count, and serum creatinine levels.*
grams on a national scale to improve secondary prevention in older patients undergoing CABG.

Although our study represents the largest study to date to assess quality of care in older patients undergoing CABG after MI, there are several issues to consider. Whereas our study assesses the use of evidence-based therapy in patients deemed ideal on the basis of national guidelines, we are unable to account for patient frailty or preferences in care decisions. Furthermore, our cohort is of older patients hospitalized with AMI undergoing CABG before discharge, and our results may not be generalizable to older patients undergoing CABG in other settings or to younger patients undergoing CABG. Nevertheless, our data represent “real-life” patterns of care in a nationally representative sample of older patients undergoing CABG during AMI hospitalization.

These data demonstrate significant gaps in secondary prevention and highlight opportunities to improve care nationally for a large number of older patients undergoing revascularization annually. These results should prompt health care providers, health care systems, and national professional organizations to strengthen efforts to improve the quality of care in older patients undergoing revascularization and to support ongoing professional society efforts to monitor and improve the quality of care for patients undergoing CABG.

Appendix: Quality Indicators for Post-AMI Care of Medicare Beneficiaries

Aspirin at Discharge

Eligible
All patients with confirmed AMI discharged alive and not transferred to another acute care hospital

Exclusions
Bleeding on admission or during hospitalization; history of bleeding or chronic liver disease; coagulopathy; platelet count <100×10^9/L; serum creatinine >3 mg/dL; history of peptic ulcer disease or discharge diagnosis of an upper gastrointestinal disorder; Hb <10.0 g/L or Hct <0.30; allergy to aspirin; treatment with warfarin; metastatic cancer or other terminal illness.

Criterion
Evidence of a discharge prescription for aspirin

β-Blockers at Discharge

Eligible
All patients with confirmed AMI discharged alive and not transferred to another acute care hospital

Exclusions
Hypotension or shock during hospitalization or systolic BP <100 mm Hg at discharge; history of asthma or chronic obstructive pulmonary disease; bradycardia or pulse at discharge <50/min (unless discharged while receiving a beta blocker); conduction disorder including 2\(^{nd}\) or 3\(^{rd}\) degree heart block, bifascicular block, or trifascicular block; left ventricular ejection fraction <35%, pulmonary edema or congestive heart failure; metastatic cancer or other terminal illness.

Criterion
Evidence of a discharge prescription for a β-blocker

ACE Inhibitors at Discharge

Eligible
All patients with confirmed AMI and left ventricular ejection fraction <40%, discharged alive and not transferred to another acute care hospital

Exclusions
Aortic stenosis; allergy or intolerance to ACE inhibitors, serum creatinine >2.0 mg/dL; systolic BP <100 mm Hg at discharge; metastatic cancer or other terminal illness.

Criterion
Evidence of a discharge prescription for an ACE inhibitor

Lipid Lowering Agent at Discharge

Eligible
All patients with confirmed AMI and documented LDL-c >130 mg/dL discharged alive and not transferred to another acute care hospital

Exclusions
Allergy or intolerance to lipid lowering therapy; liver disease documented in the chart; metastatic cancer or other terminal illness.

Criterion
Evidence of a discharge prescription for a lipid lowering agent (3-hydroxy-3-methylglutaryl-coenzyme A reductase inhibitors, resins, fibrates, bile acid sequestrants, and/or nicotinic acid)

Acknowledgments

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References

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