Inpatient and follow-up cardiology care and mortality for acute coronary syndrome patients in the Veterans Health Administration

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Background The impact of inpatient and follow-up cardiology care on patient outcomes after acute coronary syndrome (ACS) hospital discharge is unknown.

Methods This was a retrospective cohort study of all patients with ACS discharged from Veterans Health Administration facilities from 2003 to 2004. Patients were stratified into 2 categories of cardiology care: (1) inpatient and follow-up cardiology care within 60 days after discharge and (2) other levels of cardiology care (inpatient only, outpatient only, and neither inpatient nor outpatient). Multivariable regression assessed the association between inpatient and follow-up cardiology care with all-cause mortality, adjusting for demographics, comorbidities, hospital presentation and treatment variables, and clustering by site.

Results Of 4933 patients with ACS, the majority (71.6%) had inpatient and follow-up cardiology care. Patients with inpatient and follow-up cardiology care were more likely to have prior coronary disease and diabetes and to present with myocardial infarction (vs unstable angina). All-cause mortality was lower for patients with inpatient and follow-up cardiology care (18.8% vs 22.1%, $P = .009$). In multivariable analysis, patients with inpatient and follow-up cardiology care remained at lower mortality risk (hazard ratio 0.73, 95% CI 0.62-0.87) compared with patients with other levels of cardiology care. The findings were consistent when cardiology follow-up was defined as 30 or 90 days after hospital discharge.

Conclusions Patients with inpatient and follow-up cardiology care have lower mortality risk after ACS. Future studies should identify mediators of this potential benefit and determine if interventions enhancing continuity of care in general, and continuity of subspecialty care in particular, after ACS will improve patient outcomes. (Am Heart J 2007;154:489-94.)

Acute coronary syndromes (ACS), including acute myocardial infarction (AMI) and unstable angina (UA), account for more than 1 million hospitalizations yearly in the United States and have a significant impact on patient morbidity and mortality.[1] There is increasing interest in the transition from the inpatient setting to outpatient care after hospitalization for ACS, as poorly executed transitions can lead to adverse outcomes.[2] For example, a significant proportion of patients discontinue key cardiac medications within 1 month after hospitalization for ACS, and these patients have increased 1-year mortality.[3,4] One prior study of patients hospitalized for various conditions found that patients seen in the early post-discharge period by physicians who treated them in the hospital had lower 30-day hospital readmission and mortality rates.[5] However, little is known about the impact of continuity of care from the inpatient to the outpatient setting for specific conditions such as ACS.

Prior studies suggest that subspecialty care for patients with AMI is associated with improved outcomes.[6-14] In particular, patients with AMI treated by cardiologists while hospitalized had lower inhospital and short-term mortality.[6-8] In other studies, outpatient cardiology care has been associated with achieving secondary prevention goals and lower mortality.[13,14] These studies, however,

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This study was supported by a grant from the Ischemic Heart Disease Quality Enhancement Research Initiative of the US Department of Veterans Affairs. Dr Ho is supported by a Veterans Affairs Research & Development Career Development Award.
The views expressed in this article are those of the authors and do not necessarily represent the views of the US Department of Veterans Affairs.
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0002-8703/$ - see front matter

doi:10.1016/j.ahj.2007.05.018

have not assessed continuity of cardiology care between the inpatient and outpatient settings for patients with ACS.

Accordingly, the objective of this study was to assess the association between cardiology care in the inpatient and/or outpatient setting and outcomes in a national Veterans Health Administration (VHA) cohort of patients with ACS. Specifically, we assessed whether inpatient and follow-up cardiology care was associated with lower all-cause mortality compared with other levels of cardiology care (ie, cardiology care in the inpatient setting only, cardiology care in the outpatient setting only, or no cardiology care in either the inpatient or outpatient setting) for patients with ACS. The results of this study may have important implications for improving the transition of care from the hospital to the outpatient setting, as well as the development and testing of new AMI quality interventions.

Methods

Information for this study was collected as part of the VHA External Peer Review Program (EPRP) for quality monitoring and improvement for a variety of medical conditions and procedures, including AMI and UA. Patients with *International Classification of Diseases, Ninth Revision, Clinical Modification* diagnosis codes 410.xx and 411.xx were identified from the Veterans Affairs Patient Treatment File. Working with the EPRP abstraction contractor, West Virginia Medical Institute, the VHA Office of Quality and Performance generated a list of patients that was transmitted to VHA facilities where both paper and electronic medical records were manually abstracted by trained abstractors using standard reporting forms. Abstracted data were then entered into a database maintained by the contractor. Additional details of the study methods have been published.[15]

Patient population

All patients admitted with AMI or UA as documented by standard electrocardiographic criteria, elevated troponin levels, and/or other clinical evidence and discharged from VHA medical centers between July 20, 2003, and August 19, 2004, were included. Patients admitted with other primary medical conditions but who developed AMI during the hospitalization or as a postoperative complication were excluded. Patients who were transferred into VHA hospitals from other medical facilities for ACS and patients who were rehospitalized within 60 days of the index hospital discharge were excluded. In addition, patients with a decision of "not to treat" in the chart were excluded. This was based on documentation in the medical record that the patient, patient's family, or legal representative wanted comfort measures only, and/or there was agreement that the patient's cardiac condition and comorbid conditions precluded further treatment. The analytical cohort for the current study was 4933 patients.

Variables

The primary independent variable of interest was inpatient and follow-up cardiology care. Based on chart review, inpatient cardiology care was noted if one or more of the following occurred during the hospitalization: (1) a cardiologist was the attending physician; (2) a cardiologist saw the patient in consultation; (3) there was a note documenting that a cardiology consultation was obtained by telephone; or (4) coronary angiogram and/or percutaneous coronary intervention (PCI) were performed within 24 hours of hospital admission. In the primary analysis, patients were defined as having follow-up cardiology care if a cardiology clinic visit occurred within 60 days of hospital discharge. Next, patients were stratified into the following 2 categories: (1) inpatient and follow-up cardiology care (n = 3532) and (2) other levels of cardiology care (ie, only inpatient cardiology care [n = 1124], only outpatient cardiology care [n = 165], and neither inpatient nor outpatient cardiology care [n = 112]).

The primary outcome of interest was all-cause mortality after the index ACS hospitalization. The Beneficiary Identification Record Locator System death file, the Social Security Administration Death Master File, and the Medical SAS in-patient files were used to determine vital status after hospital discharge.[16,17] The median length of follow-up was 697 days.

Statistical methods

Baseline patient characteristics, comorbidities, presentation factors, hospital treatment (ie, thrombolytics, PCI, coronary artery bypass graft [CABG] surgery), discharge medications among eligible patients, and primary care follow-up visit within 60 days of hospital discharge were compared between the 2 groups with the χ^2 test for categorical variables and *t* test for continuous measures. Unadjusted all-cause mortality was compared between the 2 patient groups with the χ^2 test.

Next, unadjusted survival was compared between patients with different levels of cardiology care by the Kaplan-Meier method. Survival was computed as the time from hospital discharge to death or date of last follow-up. Differences in event rates were evaluated with the log-rank test. In multivariable analysis, Cox proportional hazards models were constructed to evaluate the association between inpatient and follow-up cardiology care with time to death. These models included patient demographics (age, race), comorbidities (coronary disease, heart failure, chronic obstructive pulmonary disease, cancer, cerebrovascular disease, diabetes), hospital presentation factors (TIMI risk score for ST-elevation MI or non–ST-elevation MI, left ventricular systolic dysfunction, abnormal serum creatinine level), hospital treatment variables (receipt of PCI and/or CABG surgery), discharge medications (aspirin, β-blockers, angiotensin-converting enzyme inhibitors or angiotensin receptor blockers, and statin medications), and follow-up visit with a primary care provider within 60 days after hospital discharge. Because practice patterns and resource availability may differ among hospitals and could influence cardiology care in both the inpatient and outpatient settings, the models also accounted for the clustering of patients by site. The Cox proportional hazards assumption was confirmed by calculating and graphing Schoenfeld residuals by survival time.[18]

Next, we performed a series of sensitivity analysis to assess the robustness of our primary analyses. First, we stratified our cohort by final diagnosis at hospital discharge, MI, or UA. Second, we redefined the criteria for outpatient cardiology clinic visit as occurring within 30 days and then within 90 days after the index ACS hospitalization. Third, we compared the benefit of inpatient and follow-up cardiology care with inpatient

Table I. Baseline characteristics of patients with inpatient and follow-up cardiology care versus other levels of cardiology care (n = 4933)

Variable	Inpatient and follow-up cardiology care (n = 3532)	Other levels of cardiology care (n = 1401)	*P*
Demographics and comorbidities			
Age (mean) (y)	66.4 (11.5)	66.5 (11.9)	.77
White	53.7	51.0	.01
Female	1.5	2.8	.003
Heart failure	26.1	24.6	.29
Prior coronary artery disease	43.6	39.5	.01
Cerebrovascular disease	5.1	4.6	.50
Diabetes	22.5	19.4	.02
Chronic obstructive pulmonary disease	16.1	16.8	.53
Cancer	7.0	7.9	.26
Inhospital treatment and presentation variables			
TIMI risk score (mean)	3.2 (1.3)	3.1 (1.3)	<.0001
Thrombolytics	4.6	1.3	<.0001
Percutaneous coronary intervention	50.7	34.0	<.0001
Coronary artery bypass graft surgery	5.8	3.2	<.0001
Creatinine level above normal reference range	35.2	35.6	.75
Left ventricular ejection fraction <0.40	26.8	22.0	<.0001
Final diagnosis			<.0001
Myocardial infarction	83.0	71.3	
Unstable angina	17.0	28.7	
Follow-up visit with primary care within 60 days of hospital discharge	98.8	55.6	<.0001

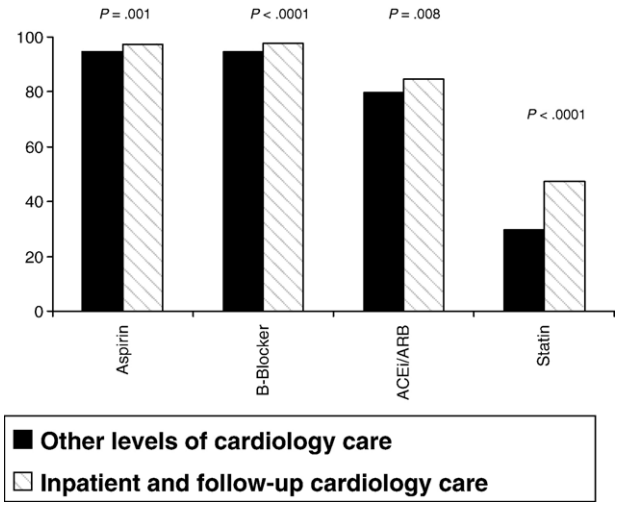
cardiology care only because prior studies have found a benefit of inpatient cardiology care compared with generalist care for AMI. Fourth, we derived a propensity score for the likelihood that a patient would get both inpatient and follow-up cardiology care and performed a propensity matched analysis to assess the association between inpatient and follow-up cardiology care with time to death. These secondary analyses used the same multivariable modeling techniques as the primary analyses.

Analyses were conducted using STATA v9.0 (StataCorp, College Station, TX). This study was approved by the University of Washington Institutional Review Board and waiver of informed consent was granted.

Results

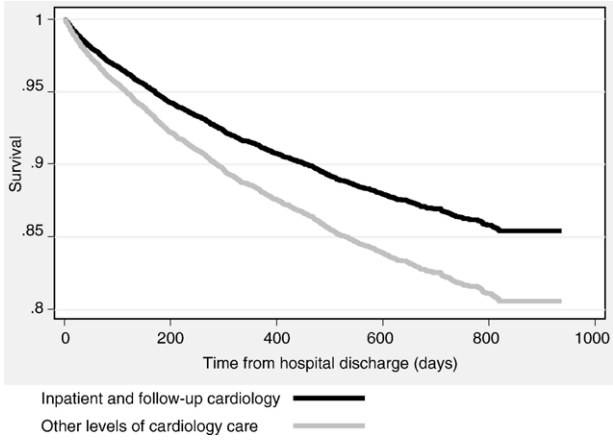
Baseline characteristics of the study population are outlined in Table I. Most patients (71.6%) had inpatient and follow-up cardiology care. Patients with inpatient and follow-up cardiology care were more likely to be of white race, to be men, and to have prior coronary disease and diabetes compared with patients with other levels of cardiology care.

Figure 1



Prescribed medications at hospital discharge among eligible patients.

Figure 2



Multivariable Cox proportional hazards regression curve comparing inpatient and follow-up cardiology care versus other levels of cardiology care.

There were no clinically significant differences in the mean TIMI risk scores between the 2 groups. However, patients with inpatient and follow-up cardiology care were more likely to receive thrombolytics, PCI, and/or CABG surgery during the hospitalization. Finally, patients with inpatient and follow-up cardiology care were more likely to have a diagnosis of MI compared with patients with other levels of cardiology care.

At hospital discharge, eligible patients with inpatient and follow-up cardiology care were more likely to receive

evidence-based medications, including aspirin, β-blockers, angiotensin-converting enzyme inhibitors or angiotensin receptor blockers, and statin among eligible patients (Figure 1). Within 60 days of hospital discharge, patients with inpatient and follow-up cardiology care were also more likely to have a primary care visit (98.8% vs 55.6%, $P < .0001$). In addition, unadjusted all-cause mortality was lower for patients with inpatient and follow-up cardiology care (18.8% vs 22.1%, $P = .009$).

The median follow-up was 697 days. In Kaplan-Meier survival analysis, patients with inpatient and follow-up cardiology care had the highest survival compared with patients with other levels of cardiology care. In multivariable analysis, patients with inpatient and follow-up cardiology care (hazard ratio [HR] 0.73, 95% CI 0.62-0.87) remained at lower risk for mortality compared with patients with other levels of cardiology care (Figure 2).

In sensitivity analysis, the lower mortality risk associated with inpatient and follow-up cardiology care was similar whether outpatient cardiology follow-up occurred at 30 days (HR 0.79, 95% CI 0.68-0.91) or 90 days (HR 0.72, 95% CI 0.61-0.86) after hospital discharge. In addition, the lower mortality risk associated with inpatient and follow-up cardiology care was consistent among subgroups of patients with a final diagnosis of AMI (HR 0.62, 95% CI 0.52-0.75). However, there was no significant association between inpatient and follow-up cardiology care with mortality among patients with UA (HR 0.89, 95% CI 0.59-1.32). Finally, inpatient and follow-up cardiology care was associated with lower mortality risk compared with inpatient cardiology care only (HR 0.63, 95% CI 0.52-0.76), and matched propensity analysis also demonstrated a consistent benefit of inpatient and follow-up cardiology care (HR 0.60, 95% CI 0.44-0.83) compared with other levels of cardiology care.

Discussion

The objective of this study was to assess the association between inpatient and follow-up cardiology care and outcomes in a national VHA cohort of patients with ACS. We found that patients with inpatient and follow-up cardiology care had a lower risk of death compared with patients with other levels of cardiology involvement, including patients with inpatient cardiology care only. The findings were consistent when the timing of the outpatient cardiology visit was redefined.

The transition period from hospital discharge to the outpatient setting after ACS is an important period in regard to patient outcomes. Several prior studies have found that a significant proportion of patients discontinue evidence-based medications during this transition period despite being discharged on medication after AMI, and these patients had increased mortality risk during the subsequent year.[3,4] In addition, one prior study found that a clinic visit with either cardiology or general medicine within 60 days of hospital discharge for AMI was associated with reduced mortality risk.[19] The findings of the current study support the theory that cardiology care in the inpatient setting as well as during the transition period to outpatient care is associated with better patient outcomes. One potential explanation for this association is that specialists can more naturally focus on a single condition—in this case, reinforcing secondary prevention—and have higher vigilance for high-risk post-ACS factors such as recurrent ischemia.[20,21] In contrast, primary care physicians often face time constraints trying to balance the need to deliver preventive services, address acute symptoms or concerns, and manage chronic conditions, which compete with the need to follow-up on post–hospital discharge issues and reinforce behaviors such as medication adherence.[22,23] Future studies should investigate potential mediators of the lower mortality risk associated with inpatient and follow-up cardiology care for patients hospitalized with ACS.

Based on the published literature, patients with AMI cared for by generalists often have greater baseline mortality risk, suggesting that the differences in outcomes by physician specialty may be related at least in part to patient risk rather than solely to provider factors.[12,20,21,24] In contrast to prior studies, patients with inpatient and follow-up cardiology care in our study were more likely to have a prior cardiac history, to present with an MI rather than UA, and to have left ventricular systolic dysfunction, all of which are established adverse prognostic factors associated with ACS. Moreover, there were no large differences in measured comorbid conditions. Therefore, the finding of improved outcomes for patients with inpatient and follow-up cardiology care in our study supports the theory that continuity of cardiology care from the inpatient to the outpatient setting for patients with AMI may have an impact on patient outcomes. In contrast, the benefit of cardiology care was not seen among patients with UA and suggests that additional studies are needed to identify potential reasons for the differential outcomes across the spectrum of ACS by physician specialty.

It is also important to note that, compared with patients with inpatient and follow-up cardiology care, patients with other levels of cardiology care (ie, inpatient cardiology only, outpatient cardiology only, or neither) were less likely to have a primary care visit within 60 days after hospital discharge. Although we adjusted for this in the analysis, the lack of close follow-up after hospitalization for ACS, regardless of physician specialty, may have a negative impact on patient outcomes. During the transition period from the inpatient to outpatient setting, medication discrepancies often occur as well as errors in follow-up of inhospital tests or in further workup, and these inconsistencies can lead to adverse outcomes.[25-29] One study of an intervention using a "transition coach" for older patients demonstrated a reduction in

rehospitalization rates and health care costs.[30] The composite of these studies suggest that better management of this transition period from the inpatient to outpatient setting can potentially improve patient outcomes, and prospective studies are needed to determine whether a disease management intervention targeting this transition period can improve outcomes for patients with ACS.

Several potential limitations of this study should be addressed. First, the study assessed care and outcomes for veterans with ACS, which may not be generalizable to the broader population of patients with ACS. However, this was a national cohort of all patients with ACS in the VHA from 2003 through 2004 and therefore represents practice patterns for ACS in a large integrated health care system. Second, we were not able to evaluate decision making around the referral for outpatient cardiology care in our cohort. However, the "decision not to treat" was captured in our data set, and these patients were excluded from the analytic cohort. Third, although there were high prescription rates of evidence-based medications at hospital discharge, we did not evaluate medication continuation after discharge. Future studies should investigate whether differences in medication adherence between patients with and without cardiology involvement after hospitalization for ACS mediates some of the differences in patient outcomes. Fourth, we do not have data on cardiology clinic visits outside the VHA system after hospitalization for ACS in a Veterans Affairs facility. However, if a significant proportion of patients sought cardiology care outside the VHA, this would tend to bias the results toward the null. Finally, because this is an observational study, there is the potential for unmeasured confounding. However, we attempted to control for confounding by adjusting for a wide array of demographic variables, comorbidities, hospital presentation factors, ACS treatment, process variables, and discharge medications, as well as using propensity analysis for the likelihood of cardiology care.

In conclusion, we found that inpatient and follow-up cardiology care for patients with ACS hospitalization was associated with lower mortality risk. These findings support the idea that the transition period from hospital discharge to the outpatient setting is a critical period in which continuity of care in general, and continuity of subspecialty care in particular, may have an impact on patient outcomes. Future studies should determine if interventions targeting the transition from the inpatient to the outpatient setting after ACS, including incorporation of subspecialty care, will improve patient outcomes.

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