Very Early Discharge After Coronary Artery Bypass Grafting Does Not Affect Readmission or Survival

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Background. This study evaluated the impact of very early hospital discharge after coronary artery bypass grafting (CABG) on subsequent readmission and survival.

Methods. Adults undergoing isolated CABG from 2011 to 2018 at a single institution were included. Patients were stratified on the basis of their postoperative length of hospital stay: short stay (≤4 days) and nonshort stay (>4 days). The primary outcomes were longitudinal survival and freedom from hospital readmission. Secondary outcomes included rates of postoperative complications. Propensity score matching with a 1:1 ratio was performed to generate cohorts with comparable baseline characteristics.

Results. A total of 6327 patients underwent CABG during the study period, and a matched cohort of 2286 patients was identified. In matched analysis, the average Society of Thoracic Surgeons predicted risk of operative mortality was low in both groups (average, 0.7%). Rates of postoperative complications were low and several complication rates were even lower in the short-stay cohort: stroke (1.14% vs 0.26%; $P = .01$), renal failure (0.87% vs 0.09%; $P = .007$), reoperations (1.84% vs 0.26%; $P < .001$), and new-onset atrial fibrillation (34.21% vs 13.04%; $P < .001$). Survival was similar between the matched groups at 30 days (99.56% vs 99.21%), 1 year (97.73% vs 97.46%), and 5 years (91.15% vs 92.48%) (all $P > .05$). Readmission rates were also comparable at all time intervals, and there were no differences in cardiac-related or heart failure–specific readmissions (all $P > .05$). Risk-adjusted analyses confirmed these findings.

Conclusions. This study demonstrates that very early discharge within 4 days of isolated CABG is safe and has no substantial impact on subsequent mortality or readmission risk.

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Isolated coronary artery bypass grafting (CABG) is the most commonly performed cardiac procedure in the United States, at more than 300,000 cases annually.[1] Growing trends toward implementing "fast-tracking" and studies demonstrating the feasibility of enhanced recovery after surgery (ERAS) programs for cardiac surgical patients have resulted in increased numbers of patients discharged before the fifth postoperative day.[2-4] Although many of these studies focus on the immediate postoperative period, including data on protocols focused on early extubation, accelerated rehabilitation, minimization of opioids, and early hospital discharge, they less frequently evaluate the longitudinal impacts of these programs on survival and hospital readmission.[5,6] Importantly, although these approaches may improve overall care and reduce health care costs during the index hospitalization, these effects may be negated by multiple readmissions or delayed complications that may not have been captured by previous studies.[7] Considering the changing landscape of accelerated postoperative care in cardiac surgery, it is prudent to examine the longitudinal impacts of very early discharge in patients who have undergone CABG. This study evaluates the impact of very early discharge after CABG on subsequent readmission and mortality risk.

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Patients and Methods

Study Population

This retrospective study included adult patients (≥18 years of age) who underwent isolated CABG between 2011 and 2018 at a multihospital single academic institution (University of Pittsburgh Medical Center, Pittsburgh, PA). Patients were stratified by timing of their index hospitalization discharge, including short stay or nonshort stay. A short stay was defined as a length of index hospitalization of 4 days or less. A nonshort stay was defined as a length of index hospitalization longer than 4 days. The decision to use 4 days as the threshold for very-early discharge was based on a previous review of the literature that demonstrated 5 days as a marker for early discharge,[2,8,9] as well as a review of the distribution of hospital length of stay in patients who underwent isolated CABG at our center (Supplemental Table 1).

Decision Making Regarding Early Discharge

Although not standardized, several criteria were used to determine whether a patient was suitable for early discharge. Chest tubes were typically removed on postoperative day 1 or 2 in these patients. Patients typically had normal sinus rhythm without new-onset atrial fibrillation, were tolerating a regular diet and having bowel movements, were breathing room air and required no supplemental oxygen, and had a weight that was within 3 kg of their baseline weight. There was also absence of fever or abnormally trending laboratory parameters, such as increasing white blood cell count or creatinine level.

Baseline Characteristics

Baseline preoperative characteristics, including demographics and comorbidities, were compared between patients with a short stay and those with a nonshort stay. The indications for CABG, operative status, cardiopulmonary bypass times, and ischemic times were also compared. Additionally, a subgroup of patients who did not experience postoperative complications but who still had differential lengths of hospitalization was also evaluated.

Outcomes

The primary outcomes for the study were longitudinal survival and freedom from all-cause readmission at 30 days, 1 year, and 5 years from discharge. The longitudinal impacts of short hospital stay on subtypes of readmission, including heart failure–specific and cardiac-related readmissions, were also evaluated. Secondary outcomes included the rates of major postoperative complications. The clinical definitions of these complications were derived from the criteria set forth from the Society of Thoracic Surgeons Adult Cardiac Surgery Database version 4.20.[10]

Data Analysis

Kaplan-Meier estimates were conducted to compare survival and freedom from readmission between the short-stay and nonshort-stay groups. For readmissions that were potentially repeating events, cumulative incidence function analyses were conducted. To reduce residual bias within our study, a propensity score model was estimated using all available preoperative patient comorbidities, the operating surgeon, and the specific hospital within our multihospital institution. To estimate the propensity score, a logistic regression model was used in which short stay vs nonshort stay was regressed on the baseline characteristics. The short-stay cohort was used as a pool from which to find appropriate participants to match those in the nonshort-stay group. Participants were matched on a 1:1 basis on the logit of the propensity score by using a caliper width of 0.2. All standardized mean differences (SMD) were less than 0.1, indicating that the cohorts were appropriately matched. This resulted in evenly distributed 2286 matched pairs. Cox regression analysis was used in the matched group to determine whether length of stay was an independent predictor of worse longer-term outcomes. In the unmatched group, multivariable Cox regression analyses incorporating univariate predictors (inclusion criteria of 2-tailed $P < .05$) were conducted to evaluate the risk-adjusted impact of the length of stay on readmission and mortality. Risk adjustment was enhanced through a hierarchic structure nesting each subject within a cluster of the 5 hospitals within our multihospital center, as well as an additional shared frailty term that was determined with a gamma distribution of 2 times the logarithmic expectation. Normality of each variable was checked with the Kolmogorov-Smirnov test. The χ^2 test or Fisher exact test was used for categoric variables. Continuous variables were analyzed with 2-sided *t* tests if normally distributed and the Mann-Whitney *U* test if nongaussian. Categoric variables are represented as number (percentage), and nonparametric continuous variables are represented as median (interquartile range). Statistical analyses were performed with SAS software version 9.4 (SAS Institute, Cary, NC).

Results

Study Cohort

A total of 6327 adult patients underwent isolated CABG during the study period; 81.86% (n = 5179) of these patients were identified as nonshort stay, and 18.14% (n = 1148) were identified as short stay. There were multiple differences in baseline characteristics between the nonshort-stay and short-stay groups (Supplemental Table 2). Foremost, in terms of demographics, patients in the nonshort-stay group were commonly older (67 years of age vs 63 years of age; $P < .001$), female (27.6% vs 17.2%; $P < .001$) and black (5.5% vs 2.3%; $P < .001$). Patients in the nonshort-stay group also had a higher frequency of comorbid conditions, such as diabetes mellitus, hypertension, end-stage renal disease requiring dialysis, chronic obstructive pulmonary disease, congestive heart failure, cardiogenic shock, and peripheral artery disease (all, $P < .001$). Patients in the nonshort-stay group were more likely to present with non–ST-segment elevation myocardial infarction (29.48% vs 23.69%; $P < .001$) or ST-segment elevation myocardial infarction (6.78% vs 5.14%; $P < .001$) than those in the short-stay group. Furthermore, those in the nonshort-stay group were more likely to have an intraaortic balloon pump (7.26% vs 3.57%; $P < .001$) and have triple-vessel coronary disease (77% vs 65.16%; $P < .001$). Propensity matching resulted in a sample of 2286 patients, evenly distributed between both groups. The propensity-matched groups were well matched, with all variables having SMDs of less than 0.10 (Table 1).

Major Postoperative Complications in Unmatched and Matched Patients

The unmatched short-stay cohort was found to have significantly fewer complications compared with their nonshort-stay counterparts (40.10% vs. 78.57%; $P < .001$) (Supplemental Table 3). This finding persisted in the matched groups, with short-stay patients having significantly lower rates of blood product transfusions (25.46% vs 9.19%; $P < .001$), all-cause reoperations (1.84 vs 0.26%; $P < .001$), stroke (1.14% vs 0.26%; $P = .01$), prolonged ventilation (3.94% vs 0.70%; $P < 0.001$), renal failure (0.87% vs 0.09%; $P = .007$), pneumonia (1.49% vs 0.00%; $P < .001$), and new-onset atrial fibrillation (34.21% vs 13.04%; $P < .001$) (Table 2).

Unadjusted Survival in Unmatched and Matched Patients

The median length of follow-up was 4.17 years (interquartile range, 2.48 to 6.23 years). In the unmatched cohort, mortality was similar at 30 days, although survival was significantly lower in the nonshort-stay group at 1 year (92.27% vs 97.47%; $P = .001$) and 5 years (83.57% vs 92.51%; $P < .001$) (Supplemental Table 4, Supplemental Figure 1). However, in the matched cohort, rates of 30-day (0.44% vs 0.79%; $P = .28$), 1-year (97.73% vs 97.46%; $P = .62$), and 5-year (91.15% vs 92.48%; $P = .56$) survival were comparable between the groups (Table 3, Figure 1A).

Unadjusted Freedom From Readmission

Both short- and long-term readmission rates were higher in the unmatched nonshort-stay group (49.16% vs 34.93%; $P < .001$) (Supplemental Figure 2). Furthermore, in the unmatched population, the nonshort-stay patients were more commonly readmitted for both cardiac (43.00% vs 30.05%; $P < .001$) and heart failure–related (18.83% vs 7.06%; $P < .001$) reasons. In the matched cohort, there were no differences in the rates of hospital readmission at 30 -day (8.84% vs 7.09%; $P = .12$) or 1-year (21.43% vs 20.82%; $P = .72$) follow-up, nor were there significant differences in the rates of cardiac-related (31.85% vs 30.10%; $P = .37$) or heart failure–specific (10.15% vs 7.09%; $P = .10$) readmissions (Table 3).

Subanalysis of Unmatched Patients Without Major Postoperative Complications

We identified 40.10% (n = 2077) of patients in the unmatched nonshort-stay group and 78.57% (n = 902) of patients in the unmatched short-stay group who did not experience any major complications during their index hospitalization. Survival was similar at 30 days (99.66% vs 99.67%; $P = –$) and 1 year (97.69% vs 98.45%; $P = .18$), although survival was lower in the nonshort-stay group at 5-year follow-up (89.51% vs 93.95%, $P = .001$) (Figure 1B). Despite the lack of complications, both 30-day (9.10% vs. 6.65%, $P = .03$) and 5-year (44.73% vs. 33.81%, $P < .001$) readmission rates were higher in the nonshort-stay group (Table 4, Figure 2). There were also higher rates of readmission for cardiac-related diagnoses (37.99% vs 29.38%; $P < .001$) as well as heart failure–specific diagnoses (13.91% vs 6.43%; $P < .001$) in the nonshort-stay cohort.

Cox Regression Analysis

Multiple predictors of mortality and readmission were identified in the multivariable Cox proportional hazards model for the unmatched population. Risk-adjusted nonshort-stay patients had similar hazards for mortality when compared with patients in the short-stay cohort (hazard ratio [HR], 1.24; 95% confidence interval [CI], 0.98, 1.58; $P = .07$). Patients in the unmatched nonshort-stay group had significantly higher unadjusted and risk-adjusted hazards for readmission (HR, 1.53; 95% CI, 1.38, 1.70, $P < .001$; and HR, 1.17; 95% CI, 1.05, 1.35; $P = .005$, respectively) (Supplemental Table 5). However, in the matched population, a nonshort-stay index hospitalization did not provide a survival benefit (HR, 1.18; 95% CI, 0.88, 1.56; $P = .26$) (Table 5), nor was there a difference in readmissions between the matched nonshort-stay and short-stay groups at 30-day (HR, 1.25; 95% CI, 0.93, 1.67; $P = .14$) or 1-year (HR, 1.03; 95% CI, 0.86, 1.23; $P = .73$) follow-up.

Subanalysis of Patients Undergoing On-Pump Coronary Artery Bypass Grafting

Given a substantial proportion of patients who underwent off-pump CABG (26.2% off-pump vs 71.6% on-pump in the unmatched groups and approximately 40% in both groups after matching) in our cohort, we investigated the short-stay results in unmatched and propensity-matched patients who underwent on-pump CABG. There were 3823 (85.0%) in the nonshort-stay, on-pump group and 670 (14.9%) in the short-stay, on-pump group. After multivariate Cox frailty modeling, there were no statistically significant differences in mortality or freedom from readmission between the matched groups (Supplemental Table 6).

Comment

Fast-tracking for hospital discharge and ERAS represent multimodal, multidisciplinary initiatives that promote recovery of patients throughout the perioperative period. There is extensive evidence in the current literature that these protocols have numerous benefits in terms of patient satisfaction, reductions in postoperative complications, and decreased lengths of hospitalization when compared with conventional recovery from surgery.[11,12] Although the feasibility of ERAS for cardiac surgery has emerged over the past few years,[7] fast-track cardiac care

Table 1. Baseline Characteristics Stratified by Length of Stay After Propensity Score Matching

Characteristics	Nonshort Stay (>4 d) n = 1143	Short Stay (≤4 d) n = 1143	*P* Value	SMD
Age, y	62.00 (56.00-69.00)	63.00 (55.00-69.00)	.97	0.04
Female	203 (17.76)	197(17.24)	.74	0.01
Race			.37	
White	1099 (96.15)	1086(95.01)		0.05
Black	18 (1.57)	26(2.27)		0.04
Other	26 (2.27)	31(2.71)		0.03
BMI, kg/m^2	22.23 (25.76-33.45)	29.07 (26.20-32.63)	.65	0.005
BSA	2.07 (1.90-2.25)	2.07 (1.92-2.22)	.80	0.007
Dyslipidemia	1048 (91.69)	1042 (91.16)	.65	0.03
Diabetes mellitus	423 (37.01)	414 (36.22)	.70	0.008
Hypertension	990 (86.61)	970 (84.86)	.23	0.05
Chronic lung disease	157 (13.74)	148 (12.95)	.58	0.02
Serum creatinine, mg/dL	0.90 (0.80-1.10)	0.97 (0.80-1.10)	.17	.001
Dialysis	7 (0.61)	5 (0.44)	.56	0.007
Immunosuppression	29 (2.54)	37 (3.24)	.32	0.04
Peripheral arterial disease	167 (14.61)	170 (14.87)	.86	0.02
Cerebrovascular disease	190 (16.62)	180 (15.75)	.57	0.008
Previous CABG	31 (2.71)	32 (2.80)	.90	0.03
Previous PCI	379 (33.16)	350 (30.62)	.19	0.02
Family history of CAD	296 (25.90)	315 (27.56)	.37	0.02
Previous MI	665 (58.18)	656 (57.39)	.70	0.01
Cardiac presentation			.97	
No symptoms	123 (10.76)	113 (9.89)		0.01
Stable angina	117 (10.24)	133 (11.64)		0.04
Unstable angina	542 (47.42)	533 (46.63)		0.007
NSTEMI	268 (23.45)	271 (23.71)		0.01
STEMI	60 (5.25)	59 (5.16)		0.01
Angina equivalent	14 (1.22)	14 (1.22)		0.01
Other	12 (1.05)	14 (1.22)		0.01
Congestive heart failure	74 (6.47)	67 (5.86)	.54	0.02
Cardiogenic shock	9 (0.79)	9 (0.79)	–	0.01
Arrhythmia	60 (5.25)	54 (4.72)	.56	0.04
Number of diseased vessels			.22	
1	80 (7.00)	107 (9.36)		0.05
2	285 (24.93)	287 (25.11)		0.04
3	776 (67.89)	747 (65.35)		0.04
Left ventricular ejection fraction, %	55.00 (48.00-60.00)	55.00 (48.00-60.00)	.77	0.03
Preoperative intraaortic balloon pump	35 (3.06)	41 (3.59)	.48	0.01
Status			.63	
Elective	441 (38.58)	444 (38.85)		0.01
Urgent	676 (59.14)	666 (58.27)		0.007
Emergency	26 (2.27)	33 (2.89)		0.008
STS PROM, %	0.71 (0.44-1.33)	0.67 (0.43-1.23)	.03	0.07
Off-pump CABG	460 (40.24)	474 (41.47)	.55	0.02
Complete revascularization	920 (80.49)	923 (80.75)	.87	0.02

Values are median (interquartile range), n (%), SMD, or *P*.

BMI, body mass index; BSA, body surface area; CABG, coronary artery bypass grafting; CAD, coronary artery disease; CPB, cardiopulmonary bypass; IABP, intraaortic balloon pump; LVEF, left ventricular ejection fraction; MI, myocardial infarction; NSTEMI, non–ST-segment elevation myocardial infarction; PASP, pulmonary artery systolic pressure; PCI, percutaneous coronary intervention; SMD, standard mean difference; STEMI, ST-segment elevation myocardial infarction; STS-PROM, Society of Thoracic Surgeons Predicted Risk of Mortality.

has been described for more than 2 decades.[13] Fast-track cardiac care similarly focuses on the integration of intraoperative low-opioid anesthesia and time-directed postoperative extubation parameters.[6,14] Importantly, the fast-track approach also streamlines perioperative care to promote cost containment through early extubation,

Table 2. Major Postoperative Complications Stratified by Length of Stay After Propensity Score Matching

Complications	Nonshort Stay (>4 d) n = 1143	Short Stay (≤4 d) n = 1143	*P* Value
30-d mortality	5 (0.44)	9 (0.79)	.28
Blood product transfusion	291 (25.46)	105 (9.19)	<.001
Reoperation	21 (1.84)	3 (0.26)	<.001
Stroke	13 (1.14)	3 (0.26)	.01
Prolonged ventilation (>24 h)	45 (3.94)	8 (0.70)	<.001
Renal failure	10 (0.87)	1 (0.09)	.007
Renal failure requiring dialysis	3 (0.26)	1 (0.09)	.32
Pneumonia	17 (1.49)	0 (0.00)	<.001
Sepsis	6 (0.52)	1 (0.09)	.06
Deep sternal infection	2 (0.17)	2 (0.17)	–
New-onset atrial fibrillation	391 (34.21)	149 (13.04)	<.001

Values are n (%) or *P*.

mobilization, and readiness for hospital discharge while maintaining similar rates of complications and mortality compared with conventional cardiac surgery care.[6,7,15] There are perioperative benefits for the adoption of these programs, although the available studies have focused only on the index hospitalization and the immediate perioperative period. This study evaluates the longitudinal impacts of very early hospital discharge on readmissions and survival.

Study Implications

The current study adds to the literature by evaluating the longitudinal effects of early discharge after isolated CABG. There are several key implications of the study findings. Foremost, we demonstrated that matched patients have similar rates of survival and readmission at all time intervals, out to 5-year follow-up, regardless of the length of index hospitalization after CABG. This finding suggests that hospital discharge should not be delayed in patients who are meeting post-CABG discharge parameters because clinical outcomes do not appear to be improved by extended inpatient monitoring. As expected, matched patients who had complications such as bleeding requiring transfusions, stroke, prolonged ventilation, and renal failure or who required reoperations were more commonly in the nonshort-stay group. Clearly, events such as postoperative bleeding requiring transfusions or other major complications would prolong time spent in the intensive care unit, as well as the length of hospitalization. In alignment with our findings, Youssefi and colleagues[16] evaluated predictors of failure for cardiac surgical fast-track management in 451 patients and found that reduced preoperative renal function, hypertension, increased age, and higher-risk surgical candidates, as evidenced by their European System for Cardiac Operative Risk Evaluation score, made them less likely to achieve early discharge. Even in patients with similar comorbidity profiles, as established in our matched analysis, postoperative complications can occur and may extend inpatient hospitalization but may not necessarily affect longitudinal survival or readmissions, as shown by our study.

Patients who experience postoperative complications usually warrant longer periods of postoperative

Table 3. Unadjusted Major Outcomes Stratified by Length of Stay After Propensity Score Matching

Outcomes	Nonshort Stay (>4 d) n = 1143	Short Stay (≤4 d) n = 1143	*P* Value
Mortality	101 (8.84)	83 (7.26)	.17
30-d	5 (0.44)	9 (0.79)	.28
1-y	26 (2.27)	29 (2.54)	.68
Readmission	434 (37.93)	400 (35.00)	.14
30-d	101 (8.84)	81 (7.09)	.12
1-y	245 (21.43)	238 (20.82)	.72
Reason for readmission			
Cardiac	364 (31.85)	344 (30.10)	.37
30-d	83 (7.26)	70 (6.12)	.28
1-y	210 (18.37)	206 (18.02)	.83
Heart failure	116 (10.15)	81 (7.09)	.10
30-d	22 (1.92)	12 (1.05)	.08
1-y	59 (5.16)	44 (3.85)	.13

Values are n (%) or *P*.

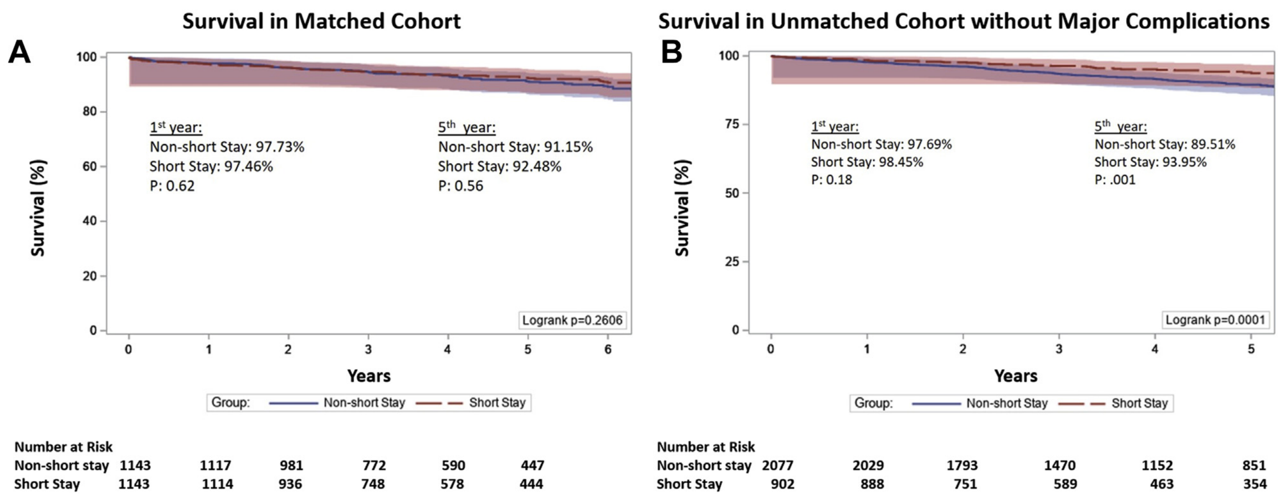

Figure 1. (A) Kaplan-Meier survival estimates stratified by short stay vs nonshort stay in the matched cohort. (B) Kaplan Meier survival estimates in unmatched patients without major complications stratified by short stay vs nonshort stay.

monitoring to allow for adequate recovery and treatment of their complications.[15,16] In patients who do not have postoperative complications after CABG, however, this raises the question whether prolonging hospitalization is a surgeon-driven or patient-driven phenomenon. For instance, with the increased scrutiny on 30-day readmission, surgeons may be more inclined to monitor patients for a set postoperative period and avoid very early discharge. Our study demonstrates evidence that even in the absence of complications, 78.8% of patients were still hospitalized for more than 4 days after CABG. Importantly, these patients had similar rates of 30-day and 1-year readmission and survival when compared with the short-stay patients with hospitalizations of 4 days or less. Even the use of cardiopulmonary bypass, a documented contributor to postoperative complications, did not appear to alter the mortality and readmission outcomes for patients discharged very early, as demonstrated in our subanalysis. This finding suggests that patients who are physically fit for discharge and are comfortable being discharged home on an accelerated time frame should be discharged without concerns of increasing rates of early readmissions or mortality. Additionally, this finding suggests that low-risk patients should be educated about potential short hospital stays so that they are prepared for the potential of leaving the hospital within 4 days after CABG, if it is deemed clinically appropriate. In some cases there are logistical issues with very early discharge, such as unavailability of a patient's family until a subsequent date or other intangible, patient-specific factors such as longer distances to home or caregiver discomfort. In addition, systems-based issues, such as limited pharmacy hours on weekends or an inability to have durable medical equipment delivered, may also postpone discharge. Most of these factors can be addressed early in attempts to mitigate prolonging hospital stays in those patients suitable for early discharge.

Table 4. Mortality and Readmission Rates in Patients With No Major Postoperative Complications Stratified by Length of Stay

Mortality and Readmission	Nonshort Stay (>4 d) n = 2077	Short Stay (≤4 d) n = 902	*P* Value
Mortality	223 (10.74)	52 (5.76)	<.001
30-d	7 (0.34)	3 (0.33)	–
1-y	48 (2.31)	14 (1.55)	.18
Readmission	929 (44.73)	305 (33.81)	<.001
30-d	189 (9.10)	60 (6.65)	.03
1-y	488 (23.50)	183 (20.29)	.06
Reason for readmission			
Cardiac	789 (37.99)	265 (29.38)	<.001
30-d	158 (7.61)	54 (5.99)	.11
1-y	410 (19.74)	161 (17.85)	.23
Heart failure	289 (13.91)	58 (6.43)	<.001
30-d	48 (2.31)	7 (0.78)	.004
1-y	135 (6.50)	29 (3.22)	.001

Values are n (%) or *P*.

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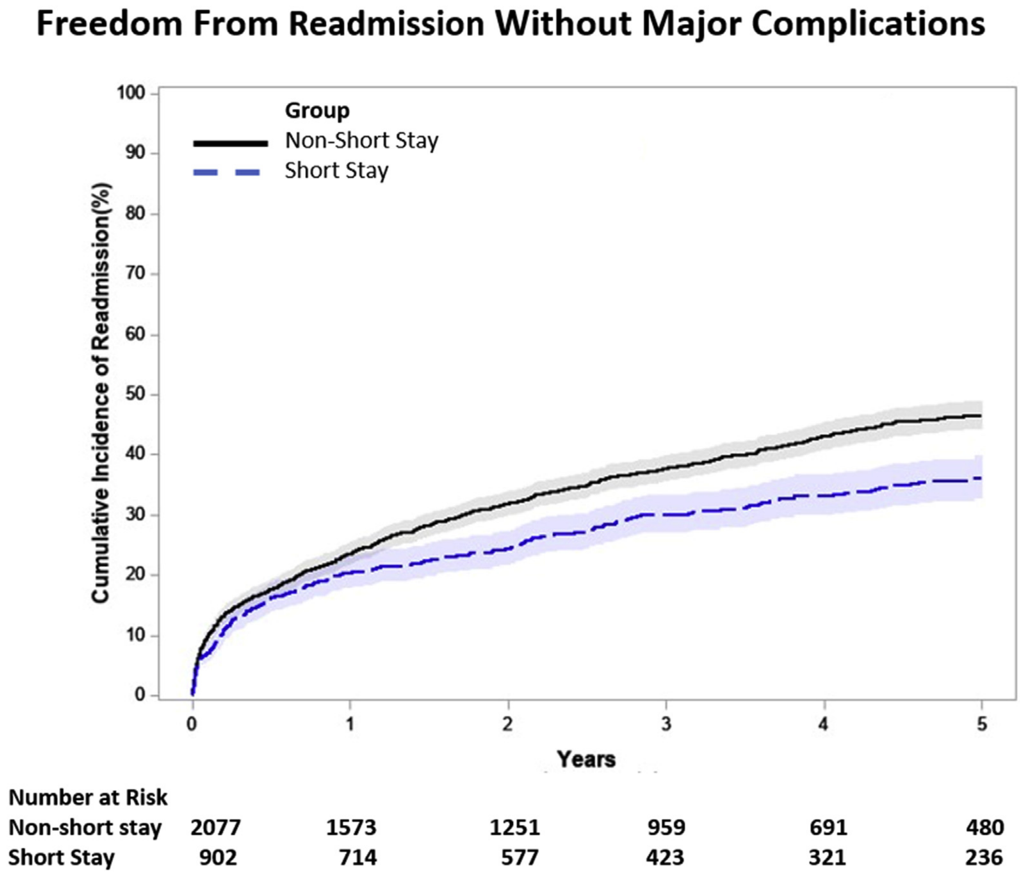

Figure 2. Freedom from readmission in unmatched patients without major complications stratified by short stay vs nonshort stay.

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Inpatient readmissions have been increasingly scrutinized, and institutions have been financially penalized for excessive 30-day readmissions.[17,18] Although ERAS and fast-track programs have significantly reduce in-hospital costs,[15] if early discharge resulted in substantial 30-day hospital readmissions these benefits would be neutralized. Our data demonstrated that the rates of 30-day readmissions after hospital discharge were similar in both groups, thus indicating that extending hospitalizations for surveillance in patients with limited comorbidities who undergo uncomplicated CABG is not necessary. Lahey and colleagues[19] evaluated 30-day readmissions and found that patients with longer hospitalizations (≥7 days) were at higher risk for increased hospital readmissions. This evidence, in conjunction with our results, suggests that patients meeting criteria for very early discharge can be safely discharged without a perceived notion of increased readmission or mortality risk.

Table 5. Univariate Cox proportional Hazards Analysis of Propensity-Matched Patients for Mortality and Hospital Readmission

Length of Stay	Hazard Ratio	95% Confidence Interval	*P* value
Mortality			
Short stay	Reference	Reference	Reference
Nonshort stay	1.18	0.88, 1.56	.26
Readmission			
Overall			
Short stay	Reference	Reference	Reference
Nonshort stay	1.10	0.96, 1.25	.19
30-d			
Short stay	Reference	Reference	Reference
Nonshort stay	1.25	0.93, 1.67	.14
1-y			
Short stay	Reference	Reference	Reference
Nonshort stay	1.03	0.86, 1.23	.73

Study Limitations

Foremost among our study's limitations is its retrospective design. We used a threshold of 4 days to define very early discharge, which is specific to our center's distribution of isolated CABG discharges and may not be applicable in other centers. There is also an inherent, unmeasured variability among providers regarding the postoperative management of patients undergoing CABG that may have influenced discharge planning. Finally, given the relatively young patient population with limited contributors to prolonged stay, such as end-stage renal failure, nearly normal left ventricular ejection fraction, and reoperations, these results may not be generalizable to all patients undergoing isolated CABG.

Conclusion

This study, which evaluated 2287 matched low-risk patients, demonstrated that very early discharge within 4 days in patients meeting appropriate discharge criteria is not associated with adverse impacts on early or late readmissions or survival. These data therefore support very early discharge after CABG in this patient population provided such criteria are met. Further research is needed to better optimize the selection of patients who are likely candidates for very early discharge and to tailor their postoperative care to facilitate this process.

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Early Discharge After CABG Is Not for Everyone: A Note of Caution

Invited Commentary:

In this issue of *The Annals of Thoracic Surgery*, the article by Afflu and associates[1] explores the impact of early discharge after coronary artery bypass grafting (CABG). They studied over 6000 patients who underwent CABG during an 8-year period to derive 2 matched groups of about 1000 of whom were discharged within 4 days of CABG. After propensity matching to compare patients who had early discharge ($\leq$ 4 days after CABG) to those who were discharged after 4 postoperative days, the authors found that several complication rates were significantly lower in the matched short-stay cohort—including stroke, renal failure, reoperations, and new atrial fibrillation. They also found similar survival rates at 30 days, 1 year, and at 5 years for matched groups. The authors conclude that very early discharge (defined as $\leq$4 days after operation) is safe and has no significant impact on subsequent readmission or mortality.

Most surgeons who read this article would be interested to know how the authors chose patients for discharge at 4 days or less. The matching algorithm and subsequent analyses do not answer this question. There are multiple components to the question of how patients were chosen for early discharge. For example, surgeons' preferences likely changed over the 8-year study period as they became more comfortable with early discharge. So there is likely a time-dependent component to the selection process involved in identifying patients for early discharge. Surgeons became more comfortable with the early discharge process as more emphasis was placed on identifying candidates for early discharge.

Further, surgeons have to be comfortable with the process and criteria for early discharge for this to be a

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