Preoperative Beta-Blocker Use Should Not Be a Quality Metric for Coronary Artery Bypass Grafting

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Background. **Preoperative beta-blockade for coronary artery bypass grafting (CABG) has become an accepted hospital quality metric. However, single-institution reports regarding the benefits of beta-blocker (ß-blocker) use are conflicting. The purpose of this study was to evaluate the associations between preoperative beta-blocker use and outcomes within a large, regional cohort.**

Methods. **Patient records from a statewide, multi-institutional Society of Thoracic Surgeons (STS) certified database for isolated CABG operations (2001 to 2011) were extracted and stratified by preoperative ß-blocker use. The influence of preoperative ß-blockers on risk-adjusted outcomes was assessed by hierarchical regression modeling with adjustment for preoperative risk using calculated STS predictive risk indices.**

Results. **A total of 43,747 (age, 63 years; ß-blocker 80% versus non ß-blocker 20%) patients were included. Median STS predicted risk of mortality scores for ß-blocker patients were incrementally lower (1.2% vs 1.4%, $p < 0.001$). Non ß-blocker patients more frequently developed pneumonia (3.5% vs 2.8%, $p = 0.001$), while ß-blocker patients surprisingly had greater intraoperative blood usage (16% vs 11%, $p < 0.001$). There was no difference in unadjusted mortality (ß-blocker: 1.9% vs non ß-blocker: 2.2%, $p = 0.15$). After risk adjustment, preoperative ß-blocker use was not associated with mortality ($p = 0.63$), morbidity, length of stay ($p = 0.79$), or hospital readmission ($p = 0.97$).**

Conclusions. **Preoperative ß-blocker use is not associated with risk-adjusted mortality, several measures of morbidity, or hospital resource utilization after CABG operations. Thus, these data suggest that the routine use of preoperative ß-blockers for CABG operations should not be used as a measure of surgical quality.**

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The administration of preoperative beta blockers (ß-blocker) to patients undergoing isolated coronary artery bypass grafting (CABG) operations has been identified as a quality measure for hospitals and surgeons, and the Society of Thoracic Surgeons (STS) has identified preoperative ß-blocker use as a quality performance measure [1–4]. The basis for these decisions has been extrapolated from several randomized controlled trials performed in noncardiac surgical patient populations and from a single nationwide retrospective analysis of STS data from the late 1990s [5–7]. Since this time, the effect of preoperative ß-blocker use among CABG patients has been minimally studied. In fact, no randomized controlled trials exist to date to specifically address the therapeutic and clinical utility of meeting this quality metric exclusively among isolated CABG operations. To the contrary, several different single institution and multi-institutional retrospective series have suggested a failure of preoperative ß-blocker use to positively impact patient mortality and morbidity [8–11].

The purpose of this study was to evaluate the associations between preoperative ß-blocker use and postoperative mortality, morbidity, and resource utilization within a large, regional cohort. We hypothesized that the administration of preoperative ß-blockers is not associated with improved patient outcomes for those undergoing isolated CABG operations.

Material and Methods

The Virginia Cardiac Surgery Quality Initiative (VCSQI) is a voluntary group of 17 different cardiac surgical centers in the Commonwealth of Virginia. This investigation was exempt from formal Institutional Review Board review at each participating center as it represents a secondary analysis of the VCSQI data registry with the

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absence of Health Insurance Portability and Accountability Act patient identifiers and because the data are collected for quality analysis and purposes other than research.

Patients and Data Acquisition

De-identified patient level data were obtained from the VCSQI for the study period January 1, 2001 thru December 21, 1011. All records included patients undergoing primary, isolated CABG operations (STS procedure type "CAB Only"). Patient records were stratified according to preoperative beta-blocker use into study cohorts (ß-blocker vs non ß-blocker). All CABG procedures represented standard surgical approaches to surgical myocardial revascularization with and without the use of cardiopulmonary bypass support. Patient preoperative risk was assessed by prevalence of patient comorbid disease, extent of coronary artery disease, operative status, and individual calculated STS Predicted Risk of Mortality (PROM) and Predicted Risk of Mortality and Morbidity (PROMM).

Measured Outcomes

The primary outcomes of interest included risk-adjusted associations between mortality and morbidity, and the administration of preoperative ß-blockers. Secondary outcomes included estimated risk-adjusted correlations between preoperative ß-blocker use and 30-day hospital readmission, postoperative length of stay, and total costs, as well as observed differences in the incidence of postoperative events. Operative mortality was defined as all patient deaths occurring during hospitalization as well as those within 30 days of the date of surgery despite discharge status. Standard STS definitions for postoperative events and complications were utilized, including prolonged ventilation (>24 hours of mechanical ventilation), presence of any new onset atrial fibrillation, and renal failure (increase in serum creatinine level > 2.0 or a doubling ($2\times$) of the most recent preoperative creatinine level) [12].

VCSQI Cost Data and Acquisition

The VCSQI utilizes an information system that combines standardized clinical data extracted from STS data entry forms with hospital inpatient discharge financial data. Hospital inpatient data from UB-92 and UB-04 files are matched with each STS patient record. These methods have been previously described elsewhere [13]. The VCSQI maintains a 99% matching rate between STS patient records and billing data.

Statistical Analysis

Categoric variables are expressed as standard group percentages, while continuous variables are expressed as either mean $\pm$ standard deviation (SD) or median [25th, 75th percentile] depending upon overall variable distribution. Descriptive, univariate statistics included either Pearson χ^2 or Fisher exact test for categoric variables and either independent sample single factor analysis of variance for comparisons of normally distributed data or the Mann Whitney *U* test for non-normally distributed data comparisons. Calculated test statistics were utilized to derive all 2-tailed p values with standard statistical significance set to alpha less than 0.05.

Hierarchic multiple logistic regression models were used to estimate confounder-adjusted associations between preoperative ß-blocker use and observed patient morbidity and operative mortality. To account for inter-hospital variance in correlated events, clustering at the hospital level was considered in the hierarchic structure of each logistic regression model. The association between preoperative ß-blocker use and dependent outcomes were adjusted for baseline patient risk by inclusion of validated and widely accepted measures of patient risk, calculated STS PROM or PROMM that take into account the influence of 30 different patient- and operation-related risk factors, individual surgeon influence on patient outcomes by inclusion of surgeon ID, and influence of baseline changes in practice over the study period by inclusion of operative year. In addition, hierarchic general linear models were utilized to assess the risk-adjusted influence of ß-blocker use on postoperative total intensive care unit (ICU) duration and length of stay as well as total costs of hospitalization, adjusting for the same model covariates. Model results are reported as confounder odds ratios (OR) with a 95% confidence interval for all logistic regressions and the unstandardized ß coefficients with a 95% confidence interval for hierarchic general linear models results. Model performance was assessed using the area under the receiver operating characteristics curve (AUC), while the Hosmer-Lemeshow test was used to verify model calibration across deciles of observed and predicted risk. Predictive Analytics SoftWare with complex sampling module software, version 20.0.0 (IBM Corporation, Somers, NY) was used for all data manipulation and statistical analyses.

Results

Patient Characteristics and Operative Features for CABG Operations

Table 1 reports risk factors for all patients undergoing CABG operations stratified by preoperative ß-blocker use. Small differences in baseline characteristics existed between study groups. The overall average patient age was 63.9 ± 10.6 years and preoperative ß-blockers were administered to 80.2% of the total study cohort (non ß-blockers = 19.8%). Females accounted for approximately 25% of all patients. Patients in the ß-blocker group had a higher prevalence of hypertension and a prior history of myocardial infarction, while those in the non ß-blocker group more frequently presented with higher rates of dyslipidemia and had incrementally higher median STS PROM scores (1.4% vs 1.2%, $p < 0.001$). The prevalence of preoperative atrial fibrillation was approximately 4% and was not significantly different between groups ($p = 0.34$).

Table 2 displays operative details for all patients. The large majority of operations were performed with the use

Table 1. Descriptive Statistics for Patients Undergoing Coronary Artery Bypass Grafting as a Function of Preoperative β-Blockade Use

Variable	ß-Blockade (n = 35,100)	Non ß-Blockade (n = 8,647)	*p* Value
Age (years)[a]	63.8 ± 10.7	64.7 ± 10.4	<0.001
Sex (Female)	26.7%	25.1%	0.01
Hypertension	81.2%	73.4%	<0.001
Diabetes	38.8%	37.5%	0.02
Dyslipidemia	50.3%	62.9%	<0.001
Atrial fibrillation	4.3%	4.5%	0.34
PVD	14.1%	15.5%	<0.001
NYHA class (III or IV)	46.8%	56.5%	<0.001
Renal failure	3.8%	4.6%	<0.001
Hemodialysis	2.3%	1.7%	0.001
Heart failure within 2 weeks	12.1%	10.8%	0.001
Prior MI	16.7%	4.5%	<0.001
MI on presentation	27.3%	28.8%	0.003
Left main >50%	28.3%	29.3%	0.01
Number of diseased vessels			<0.001
1	4.0%	4.6%	
2	17.3%	18.2%	
3	78.3%	76.5%	
Ejection fraction	0.55 [0.45–0.60]	0.55 [0.45–0.60]	<0.001
STS PROM (%)[b]	1.2 [0.6–2.4]	1.4 [0.7– 2.7]	<0.001
STS PROMM (%)	10.3 [7.1–16.2]	10.3 [7.0–16.2]	<0.001

Results reported as [a] mean ± standard deviation and [b] median [25th, 75th percentile].

MI = myocardial infarction; NYHA = New York Heart Association; PCI = percutaneous coronary intervention; PROM = predicted risk of mortality; PVD = peripheral vascular disease; STS = Society of Thoracic Surgeons.

of cardiopulmonary bypass (91%) with approximately 9% performed off-pump. Non ß-blocker patients underwent a higher percentage of elective and emergent operations. The majority of revascularizations included use of the left internal mammary artery and either 2 or 3 saphenous vein grafts.

Unadjusted Comparisons of Postoperative Events

Table 3 displays the unadjusted impact of preoperative ß-blockade on postoperative events. Few differences in the incidence of postoperative complications were observed as a function of preoperative ß-blockade. Non ß-blocker patients incurred slightly higher rates of pneumonia and prolonged ventilation. No differences were noted in the incidence of postoperative stroke, renal failure, atrial fibrillation, cardiac arrest, or operative mortality. Despite slightly longer total intensive care unit durations, similar postoperative lengths of stay (median 5 days) were observed between groups. Moreover, total cost of hospitalization for ß-blocker patients was nearly $25,000 compared with $21,000 for non ß-blocker patients ($p < 0.001$).

Table 2. Operative Features of Patients Undergoing Coronary Artery Bypass Grafting Procedures as a Function of Preoperative β-Blockade Use

Outcome	ß-blockade (n = 35,100)	Non ß-blockade (n = 8,647)	*p* Value
Cardiopulmonary bypass utilization	91.7%	91.8%	0.81
Elective status	41.9%	51.2%	<0.001
Urgent status	55.0%	42.4%	<0.001
Emergent status	2.9%	6.1%	<0.001
Saphenous vein graft (SVG)			<0.001
1 SVG	16.4%	17.2%	
2 SVG	35.4%	34.2%	
3 SVG	28.4%	27.1%	
4 or more SVG	11.8%	12.5%	
LIMA	87.4%	85.3%	0.03
RIMA	0.6%	0.6%	
BIMA	2.9%	2.9%	
Left radial artery graft	7.0%	7.9%	<0.001
Right radial artery graft	0.7%	0.7%	
Bilateral radial artery grafts	1.0%	1.4%	

BIMA = bilateral internal mammary artery; LIMA = left internal mammary artery; RIMA = right internal mammary artery.

Risk-Adjusted Associations Between Preoperative Blocker Use and Patient Outcomes

Risk-adjusted associations between preoperative β-blocker use and patient morbidity, mortality, and hospital resource utilization were estimated using hierarchic multiple regression models (Table 4). As a result, preoperative ß-blocker use was not associated with patient operative mortality ($p = 0.63$), postoperative stroke ($p = 0.19$), heart block ($p = 0.06$), atrial fibrillation ($p = 0.06$), hospital readmission (0.97), total ICU duration (ß = 3.53 [−0.70–7.76], $p = 0.10$), or postoperative length of stay (ß = −0.02 [−0.19–0.15], $p = 0.79$) for patients undergoing CABG operations. Alternatively, ß-blocker use was associated with an increased likelihood for intraoperative blood product transfusion (OR = 1.63, $p < 0.001$) and perioperative myocardial infarction (OR = 1.97, $p = 0.02$) as well as increased total costs of hospitalization (ß = 4,416 [3,868–4,963], $p < 0.001$).

The statistical performance of each logistic regression model achieved adequate discrimination AUC values ranging from 0.73 to 0.84. The AUC values of 1.0 indicate perfect model discrimination between dependent outcomes, while AUC values of 0.5 represent discrimination equal to chance. The calibration of each model was adequate across deciles of observed risk as reflected by Hosmer-Lemeshow *p* less than 0.05 for all models.

Comment

The present study reports upon the impact of preoperative ß-blocker use on the performance of CABG within the Commonwealth of Virginia. In this contemporary analysis of more than 43,000 patients over a 10-year study

Table 3. Unadjusted Patient Outcomes Grafting as a Function of Preoperative β-Blockade Use

Outcome	ß-blockade (n = 35,100)	Non ß-blockade (n = 8,647)	*p* Value
Cross-clamp time (minutes)[a]	64 [50–82]	63 [48–81]	<0.001
Cardiopulmonary bypass time (minutes)[a]	91 [72–114]	90 [71–113]	0.002
Intraoperative blood product transfusion	16.0%	11.2%	<0.001
Reoperation for bleeding/tamponade	1.7%	1.7%	0.86
Stroke	1.3%	1.5%	0.06
Perioperative MI	0.3%	0.2%	0.04
Pneumonia	2.8%	3.5%	0.001
Prolonged ventilation	8.8%	9.5%	0.03
Renal failure	3.5%	3.7%	0.22
Atrial fibrillation	16.8%	16.3%	0.23
Cardiac arrest	1.3%	1.2%	0.67
Total ICU duration (hours)[a]	43 [24–71]	40 [23–68]	<0.001
Operative mortality	1.9%	2.2%	0.15
Postoperative LOS (days)[a]	5 [4–7]	5 [4–7]	0.39
Median total hospitalization costs ($)[a]	24,696 [18,659–33,272]	21,235 [16,349–28,156]	<0.001

[a] Results reported as median [25th, 75th percentile].

ICU = intensive care unit; LOS = length of stay; MI = myocardial infarction.

period, preoperative ß-blocker use was not associated with a significant decrease in several measures of patient morbidity, mortality, resource utilization, or cost of hospitalization. To our knowledge, these data represent the largest and most current statewide, multi-institutional analysis of the adjusted impact of preoperative ß-blocker use specifically on CABG outcomes. The results, therefore, reexamine the appropriateness of preoperative ß-blocker use as a useful quality measure for hospitals and surgeons performing isolated CABG.

The adoption of preoperative ß-blocker use as a quality metric for isolated CABG populations is deeply rooted in the results of several noncardiac surgical series and randomized controlled trials as well as a single large nationwide cardiac surgical retrospective analysis. Perhaps one of the most influential reports was a randomized controlled trial conducted in 1996 among 200 patients undergoing noncardiac operations with a history of coronary artery disease, which demonstrated that over a 2-year follow-up period, a significant 6-month survival benefit was achieved among those administered preoperative ß-blockers [5]. Interestingly, however, no significant perioperative benefits were detected between patients receiving either ß-blockers or placebo. The Dutch Echocardiographic Cardiac Risk Evaluation Applying Stress Echo (DECREASE) trial demonstrated significant perioperative benefits of preoperative ß-blocker use, reporting a tenfold decrease in mortality and myocardial infarction rates [6]. Another noteworthy report by Ferguson and colleagues [7] reported on a large retrospective analysis of outcomes for over 629,000 patients undergoing CABG operations from 1996 to 1997 using the STS National Adult Cardiac Database. Based on this analysis, patients who received preoperative ß-blockers had an observed 0.6% reduction in unadjusted mortality, and preoperative ß-blockade was associated with a small (4% to 6%) reduction in adjusted mortality risk on both risk-adjustment modeling and propensity-matched cohort comparisons [7]. Moreover, the benefits of preoperative ß-blocker use were limited in this analysis as patients with left ventricular ejection fractions less than 0.30 were associated with a trend toward an increased risk for mortality (OR = 1.13, $p = 0.23$) compared with those not receiving preoperative ß-blockers. As a result, the authors concluded that "preoperative ß-blocker therapy may be a useful process measure for CABG quality improvement assessment," and shortly thereafter the National Quality Forum used these data to support the use of preoperative ß-blocker therapy as an acceptable "quality indicator" for the performance of CABG [1].

The principle findings of the present study, however, corroborate those of other series that do not support the use of routine preoperative ß-blocker therapy as

Table 4. Adjusted Odds Ratios for Associations Between Preoperative β-Blocker Use and Patient Morbidity and Mortality After Isolated Coronary Artery Bypass Grafting

Outcome	Adjusted Odds Ratio	95% CI	*p* Value
Mortality	1.04	0.88–1.24	0.63
Stroke	0.88	0.72–1.07	0.19
Perioperative MI	1.97	1.13–3.48	0.02
Heart block	0.78	0.60–1.01	0.06
Atrial fibrillation	1.06	0.99–1.14	0.06
Pneumonia	0.86	0.75–0.99	0.03
Prolonged ventilation	1.01	0.93–1.10	0.79
Renal failure	1.02	0.90–1.16	0.75
Intraoperative blood product transfusion	1.63	1.51–1.75	<0.001
Hospital readmission within 30 days	0.99	0.91–1.09	0.97

CI = confidence interval; MI = myocardial infarction.

a measure of cardiac surgical quality. Preoperative ß-blocker use in this very large multi-institution cohort of isolated CABG patients failed to demonstrate a mortality benefit for patients in both unadjusted and adjusted data analyses. The 1.9% (ß-blocker) and 2.2% (non ß-blocker) mortality rates after CABG in the present series remain favorable in the modern surgical era, and the relatively low incidence of postoperative complications compares favorably to national reported outcomes for isolated CABG [14]. Moreover, several series suggest that preoperative ß-blockers may have important adverse implications for patients in the postoperative setting. One retrospective review of 4,381 propensity-matched CABG patients revealed that preoperative ß-blocker therapy was not associated with differences in operative mortality or several measures of morbidity, including atrial arrhythmias, myocardial infarction, renal failure, or prolonged ventilation [15]. Brinkman and colleagues similarly failed to show in their multi-institution report that mortality or major morbidity benefits for ß-blocker use among 12,855 isolated CABG operations [8]. Utilizing propensity-matched cohorts, the mortality rate among preoperative ß-blocker patients was 2.4% compared with 2.5% in non ß-blocker patients ($p = 0.78$), and upon risk modeling the use of preoperative ß-blockers was not independently associated with mortality, postoperative stroke rates, prolonged ventilation, renal failure, deep sternal wound infection, or need for reoperation (all $p > 0.05$).

Perhaps even more significant are reports of the potential negative impact of preoperative ß-blocker therapy observed in the present study and elsewhere. Surprising in the present analysis were the findings of elevated perioperative myocardial infarction rates among ß-blocker patients and the significant adjusted association between perioperative myocardial infarction and preoperative ß-blocker therapy on multivariate analysis. Furthermore, it was observed that patients treated with preoperative ß-blockers also more commonly underwent intraoperative blood product transfusions, an observation also noted in prior reports [8]. While an exact cause and effect relationship between these 2 observations could not be definitively established, the increased risk of postoperative myocardial infarction in patients receiving ß-blocker therapy reported in this series may reflect the effect of other cardiovascular complications of ß-blockers (ie, hypotension and bradycardia) or higher blood product transfusion rates in this population. In fact, several prospective trials and reports have documented similar associations between ß-blocker use and postoperative hypotension, bradycardia, and bronchospasm among noncardiac surgical patients [11, 16–19]. These data are thus hypothesis generating and future prospective investigation appears warranted to more clearly elucidate a clinical explanation for these findings. Moreover, unique in the present results are the significant cost differences that existed between patient groups as a function of preoperative ß-blocker therapy. While the factors responsible for the increased financial burden of preoperative ß-blocker therapy are not well defined in current cardiac surgical literature, possible explanations for the observed increased costs may relate to the combined effects of increased pharmacologic costs to treat complications of ß-blocker therapy such as vasopressor support and medications to treat bronchospasm, prolonged monitoring for bradyarrhythmias in the postoperative setting, or increased blood product requirements for patients undergoing CABG after preoperative ß-blocker therapy.

The reported results have important clinical and health policy related implications. In an era of increasing pressure on individual hospital and surgical outcomes, the identification of appropriate measures of surgical quality remains critical. Furthermore, as public reporting of surgeon outcomes becomes more common, the cardiothoracic surgical community must play a central role in providing updated data and definitions of appropriate performance measures from which to base health care policy, hospital and surgeon reimbursement strategies, and referral patterns for cardiac surgical patients. Critical to the central debate regarding routine use of preoperative ß-blockade is a lack of detailed definitions to describe proposed therapy. The current STS definition and quality performance measure for preoperative ß-blocker use for CABG is constrained by categories that include "yes", "no," or "contraindicated." Further details related to beta-blocker type, dose, timing of administration, goal heart rate, or duration of preoperative therapy are not currently captured or available in national or regional STS registries. Without increased granularity of these data, the true efficacy of preoperative ß-blocker therapy will remain uncertain. Moreover, in light of these constraints, we do not advocate the global administration of ß-blockers in the preoperative setting by surgeons or hospitals simply to achieve an isolated performance measure, but agree with ß-blocker therapy where clinically indicated. Therefore, in the absence of reported randomized controlled trials designed to assess the efficacy of preoperative ß-blocker use specific to isolated CABG patients and considering these restraints in existing variable definitions, the present findings suggest that the use of routine preoperative ß-blockers for CABG should not be used as a valid measure of quality for cardiac surgeons and hospitals.

The present study has limitations. First, the secondary analysis of the VCSQI data registry and STS data limited the performed analyses to de-identified data, which did not allow for further investigation of certain data, including details related to the exact ß-blockers used, ß-blocker dosing, timing or duration of ß-blocker therapy, preoperative and intraoperative variations in heart rate, rhythm, or blood pressure, or postoperative vasopressor requirements, cardiac pacing requirements, and clinical details to provide insight into the observed rates of postoperative myocardial infarction, blood product use, or pneumonia. The choice to utilize VCSQI data over National STS Adult Cardiac Surgery Data was to build upon an internal quality initiative that began within the VCSQI organization and to extend the examination beyond patient outcomes reporting, but to also examine

the financial impact of such measures that would not be possible with other clinical databases. The retrospective study design is subject to limitations of inherent selection bias, and the reported results are limited to describe observed associations between the use of preoperative ß-blockers and patient outcomes and do not demonstrate a direct cause and effect relationship. The influence of differences in postoperative critical care management between institutions can also not be fully accounted for in these analyses; however, the hierarchic structure of the performed regression analyses likely mitigated this influence as it was designed to account for variance in correlated events between hospitals. All analyses were limited to short-term, operative outcomes, and intermediate or long-term follow-up data were not available. Finally, the potential for unrecognized miscoding of data must also be considered in any secondary analysis of a data registry.

The present results demonstrate that preoperative β-blocker use is not associated with risk-adjusted mortality, several measures of morbidity, or hospital resource utilization after CABG operations. These data, therefore, suggest that the routine use of preoperative β-blockers for CABG operations should not be used as a measure of surgical quality. Future randomized controlled trials are needed to more clearly define a cause-effect relationship between preoperative ß-blocker therapy and coronary artery bypass grafting outcomes before the routine use of β-blockade should be adopted as quality performance measure by the cardiothoracic surgical community. More specific definitions and increased granularity of data related to the use of preoperative ß-blocker therapy are needed to guide future recommendations for patients undergoing CABG operations.

References

1. National Quality Forum. Pre-op beat blocker in patients with isolated CABG. NQF-endorsed standards. Washington, DC: National Quality Forum; 2007.
2. O'Brien SM, Shahian DM, DeLong ER, et al. Quality measurement in adult cardiac surgery: part 2–statistical considerations in composite measure scoring and provider rating. Ann Thorac Surg 2007;83(4 Suppl):S13–26.
3. Shahian DM, Edwards FH, Ferraris, et al. Quality measurement in adult cardiac surgery: part 1–Conceptual framework and measure selection. Ann Thorac Surg 2007;83(4 Suppl): S3–12.
4. Society of Thoracic Surgeons. Quality performance measures-adult cardiac surgery. Available at: http://www.sts.org/quality-research-patient-safety/quality/quality-performance-measures. Accessed 01/03/13.
5. Mangano DT, Layug EL, Wallace A, Tateo I. Effect of atenolol on mortality and cardiovascular morbidity after noncardiac surgery. Multicenter Study of Perioperative Ischemia Research Group. N Engl J Med 1996;335:1713–20.
6. Poldermans D, Boersma E, Bax JJ, et al. The effect of bisoprolol on perioperative mortality and myocardial infarction in high-risk patients undergoing vascular surgery. Dutch Echocardiographic Cardiac Risk Evaluation Applying Stress Echocardiography Study Group. N Engl J Med 1999;341: 1789–94.
7. Ferguson TB Jr, Coombs LP, Peterson E, et al. Preoperative beta-blocker use and mortality and morbidity following CABG surgery in North America. JAMA 2002;287:2221–7.
8. Brinkman WT, Herbert MA, Prince SL, et al. Preoperative beta-blocker usage: is it really worthy of being a quality indicator? Ann Thorac Surg 2011;92:788–96.
9. Chopra V, Plaisance B, Cavusoglu E, Flanders SA, Eagle KA. Perioperative beta-blockers for major noncardiac surgery: Primum Non Nocere. Am J Med 2009;122:222–9.
10. Devereaux PJ, Beattie WS, Choi PT, et al. How strong is the evidence for the use of perioperative beta blockers in non-cardiac surgery? Systematic review and meta-analysis of randomised controlled trials. BMJ 2005;331:313–21.
11. Yang H, Raymer K, Butler R, Parlow J, Roberts R. The effects of perioperative beta-blockade: results of the Metoprolol after Vascular Surgery (MaVS) study, a randomized controlled trial. American Heart J 2006;152:983–90.
12. Ngaage DL. Off-pump coronary artery bypass grafting: the myth, the logic and the science. Eur J Cardiothorac Surg 2003;24:557–70.
13. LaPar DJ, Crosby IK, Ailawadi G, et al. Blood product conservation is associated with improved outcomes and reduced costs following cardiac surgery. J Thorac Cardiovasc Surg 2013;145:796–804.
14. ElBardissi AW, Aranki SF, Sheng S, O'Brien SM, Greenberg CC, Gammie JS. Trends in isolated coronary artery bypass grafting: an analysis of the Society of Thoracic Surgeons adult cardiac surgery database. J Thorac Cardiovasc Surg 2012;143:273–81.
15. Srinivasan AK, Shackcloth MJ, Grayson AD, Fabri BM. Preoperative beta-blocker therapy in coronary artery bypass surgery: a propensity score analysis of outcomes. Interact Cardiovasc Thorac Surg 2003;2:495–500.
16. Mackenzie JW, Bird J. Timolol: a non-sedative anxiolytic premedicant for day cases. BMJ 1989;298:363–4.
17. Magnusson J, Thulin T, Werner O, Järhult J, Thomson D. Haemodynamic effects of pretreatment with metoprolol in hypertensive patients undergoing surgery. Br J Anaesth 1986;58:251–60.
18. Stone JG, Foëx P, Sear JW, Johnson LL, Khambatta HJ, Triner L. Myocardial ischemia in untreated hypertensive patients: effect of a single small oral dose of a beta-adrenergic blocking agent. Anesthesiology 1988;68:495–500.
19. Wallace A, Layug B, Tateo I, et al. Prophylactic atenolol reduces postoperative myocardial ischemia. McSPI Research Group. Anesthesiology 1998;88:7–17.

DISCUSSION

DR FREDERICK GROVER (Aurora, CO): Thank you, Dr Rich, Dr Fullerton, Dr LaPar, members, and guests. I want to congratulate Dr LaPar for his usual concise, direct, and detailed presentation of a very important and provocative study. This study is a product of both the Virginia Cardiac Surgery Quality Initiatives that our president, Dr Jeffery Rich, has been involved with for so many years, and the Society of Thoracic Surgeons (STS) Adult Cardiac Surgery Database. It is very appropriate that this paper has been honored by receiving the Richard E. Clark award for the most outstanding adult cardiac surgery database paper at this meeting, and I am sure that Dr Clark would agree.

This study addresses the very important question of whether the scientific efficacy for preoperative beta-blockade for improving outcomes in patients undergoing coronary artery bypass is warranted. It is important to note that the 2011 American College of Cardiology/AHA guidelines for coronary artery bypass surgery recommend the following: As a class I recommendation, beta-blockers should be administered for at least

24 hours preoperatively to all patients without contraindications to reduce the incidence or clinical sequelae of postoperative atrial fibrillation with a level of evidence B. A second recommendation that is a class IIa is that preoperative use of beta-blockers in patients without contraindications, particularly those with an ejection fraction of greater than 30%, can be effective in reducing the risk of in-hospital mortality with a level of evidence of B.

As Dr LaPar has noted, this is also one of the quality improvement metrics that has been approved by the National Quality Forum and included in our Society of Thoracic Surgeons composite score as an indicator for quality and as part of our public reporting. Dr Shahian has informed me that our national STS median compliance with this element is at 87.4%.

I have several questions, however, some of which you have raised in your discussion and perhaps you can amplify on them. I am going to group some of these together because they are all interrelated: (1) Do you have any evidence about the adequacy of the dosage of the beta-blockade? In other words, was there a pulse response or not? (2) What was the timing and dosage of the specific beta-blocker? (3) Did any of the patients receiving a beta-blocker have an ejection fraction of less than 30%? (4) How many of these patients were already on beta-blockers versus those who were just started and did that affect the outcome? (5) Did they receive the drug for at least 24 hours ahead of time preoperatively, as the guidelines recommend? (6) How many patients received the drug just prior to the operation?

DR LAPAR: Dr Grover, thank you very much for your very kind remarks. Your questions are very pointed and get at the issue of where we as a surgical community need to move when looking at this question, and that is, the reassessing the granularity of the data that is available to us.

One of the greatest limitations in any of the data registry analyses that have been performed up until this point is the lack of specificity in the definition that we are using for the treatment of CABG patents with preoperative beta-blockers, and that is where my fundamental concern with using this as an established quality metric lies. As you all know, the current definition of preoperative beta-blocker use as captured in the STS data simply identifies whether a patient either received or did not receive a preoperative beta-blocker or whether it was contraindicated. In order to really help guide us and guide surgeons in the future, I believe we need to look at preoperative beta-blocker use in greater depth.

In our data, due to its de-identified nature, I unfortunately cannot provide further details regarding the type of beta-blocker used, the dosing of the drug, the timing of the administration, or whether or not they received a beta-blocker immediately before going to the OR [operating room] or whether a goal beta-blocker effect was achieved. These are things that we can look at in the future and, as we move forward, that is going to be what we need to do. We need to get more granular in our definitions of what preoperative beta-blockade is in order to help establish its clinical utility.

DR GROVER: I think those are important points, and those of us working closely with the STS Database take this paper very seriously.

My last question, Damien, is, would you be willing to, with your input on this and your group, work with our STS Workforce on National Databases, our Appropriateness of Care Taskforce, and with our Research Center headed by Fred Edwards to develop some extra data elements that we could put into the database and perhaps help design a research study, to further determine the validity of this metric?

DR LAPAR: Yes, absolutely, I would be happy to help out in any way I can. Prospectively, we are going to need to really define what our goals for beta-blocker use are going to be and expand on the data elements we capture.

DR THORALF SUNDT (Boston, MA): Would you comment on what looks like a distressingly low rate of left ITA [internal thoracic artery] utilization in that data set?

DR LAPAR: In our series, the rate of left internal thoracic artery use was 87% to 88%, which I agree is lower than other reported series. Unfortunately, I am not able to provide further details into what the circumstances were surrounding graft conduit choice as these results represent a secondary analysis of a de-identified data registry.

DR DEBASIS DAS (Kolkata, India): Because most of these patients would be under the care of a cardiologist and would be on beta-blockers anyway, based on your conclusions, would you actually stop them from beta-blocker use before their operation if it is possible?

DR LAPAR: No, I would not. I think that's a very important question. In our manuscript we are very careful in describing what we are advocating. We are not in any way suggesting that preoperative beta-blocker use is irrelevant. In fact, what we are saying is that the appropriate use of beta-blockers is where we need to take the conversation. For patients who are on beta-blockers and where it's clinically indicated, we would certainly advocate that they continue their preoperative beta-blockade. We just need to be a little bit more careful about how we are advocating for a quality metric and whether or not we are just giving a patient a preoperative beta-blocker right before they go into the OR so that during our timeout we can say that we met a predefined measure of cardiac surgical quality. Thank you.