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ORIGINAL RESEARCH

Perioperative Processes and Outcomes After Implementation of a Hospitalist-Run Preoperative Clinic

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BACKGROUND: A structured, medical preoperative evaluation may positively impact the perioperative course of medically complex patients. Hospitalists are in a unique position to assist in preoperative evaluations, given their expertise with inpatient medicine and postoperative surgical consultation.

OBJECTIVE: To evaluate specific outcomes after addition of a Hospitalist-run, medical Preoperative clinic to the standard Anesthesia preoperative evaluation.

DESIGN, SETTING, PATIENTS: A pre/post retrospective, comparative review of outcomes of 5223 noncardiac surgical patients at a tertiary care Veterans Administration (VA) medical center.

RESULTS: Length of stay was reduced for inpatients with an American Society of Anesthesia (ASA) score of 3 or higher ($P < 0.0001$). There was a trend towards a reduction in same-day, medically avoidable surgical cancellations (8.5% vs 4.9%, $P = 0.065$). More perioperative beta blockers were used ($P < 0.0001$) and more stress tests were ordered ($P = 0.012$). Inpatient mortality rates were reduced (1.27% vs 0.36%, $P = 0.0158$).

CONCLUSION: A structured medical preoperative evaluation may benefit medically complex patients and improve perioperative processes and outcomes. *Journal of Hospital Medicine* 2012;7:697–701. © 2012 Society of Hospital Medicine

Anesthesiologists typically initiate an assessment in the immediate preoperative period, focused on management of the airway, physiologic parameters, and choice of anesthetic. Given the growing complexity of medical issues in the surgical patient, the preoperative assessment may need to be initiated weeks to months prior to surgery. Early evaluation allows time to implement required interventions, optimize medical conditions, adjust medications, and collaborate with the surgical team.

Most studies of Preoperative clinics are in the Anesthesiology literature.[1] Anesthesia-run Preoperative clinics have demonstrated a reduction in surgical cancellations and length of stay (LOS).[2] Auerbach and colleagues found medical consultation to have inconsistent effects on quality of care in surgical patients, but consultations occurred, at the earliest, 1 day prior to surgery.[3] A randomized trial, performed at the Pittsburgh Veterans Administration (VA) medical center using an outpatient Internal Medicine Preoperative clinic, demonstrated a shortening of preoperative LOS but no change in total LOS, and increased use of consultants. However, there were reduced numbers of "unnecessary admissions," defined as patients who were discharged without having had surgery.[4] An analysis of a population-based administrative database found that voluntary preoperative consultations were associated with a significant, albeit small, increase in mortality. Although this study used a matched cohort, the unmatched cohort that underwent consultation was higher risk; also, selection bias was possible, as the reasons for initial consultation were unknown.[5]

Historically, the Preoperative clinic at VA Greater Los Angeles Healthcare System (VAGLAHS) was supervised by the Department of Anesthesiology. In July 2004, the Preoperative clinic was restructured with Hospitalist oversight. The Anesthesia staff continued to evaluate all surgical patients, but did so only on the day of surgery, and after the patient was deemed an acceptable risk by the Preoperative clinic.

We undertook this study to measure the institutional impact of the addition of a Hospitalist-run Preoperative clinic to our standard practice. The VA is an ideal setting, given the closed system with reliable longitudinal data. The VA electronic medical record also allows for comprehensive calculations of clinical covariants and outcomes.

MATERIALS AND METHODS

Setting

VAGLAHS is a tertiary care, academic medical center that serves patients referred from a 110,000 square

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mile area of Southern California and Southern Nevada. The Preoperative clinic evaluates all outpatients scheduled for inpatient or outpatient noncardiac surgery. Evaluations are performed by mid-level providers with physician oversight. Patients are seen within 30 days of surgery, with a goal of 2 to 3 weeks prior to the operative date. Two of the 3 mid-level providers remained after the change in leadership; a third was hired. All were retrained to perform a detailed medical preoperative assessment. Patients awaiting cardiothoracic surgery had their evaluation performed outside the Preoperative clinic by the Cardiology or Pulmonary services during both periods.

With the change in oversight, mid-level providers were given weekly lectures on medical disease management and preoperative assessment. A syllabus of key articles in perioperative literature was compiled. Evidence-based protocols were developed to standardize the evaluation. Examples of guidelines include: laboratory and radiological testing guidelines,[6–10] initiation of perioperative beta blockers,[11] selection criteria for pulmonary function tests,[12] protocols for "bridging" with low-molecular-weight heparin for patients on oral vitamin K antagonists,[13] the cardiovascular evaluation based on American College of Cardiology/American Heart Association (ACC/AHA) guidelines,[14] as well as adjustment of diabetic medications.

Prior to the change in oversight, patients who required Cardiology evaluations were referred directly to the Cardiology service generally without any prior testing. After institution of the Hospitalist-run clinic, the mid-level providers ordered cardiac studies after discussion with the attending to ensure necessity and compliance with ACC/AHA guidelines. Patients were referred to Cardiology only if the results required further evaluation. In addition, entry to the Preoperative clinic was denied to patients awaiting elective surgeries whose hemoglobin A1c percentage was greater than 9%; such patients were referred to their primary care provider. For patients awaiting urgent surgeries, the Preoperative clinic would expedite evaluations in order to honor the surgical date. Providers would document perioperative recommendations for patients anticipated to require an inpatient stay. Occasionally, the patient was deemed too high risk to proceed with surgery, and the case was canceled or delayed after discussion with the patient and surgical team. Once deemed a medically acceptable candidate, the patient was evaluated on the day of surgery by Anesthesia.

Methods

We extracted de-identified data from Veterans Health Administration (VHA) national databases, and specifically from the Veterans Integrated Service Network (VISN) 22 warehouse. All patients seen in the Preoperative clinic at VAGLAHS, from July 2003 to July 2005, were included. The patients were analyzed in 2 groups: patients seen from July 2003 to June 2004, when the Anesthesia Department staff supervised the Preoperative clinic ("Period A"); and from July 2004 to June 2005, the first year of the new Hospitalist-run system ("Period B"). We collected data on age; gender; American Society of Anesthesia (ASA) score[15]; perioperative beta blocker use; cardiology studies ordered; and surgical mortality defined as death within the index hospital stay. The length of stay (LOS) was calculated for patients who required an inpatient stay after surgery. As an internal control, we assessed the LOS of the cardiothoracic patients in our facility since this group of patients does not utilize the Preoperative clinic and maintained the same preoperative evaluation process during both time periods. In addition, same-day surgical cancellations were tracked by the Anesthesia Department, which documents daily operating room utilization and determines whether a cancellation was avoidable.

Statistical Analysis

Differences in demographic, clinical, and preoperative resource utilization characteristics were compared between Periods A and B using chi-square for categorical variables and *t* test (or Wilcoxon test) for continuous variables. A subgroup analysis was performed for patients who required an inpatient stay after surgery. The primary outcome was inpatient LOS and the secondary outcome was inpatient death. A mixed-effects regression model with patient-level random effects to account for clustering of visits by the same patient was used to assess the impact of certain patient characteristics on inpatient LOS. Covariates included age, gender, time period (A vs B), ASA classification, and perioperative period-by-ASA classification interaction. Comparisons of inpatient LOS between periods for different ASA classes were done through model contrasts. Chi-square test was used to compare the inpatient mortality between periods. A subgroup analysis was performed on postoperative inpatient deaths during the study period using a logistics regression model with age, ASA, and time period. All statistical analyses were performed using SAS Version 9.2 (SAS Institute, Cary, NC).

RESULTS

Table 1 describes the demographics and clinical characteristics of the patients evaluated in the Preoperative clinic. Number of surgeries performed in Periods A and B were 3568 and 3337, respectively, with an average of 1.3 surgeries per patient for both periods. The most common surgical specialties were Ophthalmology, Orthopedics, Urology, and General Surgery. The average ages of patients in Periods A and B were 63.9 and 61.4 years, respectively ($P < 0.0001$). The patients were predominantly male. ASA classifications were similar in the 2 periods, with over 60% of patients having an ASA score of 3 or higher.

TABLE 1. Demographics and Clinical Characteristics

	Period A N (%)	Period B N (%)	P
No. of patients	2658	2565	
Total no. of surgeries	3568	3337	
Service			0.0746
Ophthalmology	756 (21.1)	637 (19.1)	
Urology	526 (14.7)	478 (14.3)	
Orthopedics	527 (14.8)	502 (15.0)	
General surgery	469 (13.1)	495 (14.8)	
ENT	363 (10.2)	312 (9.4)	
Other	927 (26.0)	913 (27.4)	
Age, mean (SD)	63.9 (13.2)	61.4 (13.5)	<0.0001
Male	2486 (93.5)	2335 (93.0)	0.4100
ASA classification			0.1836
1. No disturbance	59 (2.3)	81 (3.3)	
2. Mild	896 (35.3)	864 (35.3)	
3. Severe	1505 (59.3)	1425 (58.1)	
4. Life-threatening or worse	77 (3.0)	81 (3.3)	
5. Missing scores	121 (4.6)	114 (4.4)	

Abbreviations: ASA, American Society of Anesthesia; ENT, Otolaryngology; Period A, July 2003–June 2004, when the Anesthesia Department staff supervised the Preoperative clinic; Period B, July 2004–June 2005, the first year of the new Hospitalist-run system; SD, standard deviation.

Table 2 presents the selected preoperative resource utilization. Less than 3% of patients referred to the Preoperative clinic were referred for Cardiology consultation during both time periods. However, during Period A, some patients required multiple Cardiology referrals resulting in 85 referrals in Period A and 64 referrals in Period B. In contrast, Preoperative clinic providers ordered more cardiac studies in Period B than in Period A ($P = 0.012$). There was a significant increase in the number of patients on perioperative beta blockers, with 26% in Period A and 33% in Period B ($P < 0.0001$). Although there was no significant difference in the number of same-day surgical cancellations between the 2 periods, there was a trend towards a reduction of cancellations for "medically avoidable" reasons, 34 (8.5%) and 18 (4.9%) cases during Periods A and B, respectively ($P = 0.065$).

Table 3 describes the clinical characteristics, inpatient LOS, and inpatient mortality for the surgical inpatients assessed in the Preoperative clinic. There were 1101 patients with 1200 inpatient surgeries in Period A, and 1126 patients with 1245 inpatient surgeries in Period B. The mean ages were 63.3 and 61.4 years in Periods A and B, respectively ($P = 0.0004$). More than 90% of patients were male. Over 62% of patients had ASA scores of 3 or higher in both periods. Both mean and median LOS was reduced in Period B. Results from the mixed-effects regression model indicated no age and gender effects. ASA classification was significantly associated with LOS ($P < 0.0001$). There were reductions in LOS from Period A to Period B across all ASA classifications, however, the levels of reduction were different among them (ie, significant interaction effect, $P = 0.0005$). Patients who were ASA 3 or higher had a significantly shorter LOS in Period B as compared to those in Period A ($P < 0.0001$).

TABLE 2. Preoperative Resource Utilization for All Patients

	Period A N (%)	Period B N (%)	P
No. of patients	2658	2565	
No. of patients that had at least 1 cardiology referral	70 (2.6)	62 (2.4)	0.660
No. of cardiology referrals	85	64	
Cardiac testing orders	40	88	0.012
Nuclear medicine	20 (50.0)	58 (65.9)	
Nuclear treadmill	2 (5.0)	12 (13.6)	
ETT	18 (45.0)	18 (20.5)	
Perioperative beta blocker	696 (26.2)	852 (33.2)	<0.0001
Cases canceled day of surgery			
Total	400 (15.0)	368 (14.3)	
Medical avoidable	34 (8.5)	18 (4.9)	0.065

Abbreviations: ETT, exercise tolerance test; Period A, July 2003–June 2004, when the Anesthesia Department staff supervised the Preoperative clinic; Period B, July 2004–June 2005, the first year of the new Hospitalist-run system.

TABLE 3. Surgical Cases Requiring Inpatient Stay

	Period A	Period B	P
No. of patients	1101	1126	
No. of inpatient surgeries	1200	1245	
Age, mean (SD)*	63.3 (12.7)	61.4 (12.8)	0.0004
Male (%)†	1022 (92.8)	1024 (90.9)	0.1039
ASA classification			0.0510
1. No disturbance	15 (1.36)	27 (2.40)	
2. Mild	324 (29.4)	364 (32.3)	
3. Severe	710 (64.5)	697 (61.9)	
4. Life-threatening	52 (4.72)	38 (3.37)	
Primary outcome			
In-patient LOS (days)			
Mean (SD)	9.87 (25.4)	5.28 (9.24)	
Median (min–max)	3.0 (1–516)	2.0 (1–120)	
Mixed-effects regression†	Period A–B Estimated difference (SE)		
1. No disturbance	1.31 (5.90)		0.8247
2. Mild	2.52 (1.39)		0.0717
3. Severe	4.22 (0.96)		<0.0001
4. Life-threatening	19.7 (3.81)		<0.0001
Secondary outcome			
Mortality,‡ N (%)	14 (1.27)	4 (0.36)	0.0158
ASA classification			
3. Severe	7 (0.99)	2 (0.29)	
4. Life-threatening	7 (13.5)	2 (5.26)	
Logistic regression§	Estimated OR (95% CI)		
Period (A vs B)	3.13 (1.01, 9.73)		0.0488
ASA classification (3 vs 4)	0.06 (0.02, 0.16)		<0.0001

Abbreviations: ASA, American Society of Anesthesia; CI, confidence interval; LOS, length of stay; OR, odds ratio; Period A, July 2003–June 2004, when the Anesthesia Department staff supervised the Preoperative clinic; Period B, July 2004–June 2005, the first year of the new Hospitalist-run system; SD, standard deviation; SE, standard error. *t Test was used. †Mixed-effects regression model with the following predictors: age ($P = 0.0513$), gender ($P = 0.1623$), ASA classification ($P < 0.0001$), period ($P = 0.0001$), ASA-by-period ($P = 0.0005$), and patient-level random effects. ‡Chi-square test (without controlling for ASA classification) was used. §Logistic regression of ASA 3 or higher was conducted. Estimated OR and their 95% CI are shown.

The LOS on the Cardiothoracic services was also evaluated. No significant difference in LOS was observed between the 2 periods (average LOS of 18 days) after adjusting for the patients' age and ASA score.

Inpatient mortality was reduced in Period B, from 14 cases (1.27%) to 4 cases (0.36%) ($P = 0.0158$).

No patients who were ASA 2 or less died. Deaths in each period were evenly split between ASA categories 3 and 4 (Table 3). Subgroup analysis on inpatient deaths showed no age effect, but a significant period effect (odds ratio [OR] = 3.13, 95% confidence interval [CI]: 1.01–9.73 for Periods A vs B; $P = 0.0488$) and ASA status effect (OR = 0.06, 95% CI: 0.02–0.16 for ASA severe vs life-threatening; $P < 0.0001$).

DISCUSSION

The addition of a Hospitalist-run, medical Preoperative clinic was associated with more perioperative beta blocker use, shortened LOS, and lower mortality rates for our veteran patients undergoing noncardiac surgery. Such LOS reduction was not apparent in our internal control of cardiothoracic surgery patients or in the VA National Surgical Quality Improvement Program (NSQIP), a national representative sample of a similar patient population. While median unadjusted LOS in the VA NSQIP did not change over the same time periods, surgical mortality rates decreased, but by a smaller magnitude (15%) than seen in our study. While mortality in our study was reduced, the absolute numbers are relatively small. However, a subgroup analysis accounting for age and ASA score demonstrated a reduction in mortality.

As multiple structure and process changes were made in the Preoperative program, it is not definitively known which specific factor or factors could have affected inpatient surgical care. The Preoperative clinic evaluation was a one-time consult, but included recommendations for perioperative management, including medication adjustments and infrequent suggestions for perioperative consultation. The decision to follow such recommendations was voluntary on the part of the surgical team. Alternatively, preoperative optimization may have played a role. By performing a multisystem evaluation with evidence-based protocols, we possibly identified patients that were at increased risk of perioperative harm, and were able to intervene or recommend deferral of the procedure. This could have resulted in better surgical candidate selection with fewer postoperative complications, especially among patients with significant medical comorbidities.

Better patient selection is also suggested by a trend toward fewer same-day cancellations for "medically avoidable" reasons during Period B. The distinction between "medical" versus "patient-related causes" and "avoidable" versus "unavoidable" causes may be imprecise; however, the same Anesthesia staff assigned the categories over both periods and therefore any possible inconsistencies should have averaged out.

Increased usage of perioperative beta blockers may also have contributed to reduced mortality rates. We anticipated that more patients in Period B would be placed on perioperative beta blockers, given the guidelines in place at the time. More recently, the evidence for perioperative beta blockade has been further refined,[16,17] but during study Periods A and B, it was considered "best practice" for wider patient populations.

Fewer repeat referrals to Cardiology clinic and more cardiac testing were ordered by the Preoperative clinic providers during Period B. Ordering cardiac studies from Preoperative clinic and referring only when guideline-driven could have streamlined the evaluation process and prevented the need for repeat referrals. We expect the number of stress tests and Cardiology consultations to have decreased even more in recent years as the 2007 ACC/AHA guidelines further emphasize medical optimization and de-emphasize cardiac testing and prophylactic revascularization prior to surgery.[18]

Our results suggest that similar healthcare systems may benefit from adding medical expertise to their preoperative clinical operations. As the LOS reduction was most noticeable in patients with higher ASA scores, the largest impact would likely be with healthcare environments with medically complex patients and variable access to primary care. The shortage of primary care physicians and the increase in chronic disease burden in the US population may cause more patients to present to a surgeon in a nonoptimized condition. Arguably, such clinics could be supervised by any discipline that is familiar with the perioperative literature, chronic disease management, and postoperative inpatient care. Other options include clinics in which Anesthesiologists jointly collaborate with Hospitalists[19] or General Internists with expertise in perioperative management.

Our study has many limitations. The VA has a largely male population and an electronic medical record, and thus results are not generalizable. Patients were younger in Period B than in Period A; however, the 2- to 3-year difference might not be clinically significant, and the standard deviation was wide in both groups. This study is a retrospective observational study, and thus we cannot identify the specific processes that could have lead to any associated outcomes. There was no ideal contemporaneous control group, but examination of trends in cardiothoracic surgery at our institution and the national VA database does not reveal changes of this magnitude. Unforeseen biases could have resulted in "upcoding" of ASA scores by the mid-level providers. Beta blocker usage was determined by patients prescribed beta blockers perioperatively, and did not exclude those on the medication prior to presentation. However, the significant increase in usage in Period B points to an increase in prescriptions originating from the Preoperative clinic. We do not have a breakdown of postoperative days in the intensive care unit (ICU) or ward settings, or the readmission rates. Thus, a true cost-effectiveness analysis cannot be done. However, the reduction in postoperative LOS and decline in same-day cancellations suggests that our institution benefited to some degree.

Since the mid-level providers were present prior to the change from Anesthesia to Hospitalist leadership, the only cost of the intervention was the hiring of a Hospitalist. However, the change freed an Anesthesiologist to work in the operating room or procedure suite. We do not have precise data regarding the number of surgeries delayed or canceled by the Preoperative clinic, but surgical workload was similar between both periods. Hopefully future studies will include richer data to minimize study limitations.

CONCLUSION

The addition of a Hospitalist-run, medical Preoperative clinic was associated with improvements in perioperative processes and outcomes. Postoperative LOS was reduced in the sickest patients, as was inpatient mortality. Perioperative beta blocker use was increased. Adding Hospitalist expertise to preoperative clinical operations may be a viable model to improve perioperative care.

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