Oral Abstract Presentations—Tuesday, September 11

1:00 Preoperative Electrocardiograms: Patient Factors Predictive of Abnormalities

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Background: Most institutions recommend preoperative electrocardiograms (ECGs) for patients over 50 years old. However, resting ECGs have been shown to be poor screening devices for coronary artery disease. Medicare has recently stopped reimbursing for preoperative routine ECGs based on age alone. This study was designed to determine whether preoperative guidelines could be refined to eliminate unnecessary ECGs. Our hypothesis was that significant abnormalities are unlikely in the absence of coronary risk factors.

Methods: We reviewed ECGs for patients presenting for preoperative evaluation during a 2-month period. ECG abnormalities considered to be significant were major Q waves, major ST segment depression, major T wave changes, ST segment elevation, Mobitz type II or higher blockade, left bundle branch block, and atrial fibrillation. Patient risk factors included myocardial infarction, anginal symptoms, congestive heart failure, severe valvular disease, diabetes, renal insufficiency, low functional capacity, stroke, hypertension, smoking, high cholesterol, coronary artery disease, and peripheral vascular disease.

Results: A total of 1,337 ECGs were reviewed, with 94 patients (7%) having at least one significant abnormality. These patients were compared with a control group of 232 patients with a normal ECG or with insignificant abnormalities. A minor T wave change, seen in 198 (14.8%) of all the ECGs, was the most common abnormality. Major T wave changes, present in 63 patients (4.7%), constituted the most common significant abnormality. Patients at higher risk for having an abnormal ECG were those older than 65 years of age and those who had a history of heart failure, high cholesterol, angina, myocardial infarction, or severe valvular disease **(Table)**. Six patients (0.5%) had an abnormal ECG without having any risk factor.

Conclusion: Although our model is capable of identifying patients who are at risk of having significant preoperative ECG abnormalities, it cannot capture all patients who have abnormal ECGs. It will need to be determined if it is economically feasible to limit ECGs to this high-risk population with the potential to cancel very few cases on the day of surgery if a patient is noted to have an abnormality on the two-lead ECG monitor.

TABLE
LOGISTIC REGRESSION ANALYSIS FINDINGS

Risk factor	*P* value	Odds ratio	95% CI
Age > 65 years	< .0001	4.3	2.32–7.96
Heart failure	< .0001	12.1	3.46–45.58
High cholesterol	.0175	2.2	1.15–4.36
Angina	.0149	5.8	1.41–23.86
Myocardial infarction	.0001	6.5	2.50–17.05
Severe valve disease	.0012	8.0	2.28–28.0

1:15 Impact of Combination Medical Therapy on Mortality in Vascular Surgery Patients

Thomas Barrett[1,2], Motomi Mori[2], Caroline Koudelka[2]
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Background: The use of combination evidence-based medical therapies consisting of aspirin, beta-blockers, statins, and ACE inhibitors in acute coronary syndrome has been shown to decrease mortality compared with the use of no evidence-based therapies. The single or combination use of beta-blockers or statins has been associated with decreased mortality after noncardiac surgery. The single use of aspirin has been associated with decreased mortality after cardiac surgery. There have been no published data on improved perioperative outcomes with ACE inhibitors.

Methods: We sought to ascertain if the combination use of four study drugs—aspirin, beta-blockers, statins, and ACE inhibitors—compared with no study drug use was associated with decreased mortality 6 months after vascular surgery. We performed a retrospective cohort study of 3,020 patients presenting for vascular surgery at five regional Veterans Affairs medical centers between January 1998 and March 2005. Patients were categorized as using the study drugs if they filled a prescription for the study drug within 30 days before surgery. Cochran-Mantel-Haenszel analysis was used to assess associations with 6-month mortality adjusted for the Revised Cardiac Risk Index score.

Results:

- Compared with taking no study drug, use of all four study drugs had an RR of 0.45 (95% CI, 0.25 to 0.82; *P* = .0078).
- Compared with taking no drug, use of three study drugs had an RR of 0.54 (95% CI, 0.35 to 0.84; *P* = .0052).
- Compared with taking no drug, use of two study drugs had an RR of 0.73 (95% CI, 0.51 to 1.05; *P* = .0934).
- Compared with taking no drug, use of one study drug had an RR of 0.88 (95% CI, 0.63 to 1.22; *P* = .4357).

The most common single agent was aspirin; the most common two-drug combination was aspirin and an ACE inhibitor; and the most common three-drug combination was aspirin, a beta-blocker, and a statin.

Conclusion: Combination use of three or more study drugs was consistently associated with decreased mortality after vascular surgery. Further study of combination perioperative use of aspirin, beta-blockers, statins, and ACE inhibitors is warranted.

1:30 Do Large Electronic Medical Record Databases Permit Collection of Reliable and Valid Data for Quality Improvement Purposes?

Ashish Aneja, Eric Hixson, Brian Harte, Vesselin Dimov, Amir Jaffer
Cleveland Clinic, Cleveland, OH

Background: A quality improvement program was initiated at Cleveland Clinic to evaluate current practices and trends in preoperative cardiac risk assessment and prescription of perioperative beta-blockers for patients undergoing elective, noncardiac surgery with a planned hospitalization of 1 day or longer.

Methods: Data for this study originated exclusively from institutional databases, primarily the electronic medical record (EMR). Determinants of eligibility were defined using a standardized assessment and treatment protocol developed by a core working group of physicians, surgeons, and nurses. A validation sample (n = 190) of patients seen in the year 2005 was randomly generated from the analysis set of 11,985 consecutive patients. A single physician re-abstracted all relevant data for determining beta-blocker eligibility from the validation sample. A kappa statistic was used to assess the rate of agreement between the original assessment and validation assessment for determining beta-blocker eligibility derived from the random sample.

Results: The initial rate of agreement was moderate (kappa = 0.62). The rates of agreement for each eligibility component are reported in the **Table**. Closer examination revealed that characterization of hypertension had the lowest level of agreement. Originally, hypertension was defined by documented diagnoses in the EMR while the validation study utilized actual measured blood pressures. When the hypertension diagnosis was replaced with actual blood pressures (defined as blood pressure > 160/90 mm Hg by the group), the rate of agreement was substantially improved (kappa = 0.81).

Conclusion: The content and quality of information contained in the EMR remains dependent in large part on the documentation practices of health care providers. EMR-derived data can be used to produce valid correlates for quality improvement if they can be confidently validated with a random sample, as documented here. Clinically derived variables should be selected before diagnosis codes to define clinical conditions when it is feasible and when they are available to investigators.

TABLE
RATES OF AGREEMENT BETWEEN ASSESSMENTS

Eligibility component	Agreement	Expected agreement	Kappa	*P*
Coronary artery disease	95.8%	72.7%	0.846	< .001
Stroke/TIA	94.2%	87.7%	0.530	< .001
Diabetes	97.9%	75.6%	0.914	< .001
Renal disease	99.0%	94.9%	0.795	< .001
Heart failure	96.8%	90.0%	0.685	< .001
Peripheral vascular disease	98.4%	93.4%	0.761	< .001
Hypertension and age > 65	80.0%	72.9%	0.262	< .001
Overall initial agreement	86.3%	63.7%	0.623	< .001
Overall agreement with revised hypertension criteria	93.7%	67.4%	0.807	< .001

Poster Abstracts

Innovations in Perioperative Medicine

(Note: Abstracts 4, 6, and 10 were chosen as the best in this section by the Innovation Abstracts Committee.)

1 PONV: 'An Ounce of Prevention is Worth a Pound of Cure'

Catherine Capitula, Shari Duguay
Seton Health/St. Mary's Hospital, Troy, NY

Background: Nursing identified postoperative nausea and vomiting (PONV) in surgical patients to be a huge source of patient dissatisfaction. Previous patient experiences predestine negative outcomes. PONV is hard to rescue with medications and has a negative impact on patient safety.

Purpose: Using evidence-based practice, we aimed to develop a screening tool to screen all surgical patients for their risk of PONV, notify all members of the perioperative team of each patient's risk score, develop a multidisciplinary team approach for the prevention of PONV, and use multimodal antiemetic prophylaxis to decrease PONV and increase patient satisfaction and safety.

Description: We developed a PONV risk assessment tool and education tools, implemented protocols involving patient education and nursing documentation, and provided in-service programs for all involved in the care of surgical patients (anesthesiologists, pharmacists, surgeons, nursing staff).

Results and Conclusions: A 6-month chart audit of all high-risk surgical outpatients showed that an average of 11% of our high-risk surgical outpatients actually experienced PONV, well below the potential risk of up to 70%, decreasing the risk of postoperative complications. We have received many letters from patients praising this process for their positive experiences. Surgeons are collaborating with nurses regarding risk and prevention from their offices preoperatively. Nurses are taking an active role as patient advocates in the prevention of PONV and increasing patient satisfaction and safety.

2 Optimization of Perioperative Processes Through Innovation and Technology for the Orthopaedic Operating Room of the Future

J.H. James Choi, Jennifer Blueter, Barbara Fahey, James Leonard, Ted Omilanowski, Vincent Riley, Mark Schauer, Timothy Sullivan, Viktor Krebs, Jonathan Schaffer
Advanced Operative Technology Group, Cleveland, OH

Background: Three key challenges are influencing orthopaedics: an increasingly older population that is living longer, improved technology, and value optimization per procedure. Domestic annual demand for knee replacements will increase 12% to 15% for the next 20 years. Similar increases in all orthopaedic subspecialties will also stress capacity and requisite perioperative processes. The Orthopaedic Operating Room of the Future (OORF) program focuses the capability to respond to these demands.

Purpose: Operating room success is dependent on preoperative, intraoperative, and postoperative processes that comprise orthopaedic care. The OORF program initiated a Lean Six Sigma–based reengineering collaboratory to increase efficiency and efficacy. The process mapping for total joint arthroplasty was initiated with the goal of improving performance and predictability, minimizing variances, decreasing "waste," and increasing value while minimizing costs. Capabilities across the continuum of orthopaedic care were investigated, starting with the initial orthopaedic clinical visit, through preoperative evaluations, standardizing operating environments, and ultimately leading to the development of three state-of-the-art, standardized orthopaedic operating rooms.

Description: An open-participation, cross-divisional collaboratory was established to integrate complementary efforts of all groups involved in the care of orthopaedic patients and included over 175 doctors, administrators, nurses, therapists, and support staff. Process engineering tools were used to identify critical path processes and their stakeholders to optimize process efficiency, efficacy, productivity, and satisfaction. Key issues included setting appropriate expectations, education and training, identification of processes while maintaining a patient-first and quality focus, and evaluating pre-, post-, and intraoperative technology.

Results and Conclusions: The OORF program identified the critical aspects of pre- and postoperative processes to achieving success with day-of-surgery processes by enhanced communication and seamless integration of perioperative information and functions. Standardization facilitated maintenance and case turnover. Updated anesthesia ceiling-mounted booms, equipment ceiling-mounted booms, and environmental controls, and better access to health information technology applications, including electronic medical records, picture archiving, and communication system and communications capabilities, added value to operative and perioperative staff. Lessons learned include setting realistic and specific problem scopes, providing continual progress updates, establishing competency, structure, and capability within the organization, and avoiding premature, overreaching solution definitions. The OORF program has been a helpful tool in the continuous pursuit of the perfect operation in the perfect environment.

3 A Systematic Approach to Interpreting Electrocardiograms by Using Two Mnemonics

Vesselin Dimov[1], Kalina Uzunova-Dimova[2], Ajay Kumar[1], Ashish Aneja[1]
[1]Cleveland Clinic, Cleveland, OH; [2]Private practice

Background: Electrocardiogram (ECG) interpretation is an integral part of the perioperative assessment. Trainees in anesthesiology and perioperative medicine often find this interpretation among the more challenging aspects in the evaluation of patients scheduled to undergo surgery.

Purpose: Our aim was to create a simple tool that can help in accurate and time-efficient interpretation of ECGs.

Description: A two-step memory tool (mnemonic) was developed at a large tertiary care center to help anesthesiology and medical residents in interpreting ECGs.

In step one, all elements of the ECG were assessed systematically with the mnemonic **A RARE PQRST**: Age, Rate, Axis, Rhythm, Evaluate, P wave, Q wave, R wave, ST segment, T wave.

In step two, the causes of abnormalities detected in step one were evaluated by using the differential diagnosis mnemonic **DR EEE III**: Drugs, Rhythm/rate/conduction abnormalities, Enlargement of a chamber, Electrolyte disturbances, Endocrine causes, Ischemia, Infarct (old), Infection.

A suggested approach to using the tool was to write the mnemonic on a piece of paper (eg, "A RARE PQRST," "DR EEE III"), circle the abnormalities discovered in step one, and then attempt to explain these abnormalities by connecting them to the list of possible etiologies listed in the second step. We conducted a pilot study focused on the perceived usefulness of the mnemonic for ECG interpretation; the study involved four anesthesiology residents and four internal medicine residents (postgraduate year 1).

Results and Conclusions: After practicing ECG evaluation with the help of the two-step mnemonic, 87% of the residents rated the tool as useful. We concluded that our two-step mnemonic for interpreting ECGs may be a valuable tool in perioperative medicine education. A follow-up study on a larger scale may be needed to confirm our findings.

4 Improving and Standardizing Medicine Consultation

Benny Gavi, Lisa Shieh, Keith Posley, Shahram Sepehri, Phil Pang
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Background: The Stanford Medicine Consult Service, staffed by hospitalist and nonhospitalist attending physicians, as well as by house staff, provided variable quality of care and education. Variability involved timeliness, frequency, and modes of communication, use of different practice guidelines, recommendation of different tests and therapies for similar conditions, and different styles of communication (eg, general vs specific recommendations). Furthermore, attending physicians provided variable supervision, feedback, and education to house staff.

Purpose: Our goal was to improve and standardize internal medicine consultation and house staff supervision and education.

Description: A working group of internal medicine physicians, hospitalists and nonhospitalists, experienced in the field of medicine consultation and quality improvement met weekly, together with house staff, and followed rapid-cycle improvement methodology. We reviewed current published trials and guidelines and we developed and standardized a "best practice" focusing on the processes, outcomes, and education of medicine consultation. Given the broad scope of medicine consultation, we focused on preoperative cardiac evaluation and risk reduction.

Results and Conclusions: Best practice was determined to include the following key competencies:

(1) Timeliness to performing consultation (respond to nonurgent consults within 4 hours)
(2) Relevant history (cardiac symptoms, pulmonary symptoms, prior revascularization, prior stress testing)
(3) Assessment of functional status
(4) Relevant physical exam (vital signs, JVP, pulmonary and cardiac auscultation, evaluation for edema)
(5) Assessment of electrocardiogram
(6) Uniform and consistent practice guidelines (ACC/AHA 2002 update and Revised Cardiac Risk Index [RCRI] score)
(7) Patient and surgery risk stratification (low, intermediate, high)
(8) Assessment for stress testing
(9) Assessment for beta-blocker therapy
(10) Effective documentation (specific, prioritized)
(11) Effective communication (verbal for any recommendation requiring action within 24 hours).

A laminated pocket card provided guidance on the key competencies, including information about practice guidelines (ACC/AHA 2002, RCRI score), patient and surgery risk stratification, and functional status assessment. Medicine consults performed by house staff were audited by hospitalist attending physicians using a checklist of the key competencies. The completed audits were given to house staff and facilitated supervision and feedback. A knowledge assessment tool was administered to house staff on the medicine consult rotation at the beginning and end of the month in order to help define required knowledge, reinforce important points, and document knowledge gained. These tools will be shared at the conference.

5 Medical Students' Assessment of a Required Rotation in Perioperative Medicine and Pain

Amir Jaffer, Samuel Irefin, John Tetzlaff, J. Harry Isaacson
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Background: Students graduating from US medical schools get little required training in perioperative medicine. In the context of new curriculum development for the Cleveland Clinic Lerner College of Medicine, a multidisciplinary group of physicians helped develop learning objectives, structure, and content for a 1-month required clerkship in perioperative medicine and pain (PMP).

Purpose: To describe the PMP clerkship curriculum and medical students' assessment of it.

Description: The overall goals of this 4-week rotation are to help medical students acquire, develop, and enhance cognitive and technical skills in the medical care of the surgical patient. The curriculum provides students with the knowledge, skills, and attitudes necessary to evaluate and medically manage patients periopera-

tively and to appreciate the evaluation of acute and chronic pain.

All students spend 1 week in the Internal Medicine Preoperative Assessment, Consultation, and Treatment (IMPACT) Center and the Preanesthesia Evaluation Clinic (PACE), where they perform preoperative and preanesthesia evaluations, respectively. One week is spent in the operating room and the PACU, where students learn the basics about airway management on a simulator and then manage patients intraoperatively with an anesthesiologist. The third week is spent on the internal medicine consult service, where students evaluate patients with postoperative medical complications. The final week is spent in the chronic pain clinic, where students learn about chronic and acute pain. Each week, students meet for 2 hours with staff to discuss cases on common perioperative topics. In addition, students meet weekly for 1 hour with a staff preceptor to review and discuss a landmark article during journal club.

At the end of each block, the students were asked to respond to multiple questions about the rotation on a Likert scale of 1 (strongly disagree) to 4 (strongly agree). These data will be presented at the meeting.

Results and Conclusions: A total of 12 students have gone through this curriculum thus far. The rotation has received a mean score of 4.6 on a Likert scale where 1 equals poor and 5 equals excellent. We believe that by actively working with a multidisciplinary group of clinician educators in managing medical problems of surgical patients, students will be better prepared to handle the aging population they encounter during their future resident training.

6 Improving Safety for Adult Surgical Patients with Obstructive Sleep Apnea

Karen Watkins
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Background: Obstructive sleep apnea (OSA) is a common and treatable medical condition that affects more than 12 million adults in the United States. This disorder results in partial or complete airway collapse causing apneic and hypoxic episodes and may result in death. Surgical patients are at special risk because of the impact of anesthetic and analgesic medications.

Purpose: This project is designed to identify patients at risk for OSA prior to surgery and to modify their care. A collaborative program among all members of the perianesthesia care team, this process enhances communication and facilitates safe handoffs across sites of care and among various disciplines.

Description: Preadmission testing nurses screen for OSA using specific questions. On admission to the hospital for surgery, anesthesiologists refine the screening process using a questionnaire and risk analysis process, rating the patient for OSA risk. A care protocol, called an OSA order set, is established by the anesthesiologist and communicated to the surgical team. Postprocedurally, patients return to the post-anesthesia care unit (PACU) for individualized care. Report is conveyed to either the ambulatory care center or the postoperative unit nurse upon PACU discharge.

Results and Conclusions: Use of a standardized screening method and an OSA order set appropriately identifies a vulnerable population, individualizes care to prevent surgical complications, and ensures appropriate patient placement. All patients are actively involved in their plan of care and meeting their postdischarge needs. Outcomes data support continuous process improvement and evidence-based practice. The OSA surgical algorithm is a concrete and measurable method of care for an at-risk population. The perianesthesia nurse joins physicians, respiratory therapists, and other specialists in assessment, evaluation of interventions, and educational aspects of perioperative patient care.

7 A Multidisciplinary Approach to Improving the Safety of High-Risk Spine Surgery: The Complex Spine Protocol

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Background: Multilevel spine fusion surgeries (defined here as greater than six levels) present unique challenges to the surgeon, anesthesiologist, and hospitalist. The extent of the surgery, in combination with a large volume of blood loss, can lead to problems that include volume overload and a consumption/dilutional coagulopathy.

Purpose: A task force consisting of physicians from neurosurgery, orthopedics, anesthesiology/critical care medicine, perioperative medicine, and hematology was charged with creating a pathway for complex spine surgeries that would improve patient safety and outcomes at a large inner-city academic institution. Primary goals included (1) reducing the degree of coagulopathic bleeding, and (2) reducing the volume of fluids administered. Secondary goals included (1) decreasing ventilator days, (2) decreasing postoperative comorbidities and death, and (3) decreasing length of stay.

Description: The three segments of the pathway include preoperative, intraoperative, and postoperative protocols. Preoperatively, patients are identified as being at high risk if their surgery is anticipated to involve greater than six levels or 6 hours of surgery time. Most patients are referred by the surgeon's office to be assessed and optimized in the preoperative clinic by hospitalists. Each patient is then presented at a multidisciplinary meeting that includes the surgeon, the perioperative medicine physician, and the select anesthesiologists involved in the complex spine protocol.

Intraoperatively, blood for lab studies (CBC, PT, PTT, fibrinogen, and ionized calcium) is drawn every 2 hours for the first 6 hours, and then every hour thereafter. Coagulopathy prevention, as advised by hematology, is focused on avoiding the use of fresh frozen plasma and the volume that is associated with its administration. Cryoprecipitate is administered when the level is less than 150. Platelets are administered below 100,000. If the patient is oozing despite adequate levels of fibrinogen and platelets, DDAVP is administered. If the patient continues to ooze and the international normalized ratio (INR) is greater than 2, factor VIIa is administered.

The coagulopathy protocol is maintained postoperatively. Vitamin K is administered to patients with elevated INRs (> 2) and no evidence of bleeding.

Results and Conclusions: The Complex Spine Protocol was introduced in stages—first intraoperatively, then pre- and postoperatively. It has been in full effect since January 2007.

8 The Nurse Practitioner Role in Evidence-Based Medication Strategies

Patricia Kidik, RNCS; Kathleen Holbrook, RNCS
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Background: Nurse practitioners at Brigham and Women's Hospital Weiner Center for Preoperative Evaluation use evidence-based medication strategies in their assessment of high-risk elective surgical patients.

Purpose: Our objective is to identify those patients who meet the criteria for perioperative beta-blockade and for deep vein thrombosis prophylaxis.

Description: Our nurse practitioners were provided with education and training in using established guidelines to identify patients at risk. The nurse practitioner communicates with the appropriate member of the health care team (anesthesiologist, primary care physician, surgeon, or anticoagulation service staff) and provides patient education.

Results and Conclusions: This process facilitates the utilization of these guidelines, with improved patient outcomes.

9 Use of the Motivator/Hygiene Theory of Motivation to Guide Quality Efforts

Ronald Kratz
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Background: Effectively improving quality in perioperative health care systems requires motivating caregivers from different disciplines to work toward the same goal. To succeed, clinical supervisors need effective tools for motivating team members.

Purpose: This abstract will describe the motivator/hygiene theory of motivation and apply it to the quality effort of maintaining perioperative normothermia.

Description: The motivator/hygiene theory was described by Frederick Herzberg, who felt that humans have a unique ability to experience psychological growth, and are motivated to do so.[1] People desire opportunities to develop a sense of responsibility and achievement along with the chance to grow and learn. Supervisors will motivate others as they provide them the avenue to achieve, increase responsibility, and provide opportunities for personal growth and advancement.

Humans are also demotivated by pain, and they desire to minimize it whenever possible. Demotivators are extrinsic to the work itself, and include system policy and administration, supervision, interpersonal relationships, working conditions, salary, and security. The best way to handle demotivators is to make them as unintrusive as possible. Thus, motivators and demotivators are not opposites but separate entities. Effective motivation occurs when motivators are increased and demotivators are decreased.

Results and Conclusions: Perioperative normothermia has been identified as a quality indicator, as it has been associated with decreased risks of infection, bleeding, and cardiovascular events.[2] Motivator/hygiene theory would suggest that an approach of designing new policies related to room temperature and warming devices (policy and administration) while telling the staff exactly how to implement them (supervision) will not be effective. Instead, if present, the culture of punishment for exposing quality defects (supervision, working conditions) must be abolished. Next, emphasis should be given to the desire to help patients by providing the highest-quality care (work itself, achievement), the opportunity to learn new ways of keeping patients warm (job growth), and recognition when milestones are reached (recognition, achievement). Staff should be involved in the design and implementation of the effort. Managers will discover that as they work to develop staff instead of controlling them, the team effort will improve remarkably due to the increased motivation of all.

1. *Herzberg F. One more time—how do you motivate employees? Harvard Business Review 1968; republished in January 2003 (reprint R0301F, pp. 1–12).*
2. *American Society of Anesthesiologists. Quality incentives in anesthesiology. Available at: http://www.asahq.org/Washington/qualityincentivesdoc.pdf. Accessed June 9, 2007.*

10 A Novel Care Model Coordinating Inpatient and Outpatient Perioperative Care, Utilizing a Computerized Patient Tracking System

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Background: Coordination of inpatient and outpatient care is an increasingly important part of perioperative medicine. Most models of care involve an inpatient consultant who is different from the preoperative evaluator. As patients in the postoperative period are often altered in physiology and mental status, an accurate assessment is difficult without knowledge of their preoperative condition. Outpatient providers are often unaware when patients are being admitted for surgery, and are usually unable to follow patients perioperatively.

Purpose: To describe a novel care model in which the same physician provides outpatient and inpatient perioperative consultation. We describe a database and tracking system that facilitates this approach.

Description: Under the model practiced at the University of Washington, the physician seeing a patient in the preoperative clinic becomes that patient's primary inpatient medical consultant. Depending on the patient's health, the complexity of the operation, and its urgency, the time between preoperative evaluation and surgery varies greatly. The primary consultant coordinates preoperative care and provides inpatient consultation after surgery.

In order for surgery dates and patient admissions to be tracked, a database was developed containing the patient's name, the consult physician, and the expected surgery date. This database is checked daily against the operative schedule using a comparative program. Each provider's patient panel is cross-referenced with the surgery schedule, and a list of upcoming admissions is generated. Patients previously seen by the medicine consult service who are undergoing subsequent operations are identified and flagged for the continuity provider to review, and they are seen again in consultation if requested.

Results and Conclusions: A model of care emphasizing coordination of inpatient and outpatient medical consultation maximizes the benefit of preoperative evaluation, providing conti-

nuity and improving patient care. From the patient's perspective, in a busy teaching hospital with multiple changing providers, the medical consultant provides an often-lacking familiar face. A database advising providers of upcoming admissions is vital to the practice of this care model, and is also used to track pending test results, generate a patient list to improve billing capture, and identify patients for research purposes. From the provider's perspective, the program allows providers to know which patients to see and how busy the upcoming days will be. We believe our model is both unique and desirable, and should be considered at other hospitals with dedicated medicine consult services.

11 The Development of an Admitting Team

Kathleen McGrath, Janet Piatek, Jeanne Lanchester
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Background: Patients are scheduled to visit the Weiner Center for Preoperative Evaluation (CPE) 1 day to 3 weeks prior to surgery. There was not a formal structure in place for communication between the preoperative and perioperative areas. In the past, an e-mail about specific patient concerns was sent to the nurse in charge in the post-anesthesia care unit (PACU), but this person may not have always been available to receive the e-mail and act on it in a timely manner.

Purpose: Our objective was twofold: (1) to create a team approach to communicate patient information and perioperative needs to make the patient's surgery safer and less stressful for both the patient and staff; and (2) to increase collaboration between the different perioperative areas.

Description: A team was created with nurses representing the CPE, day surgery unit, preoperative holding unit, and PACU. The team created guidelines and a system for communicating patient issues. An e-mail list was created including nurses from these different perioperative areas (BWH RN SURGICAL ADMIT TEAM). The staff in CPE are now able to communicate with a larger team to make sure patient concerns are responded to in a timely manner.

Results and Conclusions: Utilizing a team approach provides an improved method of communication between the different perioperative departments and provides for a smoother and safer admission process for patients.

12 Improve Communication Among Caregivers: Eliminating Unauthorized Abbreviations on Hospital Medical Records

Magdalena G. Smith, Maura Walsh, Laurie Walsh, Marjorie Guglin, Dio Sumaygaysay, Evangelina Sapalasan, Frances Haug, Olivia Voellmicke, Mahin Sanjari, Nancy Cimitile, Mariya Chernyatskaya
New York Presbyterian Hospital, New York, NY

Background: One of the Joint Commission's seven National Patient Safety Goals is to improve the effectiveness of communication among caregivers by eliminating unauthorized abbreviations on hospital medical records. Unauthorized abbreviations cause confusion and compromise patient safety.

Purpose: To achieve 100% compliance with the "do not abbreviate" policy in all handwritten orders, preprinted forms, electronic records, medication administration records, and perioperative documentation records.

Description: The perioperative department formed a "Do Not Abbreviate" Task Force Committee with representatives from the following areas: preadmission testing, same-day surgery, ambulatory surgery, operating room, and post-anesthesia care unit (PACU). The committee meets once a month and randomly reviews 100 medical records per month. Initial efforts focused on identifying commonly used unauthorized abbreviations, the frequent offenders, and factors contributing to staff noncompliance with the policy; before changes were made, compliance was only 69%.

Results and Conclusions: Changes made included revision of the doctor order sheets, progress notes, and medication administration records with the "do not abbreviate" list stamped upon them. The unauthorized abbreviations were eliminated from all electronic records. Physician offices were notified about the "do not abbreviate" policy, and pharmacy was directed not to accept any orders with unauthorized abbreviations and to require that orders be corrected before medications are dispensed. Signs and mouse pads containing the "do not abbreviate" list were distributed. The staffs were made aware of the project through in-service programs, and results were displayed as a dashboard in all unit informational bulletin boards.

After redesign implementation, the compliance rate went up 100%. We will continue to monitor to maintain 100% compliance and we will reeducate the staff as needed.

13 Improve Preadmission Testing Process

Magdalena G. Smith, Tak Tam, Rita Medrozo, Maura Walsh, Laurie Walsh, Marjorie Guglin
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Background: The preadmission testing department coordinates preoperative anesthesia and nursing assessment for both ambulatory and same-day surgery patients. The process was too long and was causing patient dissatisfaction.

Purpose: To make the preadmission testing process more efficient and reduce waiting time to less than 90 minutes.

Description: A performance improvement team was formed consisting of anesthesiology, nursing, registration, scheduling, and ancillary personnel. The problem was presented to management. The GE facilitators analyzed the problem with the team. They identified the reasons for prolonged waiting times (> 90 minutes), which included patients not having order forms from their physicians, health care providers not following their allotted appointment times, and the lack of a designated anesthesiologist to oversee preadmission testing.

Results and Conclusions: The staff was made aware of the

project through in-service programs and poster board displays with progress updates. Physician offices were notified regarding the new guidelines and preadmission testing schedules. A new software program, My Medical File (MMF), was implemented to obtain order forms from the physicians. The anesthesiology department designated an office in the department with one attending physician, one resident, and a newly hired nurse practitioner to oversee patients in the preadmission testing area.

Through staff cooperation, hard work, and proactive administrative support, preadmission testing now runs smoothly and waiting time has been reduced to 62 minutes. Obtaining order forms from physicians via the new MMF software program reduces patients' waiting time. It also increases the secretary's efficiency and reduces the number of telephone calls made to obtain order forms. The team will continue to monitor and will conduct patient and staff satisfaction surveys.

Perioperative Clinical Vignettes

14 Chronic Renal Insufficiency: An Oft-Forgotten Component of the Revised Cardiac Risk Index

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Case Presentation: A 62-year-old woman with a history of hypertension, type 2 diabetes, and chronic kidney disease (CKD) with a creatinine of 2.5 mg/dL visits her physician's office for preoperative assessment. She is to undergo a colectomy in 2 weeks for a recently diagnosed nonmetastatic colon carcinoma. Physical examination is otherwise unrevealing. Laboratory data are unremarkable. Her medications consist of glargine insulin and mealtime lispro insulin coverage, amlodipine, atorvastatin, and lisinopril. She can climb two flights of stairs without any chest pain or shortness of breath. Based upon her well-controlled hypertension and diabetes and her good functional capacity, the physician "clears" the patient for the planned operative procedure. Based upon the data presented above, would you have done anything differently?

Discussion: The case described above reflects a scenario commonly encountered by physicians performing preoperative assessments. This patient would probably have benefited from perioperative beta-blockers based upon the currently available evidence. Beta-blockers are most commonly prescribed perioperatively based upon the Revised Cardiac Risk Index (RCRI), which assigns 1 point each for a history of myocardial infarction (MI) or coronary artery disease (definition is quite specific and does not include people with prior revascularization and no prior MI), congestive heart failure, cerebrovascular accident or transient ischemic attack, surgical risk (1 point is given if surgery is deemed high-risk based on estimated blood loss), and CKD with a creatinine greater than 2.0 mg/dL.

This patent's RCRI score is at least 2 (insulin-requiring diabetes and CKD with creatinine > 2.0 mg/dL) and may be 3 if the surgery turns out to be high-risk. The physician failed to take into account the patient's elevated creatinine level, which is clearly known to confer increased perioperative cardiovascular risk. Anecdotally speaking, since CKD is not considered a classical risk factor for cardiovascular disease, it is often forgotten or ignored in the perioperative risk equation.

Conclusion: CKD with a creatinine level greater than 2 mg/dL is an often forgotten perioperative cardiovascular risk factor, and some patients with this risk factor can benefit significantly from perioperative beta-blockers. It is important to keep in mind that atenolol is excreted predominantly from the kidneys and may not be an ideal choice in this subset of eligible patients, especially in the very elderly, because of prolonged peri- and postoperative bradycardia and hypotension.

15 When Is a Stress Test Indicated in Patients with Chronic Kidney Disease Evaluated for Noncardiac Surgery?

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Case Presentation: A 67-year-old African American male with past medical history of hypertension, hyperlipidemia, and chronic kidney disease with a baseline creatinine of 2.4 mg/dL is undergoing preoperative evaluation for colectomy due to colon cancer. He is able to walk one to two blocks at ground level but is not able to climb a flight of stairs due to shortness of breath. He denies chest pain and has no history of coronary artery disease. Does he need a stress test for preoperative evaluation of cardiovascular risk?

Discussion: According to the 2002 ACC/AHA Guideline Update for Perioperative Cardiovascular Evaluation for Noncardiac Surgery, this patient will need a cardiac stress test before surgery. The guidelines use a clinical shortcut to noninvasive cardiac testing that includes high-risk surgery, intermediate clinical predictors, and poor functional class (< 4 metabolic equivalents [METs]). If a patient has 2 out of 3 of these variables, he or she will need a stress test before surgery. The intermediate clinical predictors include Canadian class 1 or 2 angina, prior myocardial infarction based on history or pathologic Q waves, compensated or prior heart failure, diabetes, or renal insufficiency (defined as creatinine level > 2 mg/dL).

Our patient has a physical activity level of less than 4 METs, and his creatinine level of 2.4 mg d/L is an intermediate clinical predictor for adverse cardiovascular outcome. According to the guidelines, he will need a cardiac stress test prior to surgery. It is important to remember that the guidelines shortcut is valid for patients who are scheduled to have high-risk or intermediate-risk surgery. Patients scheduled for low-risk surgery can usually proceed with the operation without the need for a stress test first.

Conclusion: Chronic kidney disease with serum creatinine greater than 2 mg/dL is an important and often overlooked intermediate predictor of adverse cardiovascular outcome after noncardiac surgery, in the same class as angina pectoris, prior myocardial infarction, heart failure, and diabetes. If such patients also have poor functional activity, they should be referred for a cardiac stress test prior to surgery in order to assess their cardiovascular risk more precisely.

16 When to Correct Hyperkalemia in Patients with Chronic Kidney Disease Prior to Noncardiac Surgery?

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Case Presentation: A 42-year-old male with past medical history of type 1 diabetes mellitus, hypertension, and chronic kidney disease with a creatinine level of 3.0 mg/dL is undergoing preoperative evaluation for back surgery. His potassium level is 5.8 mEq/L. His medication list includes insulin, amlodipine, atenolol, and clonidine. Electrocardiogram does not show changes related to hyperkalemia. Does his potassium level need to be corrected prior to surgery?

Discussion: Perioperative hyperkalemia may be exacerbated or precipitated by blood transfusions, acidosis, ACE inhibitors, beta-blockers, tissue trauma during surgery, rhabdomyolysis, and the use of Ringer lactate solution as a replacement fluid. Preoperative hyperkalemia is seen in 19% to 38% of patients with chronic kidney disease. There is no evidence-based recommendation for safe preoperative potassium values. One study published in 1974 suggested avoiding general anesthesia in patients with chronic kidney disease and a potassium level greater than 5.5 mEq/L.

Preoperative evaluation of patients with elevated serum potassium traditionally includes a 12-lead electrocardiogram to assess the physiologic effect of hyperkalemia. Chronic dialysis patients often develop a tolerance to elevated serum potassium, and electrocardiographic changes may not be seen until the potassium exceeds 6.0 mEq/L. If the 12-lead electrocardiogram reveals features of hyperkalemia and dialysis cannot be performed before the surgery, medical management should be used.

Intravenous glucose and insulin is the most effective method to drive potassium into the cells in patients with end-stage renal disease. Sodium bicarbonate is generally of little benefit unless the patient has moderate to severe metabolic acidosis. Other treatment modalities, which include inhaled beta-adrenergic agonists and cation exchange resins, are less effective. Treatment with intravenous calcium is reserved for severe hyperkalemia. A cation exchange resin (Kayexalate) is a rare cause of intestinal necrosis, especially within the first week after surgery. It is important to review the type of intraoperative fluid with the anesthesiology and surgical teams. The most commonly used intravenous fluid during surgery in patients without renal impairment is Ringer lactate solution, which contains potassium. To avoid hyperkalemia, the preferred solution in patients with chronic kidney disease is isotonic saline.

Conclusion: Although no recommendation exists for a safe serum potassium level in the perioperative period, a potassium level of less than 5.5 mEq/L is generally advisable.

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17 What Is the Optimal Time Frame for Performing Hemodialysis in Patients with End-Stage Renal Disease Prior to Surgery?

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Case Presentation: A 67-year-old African American female with past medical history of type 2 diabetes mellitus, hypertension, hyperlipidemia, coronary artery disease, and end-stage renal disease (ESRD), for which she undergoes hemodialysis on Tuesdays, Thursdays, and Saturdays, is scheduled for total knee replacement on a Tuesday. Her medications include insulin, simvastatin, metoprolol, clonidine, amlodipine, and diphenhydramine. Physical examination is unremarkable, and laboratory results do not show significant abnormalities. What is the optimal time frame for performing hemodialysis in patients with ESRD prior to surgery?

Discussion: Uremia causes platelet dysfunction, which can result in increased perioperative bleeding. Several medications have only minor platelet effects in patients without uremia but can have exaggerated effects in ESRD, for example, diphenhydramine (Benadryl), nonsteroidal anti-inflammatory drugs, chlordiazepoxide (Librium), and cimetidine (Tagamet). Patients with ESRD should undergo dialysis on the day before surgery to correct hyperkalemia and fluid overload and to minimize uremic complications. Due to the routine use of heparin during hemodialysis, an interim of at least 12 hours is recommended before surgery can be performed safely. In the postoperative period, patients should undergo heparin-free dialysis for at least 24 hours. Studies failed to document a significant improvement in mortality with daily dialysis for a few days prior to surgery or with intraoperative hemodialysis, and therefore this modality of intensive dialysis cannot be recommended. Patients with peritoneal dialysis who are undergoing abdominal surgery should be changed to hemodialysis until wound healing is complete. Peritoneal dialysis can be continued for patients undergoing nonabdominal surgery.

Conclusion: Patients with ESRD should undergo dialysis on the day before surgery to correct and minimize uremic complications.

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18 A Recent Vascular Graft in a Patient with End-Stage Renal Disease on Hemodialysis and the Need for Preoperative Antibiotic Prophylaxis

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Case Presentation: A 56-year-old Caucasian male with past medical history of type 2 diabetes mellitus, hypertension, hyperlipidemia, and end-stage renal disease on hemodialysis is undergoing preoperative evaluation for colectomy for colon cancer. He had a synthetic graft placed for hemodialysis access 3 months ago, and the graft has been functioning normally since then. Physical examination is remarkable for a well-healed incision on the left arm and a vascular graft with good pulse and bruit. The rest of the physical examination is normal. Laboratory results do not show significant abnormalities. His medication list includes insulin, atorvastatin, aspirin, atenolol, lisinopril, and calcium acetate. Does this patient need antibiotic prophylaxis against vascular graft infection prior to colon surgery?

Discussion: Patients with recently placed synthetic vascular access grafts (< 1 year) should be prescribed antibiotic prophylaxis using standard endocarditis regimens even for minor procedures (eg, dental cleaning). Antibiotics prevent bacterial seeding of the grafts

before full epithelialization has taken place. Antibiotic infusion should be completed at least 1 hour prior to the start of surgery to achieve optimal peak tissue level during the procedure. It is important to remember to place a sign by the bedside to inform health care providers that blood draws and intravenous lines should be avoided on the side of a current or future hemodialysis access site.

Conclusion: Antibiotic prophylaxis is recommended up to 1 year after placement of a synthetic vascular graft.

19 Postoperative Risk of Acute Kidney Injury in Patients with Chronic Kidney Disease

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Case Presentation: A 76-year-old Caucasian male with past medical history of type 2 diabetes mellitus, chronic obstructive pulmonary disease (COPD), hypertension, and chronic kidney disease is diagnosed with severe triple-vessel coronary artery disease. He is scheduled to have coronary artery bypass graft (CABG) surgery next month and is referred for preoperative evaluation. Physical examination is unremarkable and laboratory results do not show any acute abnormalities. His serum creatinine has been in the range of 1.4 to 1.6 mg/dL for the last 2 years. The patient and his family are worried about worsening of his kidney function after the surgery. What is the risk that postoperative acute kidney injury (AKI) will develop in this patient with chronic kidney disease who will undergo CABG?

Discussion: Most clinical studies define postoperative AKI as an increase in serum creatinine of more than 25% to 50% from baseline values within 1 week after surgery. AKI requiring dialysis develops in 1% to 5% of patients after cardiac surgery, and is strongly associated with increased perioperative morbidity and mortality. A recent study by Thakar et al (2005) retrospectively evaluated more than 33,000 patients who underwent open heart surgery at Cleveland Clinic and provided good clinical evidence regarding risk factors for AKI. Risk factors for postoperative AKI after cardiac surgery included higher serum creatinine level (> 1.2 mg/dL), diabetes, COPD, previous cardiac surgery, markers of severe cardiovascular disease, and female gender, as well as intraoperative factors such as longer cardiopulmonary bypass time. Each risk factor was assigned a number of points, which were then computed to calculate a total score. The frequency of AKI among these categories varied from 0.4% for the lowest risk score to 22.1% for the highest score. Our patient has a 6-point score, which translates to 7.8% risk of developing AKI after surgery. This is higher than the usually reported frequency of postoperative ARF of less than 5%.

Conclusion: Identification of patients who are likely to develop AKI after surgery is important, as it enables physicians to improve patient care and to inform patients about their individual risk. Currently, a risk score for postoperative AKI has been developed only for cardiac surgery, and no sufficiently powered study has yet been completed in patients undergoing noncardiac surgery.

20 Preoperative Hypoglycemia in a Patient on Detemir Insulin

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Case Presentation: A 34-year-old type 2 diabetic female presented to the preoperative medical optimization clinic (PMOC) prior to gynecological surgery. She was on an insulin regimen of 55 units of detemir (Levemir) SQ in the morning and 5 units of glulisine (Apidra) SQ before meals. This had been recently changed from NovoLog 70/30, 30 units in the AM and 20 units in the PM. Physical exam was unremarkable. Weight was 98 kilograms and height was 160 centimeters (body mass index of 38). Serum glucose was 220 mg/dL.

Preoperative instructions were to take the usual dose of basal insulin on the morning of surgery, but none of the short-acting insulin.

On arrival in the surgical suite on the morning of surgery, the patient's blood glucose was 68 mg/dL. She was given D5W intravenously at a rate of 250 mL/hr. There was an initial increase of glucose to 156 mg/dL, but 3 hours later, glucose was 47 mg/dL. A bolus of 15 mL of dextrose 50% was given intravenously, but the glucose level only increased to 64 mg/dL. One hour later, it was again found to be low, at 46 mg/dL, and surgery was cancelled. Further dextrose infusion brought the glucose to 168 mg/dL.

Discussion: The benefits of perioperative glycemic control are well established. Preoperative admission is increasingly rare, so glycemic control must usually be provided on an outpatient basis with variations of the patient's usual insulin regimen. Basal insulins, including detemir, have become increasingly common, and while very effective in providing basal control, they can cause hypoglycemia if used incorrectly. In this case, the patient's basal insulin exceeded her basal insulin requirement. It had likely been inappropriately increased in an attempt to control elevated postprandial glucose levels, rather than using an adequate dose of the short-acting insulin for that purpose. The preoperative fast then precipitated prolonged hypoglycemia.

Conclusion: Although the use of traditional insulins may necessitate reductions in dose due to fasting prior to a surgical procedure, long-acting basal insulins are intended to provide glucose control in the absence of caloric intake. Therefore, while the dose should generally be maintained perioperatively, if long-acting insulin has been inappropriately used to provide postprandial glucose control, recalcitrant hypoglycemia may develop.

21 Evaluation of Mobitz I Atrioventricular Block in a Preoperative Patient

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Case Presentation: M.M., a 26-year-old athlete training for the Olympic trials in rowing, presented to a local emergency department with a complaint of right arm swelling. He was found to have a subclavian vein thrombosis that was treated with thrombolysis. Further evaluation revealed thoracic outlet syndrome. He was scheduled for first rib resection. An electrocardiogram (ECG) was obtained in the Center for Preoperative Evaluation (routine for all thoracic surgery patients per thoracic surgeons). The ECG revealed SR at a rate of 47 bpm. A second-degree atri-

oventricular (AV) block was present (Mobitz I).

Discussion: Mobitz I second-degree AV block (Wenckebach block) is characterized by an increasing prolongation of the PR interval that results in a single nonconducted P wave with no QRS complex generated. An episode of Mobitz I block consists of 3 to 5 beats and then the nonconducted beat. The block is usually in the AV node, and occasionally in the His-Purkinje system. The AV node is innervated by both sympathetic and parasympathetic fibers. Mobitz II AV block is characterized by constant PR and RR intervals with every second, third, or fourth P wave being nonconducted (2:1 block, 3:1 block, etc.) Mobitz II block is rarely seen in healthy young people; however, Mobitz I AV block can be seen in 2.4% of trained, fit athletes. The mechanism is the high vagal tone seen in trained athletes. Most of these individuals are asymptomatic. Mobitz I block is not associated with increased morbidity or mortality in the absence of organic heart disease, and there is no risk of progression to a Mobitz II AV block or complete heart block. By contrast, patients with Mobitz II AV block do carry a risk of progression to complete heart block. Often in the trained athlete, normal conduction occurs with activity as the heart rate increases and sympathetic tone is enhanced.

Conclusion: Mobitz I block (Wenckebach block) in an otherwise healthy, young, asymptomatic individual, particularly a highly trained athlete, is a benign condition. No further testing or laboratory data are required prior to planned surgery. In this case, the surgery went forward uneventfully and the patient recovered from the first rib resection without incident.

22 Perioperative Cardiac Arrest in a Patient with Aortic Stenosis: Is It Preventable?

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Case Presentation: A 73-year-old female presented to the hospital with femur fracture. She reported a history of hypertension and valve abnormality. She admitted to worsening dyspnea over the past several months but had not yet seen her doctor about it. She denied chest pain. Her medications were lisinopril and hydrochlorothiazide. On admission, her blood pressure was 116/68 mm Hg, heart rate was 92 bpm, and Hgb/Hct was 10.3/29.4 and stable. On exam, her lungs were clear, rhythm was regular with normal S_1 and S_2 and SEM 2/6, and she had 1+ edema in both legs. Her electrocardiogram revealed sinus rhythm with left bundle branch block and left ventricular hypertrophy.

She was scheduled for urgent surgery for repair of the femur fracture. In the operating room, she was agitated and was given midazolam 2 mg prior to arterial line placement. After the midazolam the patient became combative, and reversal with flumazenil was administered. The patient developed bradycardia followed by cardiopulmonary arrest and was placed on emergency cardiopulmonary bypass. An echocardiogram after the arrest revealed severe aortic stenosis with valve area less than 0.7 cm^2.

Discussion: Aortic stenosis is the most common valvular disease in the elderly. Management of these patients in the perioperative period requires understanding of the valvular disease and the hemodynamic alterations that result. In this patient undergoing urgent but not emergency surgery, based on the history and the physical examination, further evaluation was warranted and should have focused on the severity of the disease, myocardial function, and the presence of coronary artery disease and other organ system disease. The preoperative assessment should direct the timing of the planned surgery, the appropriate therapy, including medical optimization, and the need for preoperative surgical intervention as well as the perioperative monitoring and selection of anesthetic techniques.

Conclusion: The risks of noncardiac surgery in patients with aortic stenosis remain high despite advances in anesthetic techniques, and heightened awareness is needed in the perioperative management of these patients.

23 Antiplatelet Therapy Interruption and Perioperative Stent Thrombosis: Too Much, Too Early

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Case Presentation: A 53-year-old man with hypertension, hypercholesterolemia, and coronary artery disease (CAD) was scheduled for gastrectomy for gastric cancer. He had undergone placement of a tacrolimus drug-eluting stent (DES) after evaluation for chest pain 9 months prior and was placed on aspirin and clopidogrel. Seven months after the stent placement, the antiplatelet therapy was held for 10 days for diagnostic laparoscopy without complications. The patient held the aspirin and clopidogrel a week before the planned gastrectomy per instructions from the surgeon and, as the surgery was rescheduled, continued to hold them for 19 days. After an uncomplicated intraoperative course, on the first postoperative day, the patient developed electrocardiogram changes and cardiac enzyme elevation consistent with myocardial infarction (MI). Cardiac catheterization revealed occlusion of the DES.

Discussion: Stent thrombosis is a complication of DES and bare metal stents (BMS) with significant mortality. Delayed thrombosis is more prevalent with DES. Dual-antiplatelet therapy reduces the incidence of thrombosis, and the recommended duration of therapy for DES has been extended to 12 months. Premature interruption of antiplatelet therapy results in increased risk of stent thrombosis. The management of patients with CAD and indications for percutaneous coronary intervention in the perioperative period requires coordination between the surgeon and preoperative physician. In this case, unnecessarily prolonged interruption of antiplatelet agents should have been avoided and aspirin continuation considered.

Prior to placement of a stent, the potential need for surgical interventions in the next 12 months should be considered and, if such procedures are planned, a BMS may be preferable. Consideration should be given to completing health maintenance interventions prior to placement of a DES. Premature interruption of dual-antiplatelet therapy should be avoided, the duration of such interruption should be minimized, and therapy should be restarted promptly. A risk/benefit assessment of continuation of aspirin alone during the perioperative period should be done. Elective procedures should be postponed until the appropriate course of antiplatelet therapy has been completed.

Conclusion: Stent thrombosis is a catastrophic event that frequently leads to MI and/or death. A dual-antiplatelet regimen markedly reduces this complication, and interruption of the therapy in the perioperative period requires consideration of bleeding and thrombosis risks and coordination among all perioperative teams.

Research in Perioperative Medicine

24 Use of an At-Home Internet-Based Patient Evaluation Tool for Preoperative Assessment

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Background: Use of a computer interface by the patient at home before the preoperative assessment visit allows submission of information that streamlines the visit. Information could be incorporated into the preoperative surgical, anesthesia, and nursing assessments and confirmed by the provider during the visit or by phone. In this study, we examined the utility of such an Internet-based questionnaire. We identified demographics of individuals most likely to use such evaluations as well as what helpful elements could be collected.

Methods: From 2001 to 2005, patients scheduled for elective surgery at Brigham and Women's Hospital were given directions for completing an online questionnaire at home. All were informed of questionniare availability; completion was not mandatory. Patients answered 34 online questions, addressing specific medications and dosages, physicians and specialists, previous testing, medical history, and specific concerns. Questionnaires were submitted securely and accessed via a secure password by providers in the preoperative clinic. Other information obtained included the need for more patient education about the surgery and anesthesia. All information was available to the provider prior to the preoperative interview.

Results: A total of 3,003 patients completed the questionnaire, which was about 5% of all patients seen during the time period studied. Of the patients completing the questionnaire, 54.1% were between the ages of 40 and 59 years, 65% were female, 94% provided an e-mail address for contact, and 98% provided callback information. Over half the patients reported the name and contact information of at least one specialist. Over 63% noted previous electrocardiograms (ECGs), and 34.7% reported having an ECG done within the past year. Thirty-two percent reported having undergone cardiac testing other than ECGs, and 24% reported a previous history of anesthesia-related problems.

Conclusion: Significant information can be obtained with an at-home Internet-based patient assessment tool. Patients can fill out medication lists at home with access to their bottles. This can streamline the visit and assure accurate completion of JCAHO-required medicine reconciliation. Information about dates of previous ECGs, cardiac testing, and other testing allows providers to obtain these results prior to the visit, streamlining assessment and reducing unnecessary repetition. The provider also has access to specific patient concerns regarding the procedure and the need for more instruction in certain areas. Further development of such systems and incorporation into online assessments will greatly aid in achieving efficient and optimal assessment prior to surgical procedures.

25 The Utility of a Preoperative Clinic Questionnaire to Predict Postoperative Delirium Risk

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Background: Postoperative delirium (POD) has been associated with worse surgical outcomes, longer hospital stays, and decreased patient satisfaction. Preventive interventions may decrease the risk of developing POD. Identifying patients at risk for POD would allow interventions that may improve outcomes. We hypothesized that patient and family questionnaires could be easily administered during the preoperative visit in order to identify patients at risk for POD.

Methods: Patients 60 years or older having elective hip or shoulder arthroplasty were included at the time of the preoperative visit. Two questionnaires were completed, one by the patient and one by a family member or close acquaintance. Questions attempted to identify impairments in cognitive or functional status as well as previous history of POD. After surgery, each patient was evaluated postoperatively, hospital records were reviewed for signs of delirium, and interventions were noted.

Results: Of the 81 patients evaluated, 24 (29.6%) had delirium postoperatively. Those who developed delirium were significantly less likely to be discharged home versus a rehabilitation facility than those who did not develop delirium (29.7% vs 63.6%; $P < .005$). Average length of stay was 6.5 days for patients with POD as compared with 5.3 days for those without delirium ($P < .02$). Patients who had perfect scores on the questionnaires included 28 in the group without delirium compared with 2 in the group with POD, giving a negative predictive value of 93.3%. The positive predictive value was 43.1%. Patients who had 1 or more incorrect answers or a history of POD included 22/24 in the group with POD and 29/57 in the group without delirium ($P < .002$). This gave a sensitivity of 91.7% and a specificity of 49.3%.

Conclusion: An easy tool can be used to predict POD, and can be especially helpful for identifying patients who are not likely to develop delirium. This would be useful in planning postoperative care. While sensitive, the questionnaires had limited specificity, suggesting that although they could be used as an initial screening tool, further work-up would be needed to identify high-risk patients.

In conclusion, POD is attributable to multiple perioperative and medical factors with no single question or test being definitive in predicting delirium.

26 A Drug by Any Other Name: Preoperative Insulin Regimens

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Background: Insulin products were most often cited in errors that resulted in harm, according to the MEDMARX error reporting system. With the rapid proliferation of insulin medications, it is difficult to be familiar with the nuances of particular agents. Recognition of a drug and its anesthetic implications is critical. Confusion among various insulin regimens and unfamiliarity with their mechanisms of action add to the complexity of perioperative management of patients receiving insulin. Preoperative conversions of insulin regimens are complicated,

and changes in brand, type, and/or species source may necessitate a change in dosage.[1–3] Hypoglycemic reactions have been reported in patients who were switched from pork to human insulin.[3] Following subcutaneous administration, human insulin is absorbed more rapidly than pork insulin.[4] Some insulin preparations, such as isophane (typically annotated "N"), should never be administered intravenously. As part of a clinical trial investigating perioperative glycemic control, we recorded the insulin regimens of our patients.

Methods: The IRB approved this prospective observational study. Written informed consent was obtained from patients at the time of enrollment in the preoperative anesthesia clinic.

Results: Data from 409 patients were analyzed. More than 25 versions of insulin or insulin combinations were noted.

Conclusion: Newer insulins and combinations of insulins are being prescribed to manage diabetic patients. Unfamiliarity with insulins adds to the complexity of perioperative glycemic control, and may be a source of medication administration error or unwanted side effects. It may be difficult for caregivers to anticipate onset times, peak effects, or duration of action of the medications. Insulins with different durations have similar-sounding names. Lantus (long-acting) may be confused with Lente (intermediate-acting). Humulin U, Humulin R, Humulin N, Humulin 50/50, and Humulin 70/30 are rapid-acting, short-acting, intermediate, and combinations of the former in different ratios, respectively.

Tools such as a database of photographs, electronic access to outside pharmacy records 24/7, and instructing patients to bring their insulin vials with them on the day of surgery may allow for accurate identification of medications.

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27 Preoperative Cardiovascular Risk Factor Assessment in Morbidly Obese Patients with an Abnormal Electrocardiogram

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Background: Obesity is an increasing epidemiologic concern and an independent risk factor for cardiovascular disease. However, there are no data available for patients with morbid obesity (body mass index > 40). We sought to evaluate the common cardiovascular risk factors among these patient populations.

Methods: We assessed 101 consecutive morbidly obese patients with an abnormal electrocardiogram (ECG) who were referred to our center for cardiac clearance prior to weight-loss surgery. We collected the demographics and pertinent medical history. We also collected the available lipid profile from these patients. Patients with recent myocardial infarction were excluded from the study.

Results: There were a total of 1,132 weight-loss surgeries performed, from which 101 morbidly obese patients were analyzed. Of these 101 patients, 84.1% were female. The age distribution was 21 to 61 years, with a mean age of 37.5 years. The majority of patients had hypertension (57.4%), and a few had stable coronary artery disease (5.9%). Diabetes and smoking were seen in 29.7% and 22.7%, respectively. Normal sinus rhythm was seen in 98% of patients; 2% had atrial fibrillation. Poor (or reverse) R wave progression was seen in 53.4% of patients, whereas left anterior fascicular block was seen in 8%. Left axis deviation and left anterior fascicular block was seen in 18.8%. There were 96 lipid profiles available for the analysis, and they revealed the following:

- 64.6% of patients had total cholesterol > 200 mg/dL
- 94.8% of patients had LDL cholesterol > 100 mg/dL
- 54.1% of patients had triglycerides > 150 mg/dL
- 75.0% of patients had HDL cholesterol < 40 mg/dL.

The LDL:HDL ratio ranged from 0.67 to 5.81; 62.5% of the morbidly obese patients had an LDL:HDL ratio greater than 2.5.

Conclusion: Significant cardiovascular risk factors were identified in these morbidly obese patients, even though they were younger in age. Abnormal lipid profiles were seen in almost every patient. Interestingly, there was also an elevated number of left anterior fascicular blocks, which may postulate to early coronary artery disease.

28 Cardiac Testing Prior to Nonvascular Surgery: The Results from a Newly Formed Preoperative Clinic

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Background: Routine stress testing for risk assessment prior to vascular surgery has fallen out of favor in recent years, given aggressive beta-blockade. Recent studies suggest that drug-eluting coronary stents require uninterrupted dual-antiplatelet therapy. Stress testing in patients undergoing nonvascular surgery has not been similarly studied. The question we asked is whether it is helpful to routinely perform stress testing in nonvascular surgery patients per ACC/AHA guidelines and how often interventions are needed as a result of such testing.

Methods: A retrospective chart review was performed for all Pre-operative Evaluation Clinic (POEC) patients. Only higher than intermediate risk surgery patients requiring a cardiac test for risk assessment were included in the analysis. The cardiac tests included were Persantine 99m-Tc sestamibi tomoscintigraphy, dobutamine stress echocardiography, and treadmill stress testing, in addition to age- and disease-specific electrocardiograms. Consequent coronary angiographies and interventions were followed if such were performed.

Results: Since the POEC inception in July 2006, a total of 790 patients were seen, of whom 87 (11%) required a stress test. All 87 patients were older than 55 years of age; 2 were women. The **Table** gives a breakdown of these patients according to type of surgery. Thirteen (14.94%) of the 87 patients had a positive stress test. Coronary angiography was performed in all 4 patients (4.5%) who needed an intervention, resulting in an average

delay in surgery of 3 months. The resulting intervention was either percutaneous coronary intervention or coronary artery bypass grafting.

Conclusion: In patients undergoing nonvascular surgical procedures (with greater than intermediate risk), the incidence of positive cardiac tests was low and intervention was seldom needed. The average surgical delay in patients undergoing testing was 3 months. In the vascular surgery population, preoperative stress testing has been replaced by aggressive beta-blockade with no increase in postoperative cardiac complications. A similar strategy may be beneficial in the nonvascular surgical population. A similar study is warranted in this patient population.

TABLE
SURGICAL DEMOGRAPHICS OF PATIENTS REQUIRING A STRESS TEST

Type of surgery	No. of patients
Major orthopedic	37
General surgery	19
Urologic	12
Ear/nose/throat	5
Other	6
Neurosurgery	8

29 Which Is Better—Half-Dose or No Insulin on Day of Surgery?

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Background: Hyperglycemia is associated with adverse outcomes in intensive care units, after myocardial infarction and stroke. Elevated perioperative glucose levels are associated with cardiac, respiratory, and neurologic morbidity. Tight control of intraoperative glucose improves outcomes after CABG. Perioperative normoglycemia is difficult because of medications (catecholamines, steroids), stress response, acute illness, anesthetic masking of hypoglycemic symptoms, fasting, and outpatient surgery. The American College of Endocrinology targets a fasting glucose of 110 mg/dL and a maximum of 180 mg/dL in noncritically ill patients.[1] We attempted to determine the effects of insulin dosing.

Methods: After IRB approval, 265 type 2 diabetics prescribed chronic morning intermediate- or long-acting insulin were randomized to either half their usual dose or no insulin before arrival at the hospital for surgery. Patients took no short-acting insulin preparations the day of surgery. Glucose was determined upon hospital arrival. Glucose levels were compared using chi-square tests, Fisher's exact test, and logistic regression. Multivariate logistic models adjusted the treatment effect for age, sex, diabetes duration, Hgb_{A1c}, and time of day. Significant covariates ($P < .05$) were included if they modified the treatment effect. Analysis was conducted on an intent-to-treat basis, regardless of compliance with insulin instructions. The final analysis was done on 220 patients (45 patients had surgery cancelled or incomplete data).

Results: Patients taking half their morning insulin on the day of surgery had better preoperative glucose levels than patients taking no insulin **(Table)**. The strong association remained after adjustment for patient characteristics and time of day. A glucose level of 60 mg/dL or less occurred in 4 patients in the half-dose group; 1 patient had hypoglycemia before insulin and did not take insulin.

The odds of having a preoperative glucose level of 110 mg/dL or less were 3 times greater in the half-dose group than in the no-insulin group (OR [SE] = 2.97 [1.60, 5.52], $P < .001$), adjusted for age, gender, and diabetes duration. The OR for a glucose level of 180 mg/dL or less was 2.44 (SE = 1.25, 4.76) ($P = .009$).

Conclusion: Administering half the usual morning dose of intermediate- or long-acting insulin on the day of surgery improves glucose control with low risk of hypogylcemia. Insulin dosing on the day of surgery is a significant determinant of preoperative glucose.

1. *Garber AJ, Moghissi ES, Bransom ED Jr, et al. American College of Endocrinology position statement on inpatient diabetes and metabolic control. Endocr Pract 2004; 10:77–82.*

TABLE
PREOPERATIVE GLUCOSE LEVELS ACCORDING TO TREATMENT GROUP

Preoperative glucose	Treatment group: Half dose (n = 107)	Treatment group: No insulin (n = 113)	*P* value
< 60 mg/dL	4 (3.7%)	0 (0%)	.054
⩽ 110 mg/dL	44 (41%)	21 (19%)	< .001
⩽ 180 mg/dL	88 (82%)	75 (66%)	.007