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PROCEEDINGS OF THE 2ND ANNUAL CLEVELAND CLINIC PERIOPERATIVE MEDICINE SUMMIT

In Conjunction with the Society of Perioperative Assessment and Quality Improvement

PROGRAM • IMPACT CONSULTS • ABSTRACTS

SEPTEMBER 18–19, 2006, CLEVELAND, OHIO

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SUPPLEMENT

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Poster Abstracts

Innovations in Perioperative Medicine

Perioperative Clinical Vignettes

Research in Perioperative Medicine

From the supplement editors

Perioperative medicine is a unique discipline in that the medical care of the surgical patient is not "owned" by any one specialty. Nothing attests to this better than the event on which this supplement is based, the "2nd Annual Cleveland Clinic Perioperative Medicine Summit: Using Evidence to Improve Quality, Safety, and Patient Outcomes," being held in Cleveland on September 18 and 19, 2006. The Summit's speakers and attendees range from anesthesiologists to internists and hospitalists, from subspecialists to nurses.

As the nation's baby boomers age and begin to undergo more surgeries than ever before, our health care system is beginning to feel a burden from the medical care related to this surgical groundswell. It is forecast that the US health care system is likely to face crisis-level demand for perioperative care in the next 20 years.[1] For this reason we must prepare health care providers to better deal with the current burden and a possible future crisis.

This year, the Cleveland Clinic Perioperative Medicine Summit is being held in conjunction with the newly formed Society of Perioperative Assessment and Quality Improvement (SPAQI). The society's goal is to bring together professionals from various disciplines to work together on all facets of optimizing surgical outcomes. We welcome SPAQI members and Summit attendees to Cleveland.

In this special supplement you will find a complete listing of the Summit faculty and program as well as all the abstracts submitted and accepted to the 2006 Research, Innovations, and Clinical Vignette Competition. We have also included 11 peer-reviewed "IMPACT Consults" that provide answers to common clinical questions related to perioperative practice; these are on display as posters during the conference. This supplement is also available online at **www.ccjm.org/toc/2006periop.htm**.

We look forward to a great meeting.

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1. ***Mangano DT.*** *Perioperative medicine: NHLBI working group deliberations and recommendations. J Cardiothorac Vasc Anesth 2004; 18:1–6.*

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Summit Program

MONDAY, SEPTEMBER 18, 2006

Morning Session

7:00 AM **Registration/Continental Breakfast/Exhibits**
MBNA Conference Center Foyer—3rd Floor

7:45 AM **Welcome—***Amir K. Jaffer, MD, Franklin A. Michota, Jr., MD, Angela M. Bader, MD, Raymond Borkowski, MD*

8:00 AM **Improving Quality, Safety and Outcomes in Perioperative Medicine—***Reuven Pasternak, MD, MPH, MBA*

8:30 AM **Q&A Period**

8:45 AM **Cardiac Risk Stratification and Risk Reduction for Noncardiac Surgery in 2006—***Lee A. Fleisher, MD, FACC*

9:30 AM **Q&A Period**

9:45 AM **Refreshment Break/Exhibits**
View Cleveland Clinic IMPACT Consult Posters

10:15 AM **Nuances in Perioperative Beta-blocker Therapy for Noncardiac Surgery—***Don Poldermans, MD, PhD, FESC*

10:45 AM **Q&A Period**

11:00 AM **Preoperative Evaluation and Cost-effective Lab Testing—***David L. Hepner, MD*

11:30 AM **Q&A Period**

11:45 AM **Lunch & Presentation: Real Age and How it Impacts Perioperative Care—***Michael F. Roizen, MD*

12:30 PM **Q&A Period**

Afternoon Session

1:00 PM **Perioperative Genomics—***Debra Anne Schwinn, MD*

1:45 PM **Q&A Period**

2:00 PM **Perioperative Management of Warfarin—***Amir K. Jaffer, MD*

2:30 PM **Q&A Period**

2:45 PM **Refreshment Break/Exhibits**
View Cleveland Clinic IMPACT Consult Posters

3:15 PM **Prevention of Venous Thromboembolism After Surgery—***Franklin A. Michota, Jr., MD*

3:45 PM **Q&A Period**

4:00 PM **From Silos to Integrated Care: Improving Communication in the Perioperative Process—***Andrew Friedrich, MD, Margaret Pothier, CRNA*

4:30 PM **Q&A Period**

4:45 PM **Breakout Sessions**

A. Postoperative Fever—*James C. Pile, MD, FACP*

B. Developing and Implementing a Perioperative Program (Continued in Session II)—*Amir K. Jaffer, MD, Raymond Borkowski, MD, Sanjeev Suri, MD, Angela M. Bader, MD, Bobbie Jean Sweitzer, MD*

C. Perioperative Medication Management—*Christopher Whinney, MD*

5:15 PM **Breakout Sessions II**

D. Tools for Quality Improvement in Perioperative Medicine—*Eric D. Hixson, MBA, PhD-Cand, Robert Patrick, MD, MBA*

B. Developing and Implementing a Perioperative Program (Continuation of Session I)

E. Perioperative Management of the Opioid-Tolerant Patient—*Darin J. Correll, MD*

5:45 PM **Adjourn**

6:00 PM **Reception and Poster Session**

TUESDAY, SEPTEMBER 19, 2006

Morning Session

7:00 AM **Continental Breakfast/Exhibits**
MBNA Conference Center Foyer—3rd Floor

7:45 AM **Welcome—***Amir K. Jaffer, MD, Franklin A. Michota, Jr., MD, Angela M. Bader, MD, Raymond Borkowski, MD*

8:00 AM **Perioperative Management of Diabetes: Translating Evidence into Practice—***Byron Hoogwerf, MD*

8:30 AM **Q&A Period**

8:45 AM **Pulmonary Risk Stratification and Risk Reduction for Noncardiac Surgery—***Gerald Smetana, MD*

9:15 AM **Q&A Period**

9:30 AM **Perioperative Care of the Elderly—***Robert M. Palmer, MD*

10:00 AM **Q&A Period**

10:15 AM **Refreshment Break/Exhibits**
View Cleveland Clinic IMPACT Consult Posters

10:45 AM **Perioperative EKG Interpretation—***James Froehlich, MD*

11:15 AM **Perioperative Management of CHF and Aortic Stenosis—***Curtis M. Rimmerman, MD, MBA*

11:45 AM **Q&A Period**

Afternoon Session

12:00 PM **Lunch: Bring Your Questions and Meet the Experts**

1. Anticoagulation—*Amir K. Jaffer, MD, Franklin A. Michota, Jr., MD*

2. Quality Improvement—*Andrew D. Auerbach, MD, MPH, Brian Parker, MD*

3. Cardiac Risk Assessment and Reduction—*Steven L. Cohn, MD, FACP, Brian Harte, MD*

4. Anesthesia—*John E. Tetzlaff, MD, Angela M. Bader, MD*

5. Hospitalists—*Christopher Whinney, MD, Ajay Kumar, MD, Collin Kroen, MD*

1:00 PM **Minimizing Perioperative Complications in Patients With Renal Insufficiency—***Martin J. Schreiber, MD*

1:30 PM **Q&A Period**

1:45 PM **Anesthesia Techniques and Their Effects on Perioperative Management—***Brian Parker, MD*

2:15 PM **Q&A Period**

2:30 PM **Best Research Abstracts**
Moderator: Angela M. Bader, MD
3 abstracts (15 minutes each, including Q&A)

3:15 PM **Refreshment Break/Exhibits**

3:30 PM **Preventing and Treating Wound Infections—***Steven M. Gordon, MD*

4:00 PM **Q&A Period**

4:15 PM **Rheumatologic Issues in the Surgical Patient—***Brian F. Mandell, MD, PhD, FACR*

4:45 PM **Q&A Period**

5:00 PM **Concluding Remarks**

5:15 PM **Adjourn**

Q: Does elevated blood pressure at the time of surgery increase perioperative cardiac risk?

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A: Elevated blood pressure by itself has not been shown to increase the incidence of perioperative cardiac events, although conclusions depend on the specific outcomes measured. However, target-organ damage caused by chronic hypertension does confer increased cardiac risk.

Proceed when hypertension is mild or moderate

Current guidelines based on ample evidence indicate no benefit to delaying surgery in patients with mild or moderate hypertension (systolic blood pressure < 180 mm Hg and diastolic blood pressure < 110 mm Hg) without associated cardiovascular abnormalities.[1,2]

Outcomes less clear with severe hypertension

In contrast, scant evidence is available to guide the clinician on the proper course of action in patients who present with severe elevations in blood pressure at the time of surgery.

Prys-Roberts and colleagues in 1971 compared the development of ischemia on continuous electrocardiographic recording among treated and untreated hypertensive patients who presented for elective surgery, with normotensive patients serving as controls.[3] The 7 untreated hypertensive patients had a mean arterial pressure (MAP) of 129.5 mm Hg; the 9 treated patients had a MAP of 129.0 mm Hg. Myocardial ischemia was documented in 3 of 9 treated patients, 5 of 7 untreated patients, and none of the 15 control patients. No adverse cardiac events occurred in any group. Every patient who experienced ischemia had a 50% or greater decrease in MAP after induction of anesthesia. Although the study was observational in nature and included few patients, it represents the only such study to include patients with an extreme elevation of blood pressure.

Authors of larger studies in which hypertension was not identified as a predictor of cardiovascular complications acknowledged the lack of inclusion of patients with severe hypertension. In an evaluation of hypertensive patients with differing levels of blood pressure control who presented for surgery, Goldman and Caldera found that only five had diastolic blood pressure greater than 110 mm Hg.[4] In this study, no increase in the incidence of perioperative myocardial infarction or death was observed in any group regardless of treatment or blood pressure control.

Target-organ damage carries high risk

Hypertension is causally linked to occult and symptomatic coronary artery disease, heart failure, renal insufficiency, and cerebrovascular disease. These diseases place the patient at higher risk for adverse cardiac events, and constitute four of the six criteria for the Revised Cardiac Risk Index (RCRI), which is the current recommended tool for assessing perioperative cardiac risk.[5] Patients with longstanding uncontrolled hypertension, especially those with severe hypertension, are at greater risk for target-organ damage.

More controversial is the appropriate course in these patients with uncontrolled or severe hypertension. Guidelines recommend antihypertensive treatment, although no evidence suggests that treatment modifies cardiac risk. Also, it remains to be determined whether blood pressure control needs to be achieved over a period of weeks or if gaining control in the immediate preoperative period is sufficient.

Severe hypertension: Assess for target-organ damage

A reasonable strategy for managing patients with severe or uncontrolled hypertension therefore starts with an assessment of target-organ damage (Figure).[6] If the extent of target-organ damage is unknown or if an assessment cannot be performed before elective surgery, then surgery should be postponed until the cardiac risk can be determined. If a patient has one or more of the RCRI criteria, conventional wisdom is to treat with beta-blockade.[5] Again, the optimal timeframe for achieving control of blood pressure is not known. Whether treatment by itself (regardless of the achieved blood pressure) is adequate to reduce risk, or whether treatment must result in a blood pressure decline into the range defined as mild or moderate hypertension, is also not known.

Finally, if a patient has no evidence of end-organ damage and is otherwise fit, there is no evidence to suggest that surgery should be cancelled until better blood pressure control is obtained.

* Dr. Kroen reported that he has no commercial affiliations or financial interests that pose a potential conflict of interest with this article.

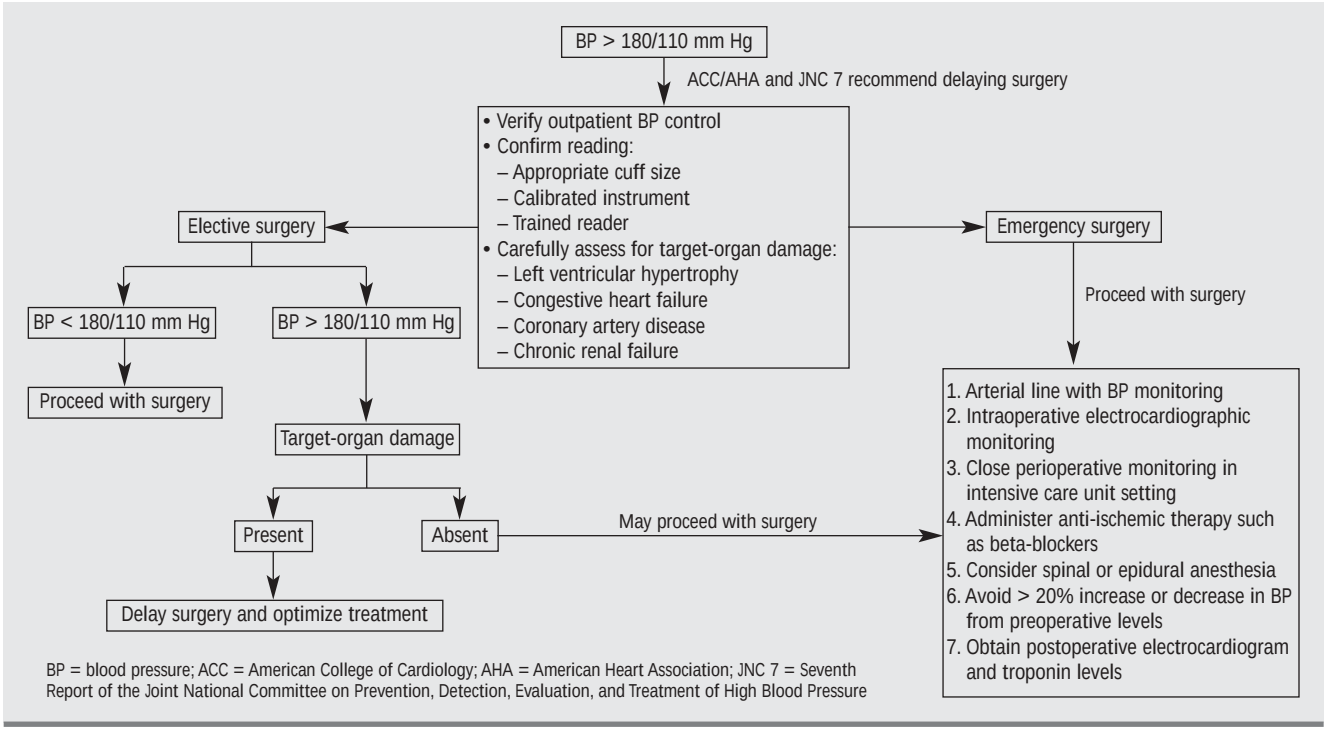

FIGURE. Proposed management of patients with uncontrolled hypertension before surgery. Reproduced with permission of John Wiley & Sons, Inc., from Shafi T. Perioperative management of hypertension. The Hospitalist. Copyright © 2006, The Society of Hospital Medicine.

Teamwork is essential

Close communication between the surgeon, anesthesiologist, and medical consultant is necessary to elaborate the need for close invasive arterial pressure monitoring, as well as aggressive treatment of blood pressure to prevent the precipitous drop in MAP that can lead to ischemia.

REFERENCES

1. Eagle KA, Berger PB, Calkins H, et al. ACC/AHA guideline update for perioperative cardiovascular evaluation for noncardiac surgery: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee to Update the 1996 Guidelines on Perioperative Cardiovascular Evaluation for Noncardiac Surgery). 2002. American College of Cardiology Web site. Available at: http://www.acc.org/clinical/guidelines/perio/dirIndex.htm.
2. Chobanian AV, Bakris GL, Black HR, et al. The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: the JNC 7 report. JAMA 2003; 289:2560–2572.
3. Prys-Roberts C, Meloch R, Foex P. Studies of anesthesia in relation to hypertension. I. Cardiovascular responses of treated and untreated patients. Br J Anaesth 1971; 43:122–137.
4. Goldman L, Caldera DL. Risks of general anesthesia and elective operation in the hypertensive patient. Anesthesiology 1979; 50:285–292.
5. Wesorick DH, Eagle KA. The preoperative cardiovascular evaluation of the intermediate-risk patient: new data, changing strategies. Am J Med 2005; 118:1413.e1–1413.e9.
6. Shafi T. Perioperative management of hypertension. The Hospitalist 2006; 10(Suppl):28–31.

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Q: When is it appropriate to stop antiplatelet therapy in a patient with a drug-eluting stent prior to noncardiac surgery?

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A: The US Food and Drug Administration recommends that combined antiplatelet therapy (aspirin plus clopidogrel) be continued for at least 3 months after placement of a sirolimus-eluting stent and at least 6 months after placement of a paclitaxel-eluting stent. Current guidelines from the American College of Cardiology/American Heart Association (ACC/AHA) and from the American College of Chest Physicians recommend 9 to 12 months of dual-antiplatelet therapy after placement of either stent. Multidisciplinary discussions are necessary if surgery is considered prior to completion of 1 year of combined antiplatelet therapy. Antiplatelet therapy must also be reinstituted as soon as possible after surgery in suitable patients.

Drug-eluting stents: Less restenosis, more late thrombosis

In the first decade of interventional cardiology practice (1977–1987), the restenosis rate at 6 months after balloon angioplasty was 32% to 40%.[1] This was in addition to a high acute closure rate that often required repeat interventions. This led to the introduction of bare-metal stents (BMS) in 1986, but the 6-month restenosis rate with these stents remained as high as 17% to 32%.[1]

Drug-eluting stents (DES) were designed to address the high rates of in-stent restenosis associated with BMS. DES, which now constitute about 90% of all stents placed in the United States, have reduced the restenosis rate to less than 10%.[1] However, late stent thrombosis, which occurs more than 30 days after stent placement, is thought to occur more frequently with DES than with BMS, and results in death or infarction in 60% of patients.[2]

Extended dual-antiplatelet therapy is recommended in patients with DES because of the delayed endothelial regeneration caused by drug elution within the stent's local environment. This creates a microenvironment conducive to platelet thrombus formation.

With adequate antiplatelet therapy, however, the rate of stent thrombosis is less than 1% with DES.[3] A pooled analysis of 10 randomized trials showed no difference in rates of stent thrombosis between DES and BMS when patients were on appropriate combined antiplatelet therapy.[3] Although another recent clinical trial found no significant difference in the incidence of late stent thrombosis between patients receiving DES or BMS, it did find higher rates of major adverse cardiovascular events with DES compared with BMS in the year following clopidogrel discontinuation and showed that late stent thrombosis occurred up to 18 months after stent placement.[4] A study of 2,006 patients who were followed for at least 1 year after stent placement found that late stent thromboses developed in patients on stable aspirin monotherapy while no thromboses occurred in patients on combined antiplatelet therapy.[5]

The recently modified ACC/AHA guidelines on percutaneous coronary intervention recommend 325 mg of aspirin and 75 mg of clopidogrel daily for at least 3 months following placement of a sirolimus-eluting stent and for at least 6 months following placement of a paclitaxel-eluting stent, followed by 75 to 162 mg of aspirin daily indefinitely.[1] These guidelines also recommend that, in the absence of excessive bleeding risks, clopidogrel 75 mg daily ideally be continued for 12 months following DES placement.

Limited data from noncardiac surgeries

In addition to the above issues, perioperative management also must take into account the "prothrombotic rebound" phenomenon upon stopping antiplatelet therapy (which has never been studied) as well as the prothrombotic state portended by the surgery itself. Noncardiac surgeries performed within 3 to 6 weeks of coronary artery stent placement were associated with an increased incidence of major adverse cardiovascular events.[6–9]

No published studies have addressed the issue of perioperative stent thrombosis in patients with DES undergoing noncardiac surgeries; the only study we know of that has done so is a retrospective analysis conducted at the Cleveland Clinic and presented in pre-

* All authors reported that they have no commercial affiliations or financial interests that pose a potential conflict of interest with this article.

liminary form.[10] The median time to surgery in this cohort of 114 patients was 236 days after DES placement. Eighty-eight patients (77%) had all antiplatelet agents discontinued prior to surgery. Aspirin and clopidogrel were both discontinued a median of 10 days before surgery. Clopidogrel was discontinued within 90 days of stenting in 13 patients and within 180 days of stenting in 35 patients. No patients died in this study. Two patients developed myocardial infarction (on postoperative days 3 and 7, respectively); neither of these patients had DES thrombosis by postoperative catheterization. One patient developed major bleeding.

While encouraging, these data alone are not sufficient to demonstrate that discontinuation of antiplatelet therapy in patients with DES is safe. Most patients in this study continued antiplatelet therapy for at least 4 months after stent placement. Also, the study's retrospective design and small size are major limiting factors.[10]

What should drive the decision?

Preoperative decisions about antiplatelet therapy in a patient with a DES are dictated by several factors, most importantly the date of stent implantation. Other factors are DES type, risk of postoperative bleeding, surgeon and surgical center experience, and possibly the technical details of stent deployment (eg, stent length, diameter, or underexpansion). Patient characteristics that suggest a higher risk of stent thrombosis include renal failure, diabetes, and a lower ejection fraction.[2,11] The risk of thrombosis after DES placement rises proportionally with the length of the stent and is also increased in patients undergoing treatment for in-stent restenosis and bifurcations.[3,11] Premature discontinuation of antiplatelet therapy is the most important predictor of stent thrombosis after DES implantation.[2]

Discussion with the surgeon to verify that continuing antiplatelet therapy is truly a significant risk for bleeding is imperative. Aspirin can be continued for coronary artery bypass graft and cataract surgeries, and most vascular surgeons are comfortable with continuing antiplatelet therapy perioperatively. Studies of perioperative bleeding in patients on antiplatelet therapy have yielded varied results and have been conducted mainly in cardiac surgery patients. Only a few studies address antiplatelet therapy and noncardiac surgery. One study of 40 consecutive patients reported 7 myocardial infarctions, 11 major bleeding episodes, and 8 deaths, with stent thrombosis accounting for most of the fatal events.[6] In another study of patients who had received stents within the prior year, antiplatelet therapy was not interrupted perioperatively or was interrupted only briefly; of the study's 103 patients, 46 suffered complications and 5 died.[9]

Despite uncertainties, some recommendations emerge

Several important recommendations can be drawn from the discussion above.

Coronary revascularization should be undertaken only if the patient's clinical characteristics dictate it, irrespective of the surgery. If revascularization is inevitable, consider BMS or optimized plain balloon angioplasty. There is no evidence that preoperative revascularization in an asymptomatic patient changes postoperative outcomes.[12]

All patients should be optimized with beta-blockade.[13] If surgery is required urgently, a multidisciplinary risk-benefit analysis should be done with the surgeon at the helm. Every effort should be made to continue dual-antiplatelet therapy if possible. If the surgical team has reservations about hemorrhagic risk and surgery is indicated, consider referral to a tertiary surgical center with more experience. A cardiologist should be an integral part of any decisions related to discontinuing antiplatelet therapy because high-risk patient and stent characteristics are best interpreted by a cardiologist. Wherever feasible, discontinuation of clopidogrel 5 days before surgery and aspirin 7 days before surgery appears reasonable, but this largely depends on the surgeon's preference. Multiple reports of very late stent thrombosis in patients with DES (> 1 year after placement) suggest that antiplatelet therapy must be reinstituted as soon as possible after surgery.

REFERENCES

1. Smith SC Jr, Feldman TE, Hirshfeld JW Jr, et al. ACC/AHA/SCAI 2005 guideline update for percutaneous coronary intervention—summary article: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. J Am Coll Cardiol 2006; 47:216–235.
2. Iakovou I, Schmidt T, Bonizzoni E, et al. Incidence, predictors, and outcome of thrombosis after successful implantation of drug-eluting stents. JAMA 2005; 293:2126–2130.
3. Moreno R, Fernandez C, Hernandez R, et al. Drug-eluting stent thrombosis: results from a pooled analysis including 10 randomized studies. J Am Coll Cardiol 2005; 45:954–959.
4. Pfisterer ME, Kaiser CA, Bader F, et al. Late clinical events related to late stent thrombosis after stopping clopidogrel: prospective randomized comparison between drug-eluting versus bare-metal stenting. Program and abstracts of the American College of Cardiology 55th Annual Scientific Session; March 11–14, 2006; Atlanta, GA. Abstract 422-11.
5. Ong AT, McFadden EP, Regar E, et al. Late angiographic stent thrombosis (LAST) events with drug-eluting stents. J Am Coll Cardiol 2005; 45:2088–2092.
6. Kaluza GL, Joseph J, Lee JR, et al. Catastrophic outcomes of noncardiac surgery soon after coronary stenting. J Am Coll Cardiol 2000; 35:1288–1294.
7. Wilson SH, Fasseas P, Orford JL, et al. Clinical outcome of patients undergoing non-cardiac surgery in the two months following coronary stenting. J Am Coll Cardiol 2003; 42:234–240.
8. Sharma AK, Ajani AA, Hamwi SH, et al. Major noncardiac surgery following coronary stenting: when is it safe to operate? Catheter Cardiovasc Interv 2004; 63:141–145.
9. Vicenzi MN, Meislitzer T, Heitzinger B, Halaj M, Fleisher LA, Metzler H. Coronary artery stenting and non-cardiac surgery—a

prospective outcome study. Br J Anaesth 2006; 96:686–693.
10. Bakhru M, Saber W, Brotman D, et al. Is discontinuation of antiplatelet therapy after 6 months safe in patients with drug-eluting stents undergoing noncardiac surgery? Oral abstract presented at 2nd Annual Perioperative Medicine Summit; Sept. 18–19, 2006; Cleveland, OH. Cleve Clin J Med 2006; 73(E-Suppl 1):S23.
11. Kuchulakanti PK, Chu WW, Torguson R, et al. Correlates and long-term outcomes of angiographically proven stent thrombosis with sirolimus- and paclitaxel-eluting stents. Circulation 2006; 113:1108–1113.
12. McFalls EO, Ward HB, Moritz TE, et al. Coronary-artery revascularization before elective major vascular surgery. N Engl J Med 2004; 351:2795–2804.
13. Auerbach A, Goldman L. Assessing and reducing the cardiac risk of noncardiac surgery. Circulation 2006; 113:1361–1376.

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Q: Should statins be discontinued preoperatively?

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A: Although discontinuation of 3-hydroxy 3-methylglutaryl coenzyme A reductase inhibitors (statins) preoperatively has largely become routine practice, recent literature indicates that this action may be inappropriate.

Historical reasons for statin interruption

The rationale for stopping statins preoperatively has been unclear. Statin manufacturers recommend discontinuing these agents a few days prior to elective major surgery, claiming the potential for major surgery to cause rhabdomyolysis in patients predisposed to renal failure. Apart from a small number of case reports, there is minimal evidence that statin therapy increases the risk of postoperative rhabdomyolysis. A retrospective cohort study of 981 consecutive patients undergoing major elective vascular surgery assessed the effect of statin exposure on the risk of myopathy.[1] In addition to no cases of rhabdomyolysis, there was no increased risk of myopathy in statin users.

Most research on statins in the perioperative setting has focused on their role in cardiovascular risk reduction. Well known for their powerful lipid-lowering role, statins also appear to prevent plaque rupture, optimize endothelial function, and provide anti-inflammatory effects. These effects are referred to as the "pleiotropic effect" of statins.[2] In contrast to these drugs' lipid-lowering effects, which take several weeks to months to occur, their pleiotropic effects are thought to take place within hours to days. It is likely one or more of the pleiotropic mechanisms that improves outcomes when statins are given in the setting of acute coronary syndromes.[3]

* Both authors reported that they have no commercial affiliations or financial interests that pose a potential conflict of interest with this article.

Clinical trial evidence: reduction in perioperative risk with statin continuation

The few clinical trials assessing perioperative statin use have evaluated patients undergoing major noncardiac surgery (largely vascular procedures) and the incidence of perioperative complications such as death, myocardial infarction (MI), and other ischemic events such as angina and stroke.[4–7] All trials assessing the association between statin exposure and reduction in perioperative complication rates have shown positive results, with adjusted risk reductions ranging from 30% to 78% in each study's primary end point.

The first trial to investigate statin use and perioperative risk reduction was a retrospective, case-control study of 2,816 patients undergoing vascular surgery.[4] It demonstrated a greater than fourfold reduced risk of perioperative mortality with statin use. A retrospective study using a large database of 780,591 patients evaluated whether lipid-lowering therapy was associated with reduced mortality in the setting of major noncardiac surgery.[5] Using propensity matching analysis, the authors found significantly less in-hospital mortality for patients receiving lipid-lowering therapy (odds ratio: 0.62; 95% CI, 0.58 to 0.67; $P < .001$).

The only prospective trial to date was a randomized, double-blind study of 100 patients undergoing elective vascular surgery.[7] Patients were randomized to atorvastatin 20 mg/day or placebo, with therapy starting a mean of 31 days before surgery and continuing for 45 days. The primary end point was a composite of death from cardiac causes, nonfatal MI, unstable angina, and ischemic stroke. At 6 months, a significant reduction in the primary end point was noted in the statin group ($P = .031$). Limitations of this single-center trial were its small sample size, a low event rate, and a broad composite end point.

Statin withdrawal may be risky

Although never studied directly, information would suggest that perioperative statin withdrawal in higher-

risk patients may be detrimental. Considering the proven benefits of these medications in the setting of myocardial ischemia, and recognizing that major surgery poses an increased risk for such an event, it may be prudent to have statin therapy continued during this time of potential need.

Given the current evidence, we recommend continuing statin therapy perioperatively for patients already receiving it. This recommendation includes taking the medication on the day of (or evening before) surgery to maximize the potential benefit. Future research is needed to address whether statin therapy should be initiated in high-risk patients as a means of decreasing perioperative cardiovascular risk.

REFERENCES

1. Schouten O, Kertai MD, Bax JJ, et al. Safety of perioperative statin use in high-risk patients undergoing major vascular surgery. Am J Cardiol 2005; 95:658–660.
2. Farmer JA. Pleiotropic effect of statins. Curr Atheroscler Rep 2000; 2:208–217.
3. Cannon CP, Braunwald E, McCabe CH, et al. Intensive versus moderate lipid lowering with statins after acute coronary syndromes. N Engl J Med 2004; 350:1495–1504.
4. Poldermans D, Bax JJ, Kertai MD, et al. Statins are associated with a reduced incidence of perioperative mortality in patients undergoing major noncardiac vascular surgery. Circulation 2003; 107:1848–1851.
5. Lindenauer PK, Pekow P, Wang K, Gutierrez B, Benjamin EM. Lipid-lowering therapy and in-hospital mortality following major noncardiac surgery. JAMA 2004; 291:2092–2099.
6. O'Neil-Callahan K, Katsimaglis G, Tepper MR, et al. Statins decrease perioperative cardiac complications in patients undergoing noncardiac vascular surgery. J Am Coll Cardiol 2005; 45:336–342.
7. Durazzo AE, Machado FS, Ikeoka DT, et al. Reduction in cardiovascular events after vascular surgery with atorvastatin: a randomized trial. J Vasc Surg 2004; 39:967–976.

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Q: What is the appropriate means of perioperative risk assessment for patients with cirrhosis?

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A: There are no prospective data to answer this question definitively, but the body of available evidence suggests that the model for end-stage liver disease (MELD) score offers the most prognostic information.

Data are from small, retrospective studies

Although only a small minority of patients undergoing surgery suffers from cirrhosis, patients with clinically significant chronic liver disease do have a higher rate of perioperative morbidity and mortality than the general population, due to an excess of bleeding episodes, infection, encephalopathy, and renal failure, among other causes.[1] Complications of chronic liver disease, including gastrointestinal bleeding, ascites, and thrombocytopenia, also may worsen outcomes.

Intuitively, more advanced liver disease should be accompanied by worse perioperative outcomes. While multiple studies have found this to be true, the available data are from small, retrospective studies with heterogeneous populations, and thus offer limited data from which to extrapolate.

* Dr. Harte reported that he has no commercial affiliations or financial interests that pose a potential conflict of interest with this article.

Two common scoring schemes

Two commonly used clinical scoring schemes have both been found to correlate with postoperative mortality.

The Child-Turcotte-Pugh (CTP) classification categorizes patients into three groups (A, B, and C) based on points assigned according to five clinical and laboratory measures (Table). Multiple studies have shown the CTP classification to correlate with perioperative mortality. A retrospective study from 1984 reported postoperative mortality rates of 10%, 31%, and 76% among patients in classes A, B, and C, respectively, after various abdominal surgeries.[2] A 1997 study of 92 patients yielded similar results,[3] leading to a general conclusion that surgery is reasonably safe for patients in CTP class A and all but contraindicated for patients in class C. Class B constitutes a group of patients at substantially increased risk of mortality.

The CTP scheme has a number of limitations, however. Most notably, it is derived from clinical experience, it is subject to "floor" and "ceiling" effects (values at one extreme of a range are grouped with values at the other extreme), and it uses subjective criteria (ascites and encephalopathy).

The MELD score was developed to predict mortality in patients with chronic liver disease undergoing transjugular intrahepatic portosystemic shunting,

TABLE
Child-Turcotte-Pugh scoring system and classification

Scoring system	**1 Point**	**2 Points**	**3 Points**
Ascites	Absent	Slight	Moderate
Encephalopathy	None	Grade I/II	Grade III/IV
Bilirubin	1–2 mg/dL	2–3 mg/dL	> 3 mg/dL
Prothrombin time	1–4 s > control	4–6 s > control	> 6 s > control
Albumin	> 3.5 g/dL	2.8–3.5 g/dL	< 2.8 g/dL

Classification

Class A: 5–6 points Class B: 7–9 points Class C: 10–15 points

but it has since been found to have predictive value in other clinical settings. The score relies solely on objective measurements—creatinine, bilirubin, and the international normalized ratio—but its formula is cumbersome (Figure). Fortunately, online MELD score calculators (such as www.unos.org/resources/MeldPeldCalculator.asp?index=98) obviate the need to perform the calculations.

A number of studies have examined the predictive value of the MELD score in the perioperative setting, although these studies have been small and retrospective. The largest assessed 131 patients who underwent 140 inpatient procedures, including 67 intra-abdominal and 29 orthopedic surgeries.[4] Fifty-nine of the surgeries were considered "nonelective." Mortality at postoperative day 30 was correlated with MELD score and was higher in general surgical patients than in the cohort as a whole. The authors presented a "rule of thumb" in which each 1-point increase in the MELD score up to 20 points is associated with a 1% increase in mortality, and each 1-point increase beyond 20 points is associated with a 2% mortality increase.

This study looked at the MELD score upon admission; no study has assessed whether intervening upon the individual components of the MELD score to improve the score changes surgical outcomes.

Another retrospective study (N = 53) concluded that patients with a MELD score greater than 14 have substantially poorer outcomes after abdominal surgery than do patients with lower scores.[5] However, the small numbers of patients in studies such as this result in wide confidence intervals for the outcomes.

MELD score vs CTP classification

A number of studies have compared the MELD score with the CTP classification. However, accurate retrospective calculation of the CTP score is probably very difficult, and comparisons based on such calculations may be imprecise. A higher score in both scoring systems is accompanied by excess and increasing mortality, but because the MELD score is based on objective data and provides a more continuous assessment of liver disease, it may be a superior method of risk stratification.

$$\text{MELD score} = 3.78 \times \log_e(\text{bilirubin in mg/dL}) + 11.2 \times \log_e(\text{international normalized ratio}) + 9.57 \times \log_e(\text{creatinine in mg/dL}) + 6.43$$

Round to nearest integer; bilirubin or creatinine < 1.0 mg/dL is rounded to 1.0; creatinine > 4.0 mg/dL is rounded down to 4.0.

Calculators for this formula are available online (see text).

FIGURE. Formula for calculating the model for end-stage liver disease (MELD) score.

Factors beyond scoring systems also matter

The likelihood of complications is also affected by nonclinical factors. Emergent operations, abdominal surgeries, certain types of anesthesia, and biliary obstruction all increase patient risk, while laparoscopy is associated with lower risk. Appropriate measures should also be taken to optimize the patient's status before surgery, although little evidence exists to suggest that the postoperative course is improved by interventions such as paracentesis or plasma transfusion. Furthermore, while cirrhosis may be a patient's most prominent clinical issue, clinicians must not overlook the possibility of heart disease, lung disease, or other comorbidities that would independently alter the patient's risk profile.

REFERENCES

1. Friedman LS, Maddrey WC. Surgery in the patient with liver disease. Med Clin North Am 1987; 71:453.
2. Garrison RN, Cryer HM, Howard DA, Polk HC Jr. Clarification of risk factors for abdominal operations in patients with hepatic cirrhosis. Ann Surg 1984; 199:648–655.
3. Mansour A, Watson W, Shayani V, Pickleman J. Abdominal operations in patients with cirrhosis: still a major surgical challenge. Surgery 1997; 122:730–735.
4. Northup PG, Wanamaker RC, Lee VD, Adams RB, Berg CL. Model for end-stage liver disease (MELD) predicts nontransplant surgical mortality in patients with cirrhosis. Ann Surg 2005; 242:244–251.
5. Befeler AS, Palmer DE, Hoffman M, et al. The safety of intra-abdominal surgery in patients with cirrhosis: model for end-stage liver disease score is superior to Child-Turcotte-Pugh classification in predicting outcome. Arch Surg 2005; 140:650–655.

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Q: Who is at risk for developing acute renal failure after surgery?

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A: Patients who are at risk of developing acute renal failure (ARF) after cardiac surgery are usually older than 65 years of age; have diabetes, underlying renal disease, or cardiovascular disease; and have undergone recent coronary angiography or other procedures requiring intravenous contrast.

Perioperative ARF has clinical consequences

In most clinical studies, ARF has been defined as a greater than 25% to 50% increase in serum creatinine from baseline within 1 week after surgery. Monitoring serum creatinine is the most commonly used method to observe changes in renal function perioperatively. Unfortunately, an elevated creatinine level is a late indicator of renal injury, and even a minor increase should be regarded as clinically important and followed closely.[1]

ARF requiring dialysis develops in 1% to 5% of patients after cardiac surgery, and is strongly associated with perioperative morbidity and mortality.[2] A prospective multicenter trial of patients who had myocardial revascularization found that mortality in patients with renal dysfunction not requiring dialysis was 19%, compared with 63% in those who needed dialysis.[3] In patients without renal dysfunction after cardiac surgery, mortality was 0.9%.[3] Postoperative ARF also confers an increased risk of mortality in follow-up more than 5 years after cardiac surgery.[4] Only about 15% of patients who develop ARF at the time of cardiac surgery fully recover.[1]

ARF risk score developed for open-heart surgery

A recent retrospective study of more than 33,000 patients who underwent open-heart surgery at the Cleveland Clinic offers the first solid evidence of risk factors for ARF.[5] About 70% of the study population was male, and 89% was Caucasian. The primary outcome was ARF that required dialysis during the postoperative period. A risk score was derived to calculate the risk for developing ARF (Table).

TABLE
Risk factors and risk score for acute renal failure after cardiac surgery

Risk factor	Points
Female gender	1
Congestive heart failure	1
Left ventricular ejection fraction < 35%	1
Preoperative use of IABP	2
Chronic obstructive pulmonary disease	1
Insulin-requiring diabetes	1
Previous cardiac surgery	1
Emergency surgery	2
Valve surgery only (reference to CABG)	1
CABG + valve (reference to CABG)	2
Other cardiac surgeries	2
Preoperative creatinine 1.2 to < 2.1 mg/dL	2
Preoperative creatinine ≥ 2.1 mg/dL	5

Calculated risk score	Risk of acute renal failure requiring dialysis
0–2 points	0.4%
3–5 points	1.8%
6–8 points	7.8%
9–13 points	21.5%

IABP = intra-aortic balloon pump; CABG = coronary artery bypass graft surgery
Reprinted, with permission, from reference 5.

Patient-specific risk factors for ARF after cardiac surgery included higher serum creatinine level (> 1.2 mg/dL), diabetes, chronic obstructive pulmonary disease, previous cardiac surgery, markers of severe cardiovascular disease, and female gender. The major intraoperative factor was longer cardiopulmonary bypass time. Age, weight, race, peripheral vascular disease, and cerebrovascular disease were excluded from the scoring model on the basis of the statistical analysis done by the authors.

Each risk factor was assigned a number of points, and the points were then computed to calculate a total score (Table). The risk for developing ARF was directly related to the number of risk factors. The risk

* All authors reported that they have no commercial affiliations or financial interests that pose a potential conflict of interest with this article.

score ranged from 0 to 17 points. Four risk categories of increasing severity (scores 0 to 2, 3 to 5, 6 to 8, and 9 to 13) were determined arbitrarily by the authors. The frequency of ARF among these categories varied between 0.4% for the lowest risk score to 21.5% for the highest score.

This study involved a large cohort of patients, sufficient to generate and validate a postoperative ARF score that incorporated multiple independent risk factors. Limitations included the single-center data source and the retrospective observational design. Nevertheless, the study provided a valuable tool for both determining the risk of ARF for individual patients and planning future clinical trials.

Clinical score needed for noncardiac surgery

Currently, a risk score for ARF has only been developed for patients who have had cardiac surgery; no sufficiently powered study has yet been done for those undergoing noncardiac surgery. The Section of Hospital Medicine and the Department of Nephrology and Hypertension at the Cleveland Clinic are currently conducting a large retrospective cohort study in patients undergoing elective noncardiac surgery.

Importance of identifying patients at risk

Identification of patients likely to develop ARF after surgery is important, as it enables physicians to improve care and to inform patients about their individual risk. Future intervention-based trials can be conceived to target high-risk populations to decrease length of stay, morbidity, and mortality.

REFERENCES

1. Schreiber MJ Jr. Minimizing perioperative complications in patients with renal insufficiency. Cleve Clin J Med 2006; 73(Suppl 1):S116–S120.
2. Chertow GM, Lazarus JM, Christiansen CL, et al. Preoperative renal risk stratification. Circulation 1997; 95:878–884.
3. Mangano CM, Diamondstone LS, Ramsay JG, Aggarwal A, Herskowitz A, Mangano DT. Renal dysfunction after myocardial revascularization: risk factors, adverse outcomes, and hospital resource utilization. Ann Intern Med 1998; 128:194–203.
4. Loef BG, Epema AH, Smilde TD, et al. Immediate postoperative renal function deterioration in cardiac surgical patients predicts in-hospital mortality and long-term survival. J Am Soc Nephrol 2005; 16:195–200.
5. Thakar CV, Arrigain S, Worley S, Yared J-P, Paganini EP. A clinical score to predict acute renal failure after cardiac surgery. J Am Soc Nephrol 2005; 16:162–168.

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Q: Why treat anemia in the preoperative period of joint replacement surgery with erythropoietin?

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A: Recombinant human erythropoietin (epoetin alfa) is an effective therapy approved by the US Food and Drug Administration (FDA) to treat preoperative anemia in patients undergoing knee or hip replacement surgery.

Anemia is linked to poor outcomes

Anemia in the preoperative period is a known predictor of adverse outcomes in surgical patients. Carson et al[1] studied 125 consecutive patients who declined blood transfusions and found that operative mortality was 16 times greater in patients with hemoglobin levels less than 8 mg/dL than in patients with higher hemoglobin levels. Other studies suggest that it is not the anemia itself that is associated with increased mortality, but the practice of treating anemia with blood transfusions.[2]

Blood transfusion used most often, alternatives needed

Allogenic blood transfusion is the most commonly used technique in the United States to correct perioperative anemia. Although several methods are available to reduce the need for blood transfusion, the use of allogenic blood remains very high; for example, 47,456 units of blood products were used in the perioperative period of various orthopedic surgeries at the Cleveland Clinic in 2004.

In the next decade, with the aging of the population, the number of major joint replacements to be performed annually will increase, likely leading to an

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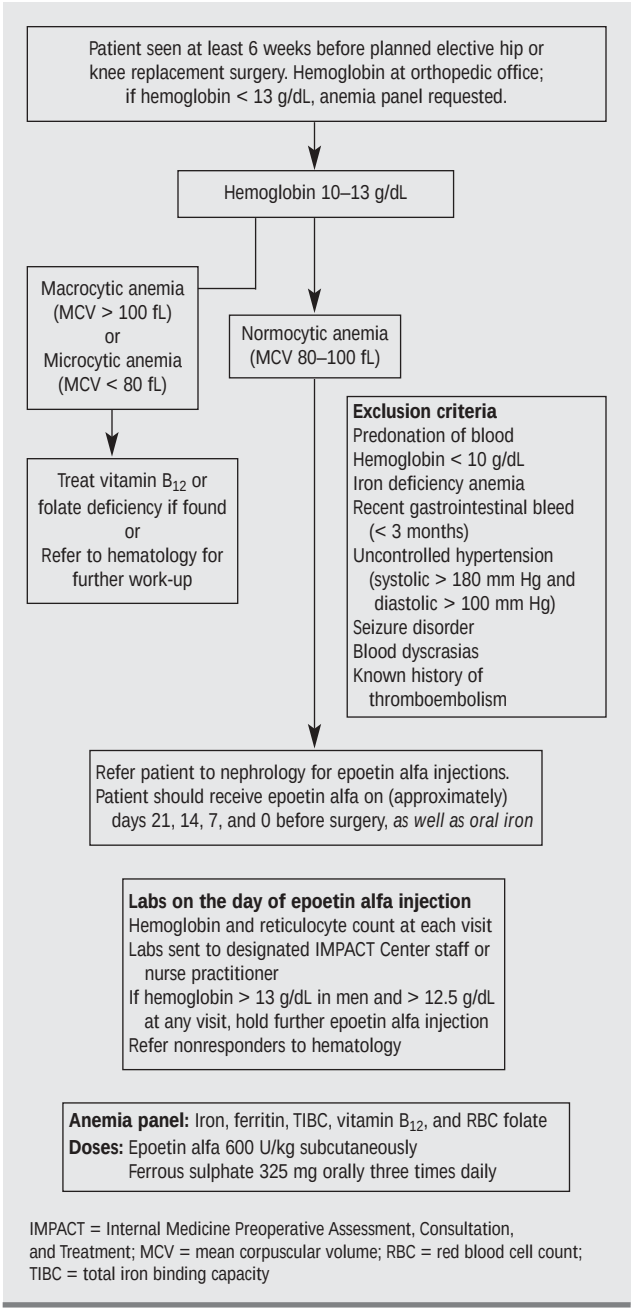

FIGURE. Protocol for management of preoperative anemia at the Cleveland Clinic.

increase in the demand for blood products. Due to the fluctuating supply and the costs and risks associated with the administration of blood products, searching for potential alternatives to transfusions is imperative.

Because blood loss associated with orthopedic surgery is predictable, the application of a carefully designed blood management program is appropriate. However, the usefulness of autologous donations and cell saver machines is limited by incomplete utilization of predonated blood and high cost. Furthermore, allogenic blood transfusions carry certain risks, in particular ABO incompatibility caused by administrative error and transfusion-related lung injuries.[3] Exposure to leukocytes in allogenic blood can also cause immunosuppression.[4] In a large prospective study of 6,301 patients undergoing noncardiac surgery, Dunne et al[5] concluded that the incidence of perioperative anemia in surgical patients is high and is related to an increase in blood utilization. These factors are associated with an increased risk for perioperative infection and other adverse outcomes (including death) in surgical patients.

In a large study by Bierbaum et al,[6] blood management data were collected prospectively on patients who had undergone total hip replacement and knee replacement. Fifty-seven percent of the patients undergoing hip replacement and 39% of the patients undergoing knee replacement received blood transfusions. Patients who were transfused were more likely to have infections, fluid overload, and an increased length of hospitalization compared with patients who did not receive transfusions. The Orthopedic Surgery Transfusion Hemoglobin European Overview study from 225 centers in Europe produced similar results.[7] In this study, allogenic transfusion was associated with a higher rate of wound infection than autologous transfusion (4.2% vs 1%, respectively).

Treatment of anemia and blood conservation

Treatment of perioperative anemia has been shown to decrease the need for transfusion and to improve perioperative outcomes such as postoperative infections, length of stay, and mortality in patients undergoing joint replacement surgery. The efficacy of preoperative erythropoietin therapy for increasing patients' hemoglobin concentrations and reducing exposure to allogenic red blood cell transfusion in orthopedic surgery has been demonstrated in several double-blind randomized clinical trials.[8–11] Synthetic erythropoietin was approved by the FDA and has been used for almost 9 years in orthopedic surgeries as a method to improve hemoglobin levels in anemic patients undergoing surgery, and thus to decrease blood transfusions. Several centers in the United States have adopted this novel therapy to reduce the use of blood transfusions.

At the Cleveland Clinic, patients selected for a blood conservation protocol (Figure) with erythropoietin are eligible for four subcutaneous injections of epoetin alfa (600 U/kg) at days 21, 14, and 7 before surgery and on the day of surgery. Exclusion criteria for preop-

erative erythropoietin treatment are hemoglobin of less than 10 g/dL, iron deficiency anemia, recent gastrointestinal bleed (within 3 months), uncontrolled hypertension, seizure disorder, predonation of blood, blood dyscrasias, and history of thromboembolism.

Reticulocyte count, hemoglobin, and blood pressure should be checked prior to each injection. Iron deficiency may occur during erythropoietin therapy. Normal ferritin but low transferrin saturation may be observed due to an inability to mobilize iron stores rapidly enough to keep pace with the increased erythropoiesis. Supplemental oral or intravenous iron supports erythropoiesis and prevents iron store depletion.

Summary

Treatment of anemia in the perioperative period of major orthopedic surgery decreases the need for blood transfusion and improves perioperative outcomes. Use of epoetin alfa in this setting is FDA-approved and provides significant benefit to qualified and carefully chosen patients.

REFERENCES

1. Carson JL, Poses RM, Spence RK, et al. Severity of anemia and operative mortality and morbidity. Lancet 1988; 1:727–729.
2. Benoist S, Panis Y, Pannegeon V, Alves A, Valleur P. Predictive factors for perioperative blood transfusions in rectal resection for cancer: a multivariate analysis of a group of 212 patients. Surgery 2001; 129:433–439.
3. Goodnough LT. Risks of blood transfusion. Anesthesiol Clin North America 2005; 23:241–252.
4. Goodnough LT, Brecher ME, Kanter MH, AuBuchon JP. Transfusion medicine. First of two parts—blood transfusion. N Engl J Med 1999; 340:438–447.
5. Dunne JR, Malone D, Tracy JK, et al. Perioperative anemia: an independent risk factor for infection, mortality, and resource utilization in surgery. J Surg Res 2002; 102:237–244.
6. Bierbaum BE, Callaghan JJ, Galante JO, et al. An analysis of blood management in patients having a total hip or knee arthroplasty. J Bone Joint Surg Am 1999; 81:2–10.
7. Rosencher N, Kerkkamp HE, Macheras G, et al. Orthopedic Surgery Transfusion Hemoglobin European Overview (OSTHEO) study: blood management in elective knee and hip arthroplasty in Europe. Transfusion 2003; 43:459–469.
8. de Andrade JR, Jove M, Landon G, et al. Baseline hemoglobin as a predictor of risk of transfusion and response to epoetin alfa in orthopedic surgery patients. Am J Orthop 1996; 25:533–542.
9. Goldberg MA, McCutchen JW, Jove M, et al. A safety and efficacy comparison study of two dosing regimens of epoetin alfa in patients undergoing major orthopedic surgery. Am J Orthop 1996; 25:544–552.
10. Faris PM, Ritter MA, Abels RI. The effects of recombinant human erythropoietin on perioperative transfusion requirements in patients having a major orthopaedic operation. The American Erythropoietin Study Group. J Bone Joint Surg Am 1996; 78:62–72.
11. Laupacis A, Fergusson D. Erythropoietin to minimize perioperative blood transfusion: a systematic review of randomized trials. The International Study of Perioperative Transfusion (ISPOT) Investigators. Transfus Med 1998; 8:309–317.

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Q: Obstructive sleep apnea: What to do in the surgical patient?

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A: Adverse surgical outcomes appear to be more frequent in patients with known obstructive sleep apnea syndrome (OSAS). Anesthetic, sedative, and analgesic drugs should be used with extreme caution in patients with known or suspected OSAS, and close perioperative monitoring of high-risk patients is recommended.

Epidemiology

In Western countries, the prevalence of OSAS is about 5%.[1] The estimated prevalence in surgical patients is 1% to 9%, though it may be even more common in certain populations.[2]

Disruption of sleep architecture

Sleep studies in patients who undergo major abdominal or cardiac surgery have demonstrated suppression of rapid eye movement (REM) sleep and slow-wave sleep after surgery. The REM sleep returns or rebounds in the late postoperative period (when oxygen may have been discontinued). This return of REM sleep was linked to significant respiratory abnormalities in a group of elderly patients who underwent abdominal vascular surgery.[3] In REM sleep, the neural drive to the pharyngeal muscles is at a minimum, and the atonia of antigravity muscles predisposes to airway instability, causing episodic hypoxemias. Reductions in REM and slow-wave sleep

* Both authors reported that they have no commercial affiliations or financial interests that pose a potential conflict of interest with this article.

and the lack of inherent rhythmicity are more pronounced after major surgery than after minor surgery and laparoscopic surgery.

Sedatives, analgesics, and the residual effects of anesthetic agents may worsen OSAS by decreasing pharyngeal tone, thereby increasing upper airway resistance and attenuating the ventilatory and arousal responses to hypoxia, hypercarbia, and obstruction.

In a study of patients who underwent hip and knee replacement, up to one third with OSAS developed substantial respiratory or cardiac complications, including arrhythmias, myocardial ischemia, unplanned transfers to the intensive care unit (ICU), and reintubation.[4] In another small prospective study evaluating the incidence of arrhythmias in patients with OSAS who underwent coronary artery bypass graft surgery, those with an oxygen desaturation index of 5 or greater (defined as the number of desaturations > 4% per hour) had a relative risk of 2.8 for the development of atrial fibrillation postoperatively.[5]

Preoperative assessment

Physical examination may reveal characteristic stigmata of OSAS, which include:

- A short, thick neck
- Nasal obstruction
- Tonsillar hypertrophy
- A narrow oropharynx that precludes visualization of the soft palate
- Retrognathia
- Obesity.

In patients with these characteristics and a history of daytime somnolence, snoring, or observed apneas, a presumptive diagnosis of OSAS can be made in the absence of a sleep study. Because the severity of these historical items correlates with the severity of sleep study-proven OSAS, use of a simple screening questionnaire for OSAS appears reasonable. None, however, have been validated for use in the preoperative setting.

Clinical suspicion for sleep apnea may first arise intraoperatively. The degree of difficulty in visualizing the faucial pillars, the soft palate, and the base of the uvula predicts difficulty with intubation and should increase the suspicion of OSAS.[6] Airway obstruction out of proportion to the apparent degree of sedation, and a pronounced tendency for upper airway obstruction during or upon recovery from anesthesia, can suggest undiagnosed sleep apnea as well.

Perioperative monitoring and interventions

Continued inpatient monitoring is advised for the following types of patients with OSAS: those having abdominal or other major surgery, those with significant expected pain or opioid requirements, those with severe OSAS (requiring continuous positive airway pressure [CPAP] at home) at baseline, and those with observed obstruction or episodic desaturations in the recovery room.[7]

Routine ICU admission after surgery may not be necessary except in patients with coexisting cardiopulmonary disease or a difficult airway. Patients at increased perioperative risk from OSAS should be extubated while awake and after full reversal of neuromuscular blockade is verified.

Benzodiazepines should be avoided altogether and narcotic use should be limited. Alternative forms of analgesia, such as nonsteroidal anti-inflammatory drugs, nerve blocks, or local analgesics, should be considered. If narcotics are required for pain control, patients should be in a monitored setting. Patient-controlled analgesia with no basal rate may help limit dosing.

General anesthesia with a secure airway is preferable to deep sedation without a secure airway, particularly for procedures that may compromise the airway mechanically. Respiratory arrest has been reported in patients with OSAS receiving epidural opioids at 2 to 3 days postoperatively.[8] If neuraxial analgesia is planned, local anesthetics alone should be preferred over opioids in combination. Case series and limited data suggest that the use of CPAP in the perioperative setting for known cases of OSAS may help reduce postoperative complications.

Until additional information is available to guide decision making, screening for OSAS should be incorporated as part of the preoperative assessment of patients undergoing surgery.

REFERENCES

1. Young T, Peppard P, Gottlieb D. Epidemiology of obstructive sleep apnea: a population health perspective. Am J Respir Crit Care Med 2002; 165:1217–1239.
2. Auckley DH, Steinel J, Southwell C, Mustafa M. Does screening for sleep apnea with the Berlin Questionnaire predict elective surgery postoperative complications? Sleep 2003; 26(Suppl): A238–A239. Abstract 0596.J.
3. Reeder MK, Goldman MD, Loh L, Muir AD, Casey KR, Lehane JR. Late postoperative nocturnal dips in oxygen saturation in patients undergoing major abdominal vascular surgery: predictive value of pre-operative overnight pulse oximetry. Anaesthesia 1992; 47:110–115.
4. Gupta R, Parvizi J, Hanssen A, et al. Postoperative complications in patients with obstructive sleep apnea syndrome undergoing hip or knee replacement: a case-control study. Mayo Clin Proc 2001; 76:897–905.
5. Mooe T, Gullsby S, Rabben T, Eriksson P. Sleep-disordered breathing: a novel predictor of atrial fibrillation after coronary artery bypass surgery. Coron Artery Dis 1996; 7:475–478.
6. Mallampati SR, Gatt SP, Gugino LD, et al. A clinical sign to pre-

dict difficult tracheal intubation: a prospective study. Can Anaesth Soc J 1985; 32:429–434.
7. Tung A, Rock P. Perioperative concerns in sleep apnea. Curr Opin Anesth 2001; 14:671–678.
8. Ostermeier AM, Roizen MF, Hautkappe M, Klock PA, Klafta JM. Three sudden postoperative respiratory arrests associated with epidural opioids in patients with sleep apnea. Anesth Analg 1997; 85:452–460.

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Q: What is the optimal venous thromboembolism prophylaxis for patients undergoing bariatric surgery?

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A: The optimal drug, dose, and duration of pharmacologic therapy to prevent venous thromboembolism (VTE) is not known. However, mechanical prophylaxis combined with some form of heparin, in most cases low-molecular-weight heparin (LMWH), is strongly recommended.

VTE risk is elevated in bariatric surgery patients

Patients undergoing bariatric surgery are at increased risk for VTE. The reported frequency of thromboembolic complications from bariatric surgery, including deep venous thrombosis (DVT) and pulmonary embolism (PE), is as high as 2.4%.[1] PE was the most frequently reported cause of death within 30 days of a bariatric procedure in reports from the International Bariatric Surgery Registry.[2] All patients undergoing bariatric surgery have at least two risk factors for VTE (obesity and surgery), and most have one or more additional risk factors.

Combine multiple strategies whenever possible

Mechanical prophylaxis alone is never adequate. Early ambulation should always be encouraged in addition to mechanical prophylaxis measures. The Seventh American College of Chest Physicians Conference on Antithrombotic and Thrombolytic Therapy recommends that pharmacologic prophylaxis be combined with the use of graded compression stockings and/or intermittent pneumatic compression devices in high-risk patients undergoing general surgery.[3]

Consider weight-adjusted LMWH dosing

The optimal form and duration of pharmacologic prophylaxis against VTE in morbidly obese patients is not known. Prophylaxis with LMWH is generally recommended, but there is a general lack of consensus on the timing, dose, and duration of treatment. No randomized controlled trials have evaluated the optimal LMWH dosage in severely obese patients.

When the LMWH enoxaparin is used in fixed doses, there is a strong negative correlation between total body weight and enoxaparin's anticoagulant effect based on anti-Xa assay levels.[4] Weight-adjusted doses may be better than fixed doses for obese patients.

One retrospective study compared two dosages of enoxaparin—30 mg or 40 mg subcutaneously every 12 hours—for patients undergoing Roux-en-Y gastric bypass surgery (97.5% of the surgeries were open procedures).[5] Enoxaparin was administered 2 hours before surgery and continued until the patient was fully ambulatory or discharged from the hospital. As detailed in the Table, patients in the 40-mg group had a statistically significantly lower risk of postoperative DVT or PE compared with those in the 30-mg group. Operating room time and length of stay were greater

TABLE
Comparative outcomes with two enoxaparin dosages in bariatric surgery*

	30 mg q12h (n = 92)	40 mg q12h (n = 389)	Significance of difference
No. of postoperative DVTs/PEs (combined incidence)	1/4 (5.4%)	2/0 (0.6%)	$P < .01$
No. of bleeding complications	1	1	NS
Length of stay (days)	5.67	3.81	$P < .05$
Operating room time (min)	213	175	$P < .05$

* In a retrospective study of 481 patients undergoing Roux-en-Y gastric bypass procedures.[5] See text for details.
DVT = deep venous thrombosis; PE = pulmonary embolism; NS = not significant

* Dr. Gugliotti reported that he has no commercial affiliations or financial interests that pose a potential conflict of interest with this article.

in the 30-mg group, however, which makes the results of this study less compelling. Nevertheless, the decreased effectiveness of LMWH in obese patients suggests that weight-based dose adjustments should be indicated.

Consider extended pharmacologic prophylaxis

Extended pharmacologic prophylaxis may be needed in patients undergoing bariatric surgery, particularly those with multiple risk factors for VTE. The PROBE study (Prophylaxis against VTE Outcomes in Bariatric Surgery Patients Receiving Enoxaparin) was a multicenter retrospective survey that assessed the frequency of symptomatic DVT or PE in morbidly obese bariatric surgery patients who received six different prophylactic regimens of enoxaparin.[1] Among the 668 patients in this analysis, 7 VTE events occurred—6 PEs (0.9% incidence) and 1 DVT (0.1% incidence). All but one episode of VTE occurred after the cessation of prophylaxis; therefore, extended prophylaxis may have some benefit. However, no trials have evaluated the optimal dose or duration of treatment.

Summary: What the current evidence suggests

Patients undergoing bariatric surgery are at increased risk for VTE and frequently have multiple significant risk factors. Mechanical prophylaxis measures should always be used, and early ambulation should always be encouraged. A lack of randomized controlled trial data precludes specific guidelines for pharmacologic VTE prophylaxis. Increased, weight-based doses of LMWH should be considered, starting preoperatively or as soon as possible after the operation. Extended prophylaxis, particularly for patients at the highest risk for VTE, should also be considered. Further study is needed to define the optimal regimen for pharmacologic VTE prophylaxis for bariatric surgery patients.

REFERENCES

1. Hamad GG, Choban PS. Enoxaparin for thromboprophylaxis in morbidly obese patients undergoing bariatric surgery: findings of the prophylaxis against VTE outcomes in bariatric surgery patients receiving enoxaparin (PROBE) study. Obes Surg 2005; 15: 1368–1374.
2. American Society for Bariatric Surgery. Rationale for the surgical treatment of morbid obesity. Available at: http://www.asbs.org/html/rationale/rationale.htm.
3. Geerts WH, Pineo GF, Heit JA, et al. Prevention of venous thromboembolism: the Seventh ACCP Conference on Antithrombotic and Thrombolytic Therapy. Chest 2004; 126(Suppl):338S–400S.
4. Frederiksen SG, Hedenbro JL, Norgren L. Enoxaparin effect depends on body-weight and current doses may be inadequate in obese patients. Br J Surg 2003; 90:547–548.
5. Scholten DJ, Hoedema RM, Scholten SE. A comparison of two different prophylactic dose regimens of low molecular weight heparin in bariatric surgery. Obes Surg 2002; 12:19–24.

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Q: Do hip fractures need to be repaired within 24 hours of injury?

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A: Patients with unstable medical conditions or with impaired cardiopulmonary function should have operative repair delayed to return them to their healthiest baseline prior to surgery. Otherwise, patients should proceed to operative repair as soon as practically possible.

The case for operating immediately

Early operation (ie, 8 to 24 hours from admission) has been associated with a reduction in the incidence of nonunion of fracture and avascular necrosis of the femoral head, improved long-term functional status, and decreased rates of urinary tract infections, decubitus formation, pneumonia, and venous thromboembolism.[1–3]

Retrospective uncontrolled studies show that failure to repair hip fractures within 24 hours is associated with increased mortality. As there are no randomized prospective studies comparing delayed surgery with expeditious surgery, it is not known whether surgical delay adversely affects outcomes directly or if delay in surgery is simply a reflection of underlying morbidities that adversely affect outcomes. The literature does show that early operation improves pain control,

* Dr. Whinney reported that he has no commercial affiliations or financial interests that pose a potential conflict of interest with this article.

which decreases the incidence of delirium and reduces length of hospital stay.

Delay surgery when comorbidities are significant

Patients with hip fractures often have comorbidities such as diabetes, congestive heart failure, coronary artery disease, anemia, malnutrition, dehydration, electrolyte disturbances, and rhabdomyolysis with renal failure. These problems may contribute to the event leading to the fracture (neuropathy, visual impairment, weakness) or may be related to immobility after the fracture. Such conditions, if not assessed and treated preoperatively, may lead to perioperative complications such as myocardial ischemia and infarction, delirium, and nutritional compromise, increasing in-hospital and overall mortality and delaying weight bearing and rehabilitation.[2,4] Therefore, a delay in surgical intervention of 24 to 48 hours after admission is appropriate to correct such metabolic disturbances and to optimize chronic medical conditions in an attempt to improve overall outcomes.

Several studies note no significant difference in the incidence of postoperative mortality between immediate and delayed hip fracture repair when controlling for the severity of medical conditions. In a retrospective study, Grimes et al[5] evaluated 8,383 patients with hip fractures that were repaired surgically between 1983 and 1993. In unadjusted analyses, a delay in surgery greater than 24 hours from admission was associated with increased long-term mortality compared with prompt surgery (ie, < 24 hours from admission); however, after adjustment for demographic variables and for the severity of underlying medical problems, no significant association was found. Mortality at 30 days and postoperative morbidity measures were similar, although a longer time to surgery was associated with the development of decubitus ulcers.

A recent retrospective study of more than 120,000 admissions in the United Kingdom noted that delay of 2 or more days was associated with increased mortality, but the magnitude of this effect was reduced with adjustment for comorbidities.[6]

Many agree that uncontrolled medical comorbidities and postoperative complications increase the risk of death in association with hip fracture, but the effect of optimization of these comorbidities on outcomes had not been assessed until a recent prospective cohort study.[7] Researchers evaluated 571 patients with hip fractures from four New York hospitals and categorized their medical abnormalities as either major (more likely to require correction prior to surgery) or minor (less likely to require correction prior to surgery). The odds ratio of having a complication was increased in the presence of a major abnormality but not in the presence of a minor abnormality. If a major abnormality was present on admission but only minor abnormalities were present at the time of surgery (ie, the major abnormality was corrected), no increased risk was noted.

Conclusion

Medical comorbidities contribute to morbidity and mortality after hip fracture repair. Existing evidence suggests that brief surgical delay (up to 72 hours) does not adversely affect health or functional outcomes in patients with hip fracture, and may allow for stabilization of uncontrolled medical conditions prior to surgery. Further studies are needed, however, to characterize the group of patients who would benefit from operative delay for medical optimization.

REFERENCES

1. Zuckerman JD. Hip fracture. N Engl J Med 1996; 334:1519–1525.
2. Parker MJ, Pryor GA. The timing of surgery for proximal femoral fractures. J Bone Joint Surg Br 1992; 74:203–205.
3. Perez JV, Warwick DJ, Case CP, Bannister GC. Death after proximal femoral fracture—an autopsy study. Injury 1995; 26:237–240.
4. Morrison RS. The medical consultant's role in caring for patients with hip fracture. Ann Intern Med 1998; 128:1010–1020.
5. Grimes JP, Gregory PM, Noveck H, Butler MS, Carson JL. The effects of time-to-surgery on mortality and morbidity in patients following hip fracture. Am J Med 2002; 112:702–709.
6. Bottle A, Aylin P. Mortality associated with delay in operation after hip fracture: observational study. BMJ 2006; 332:947–950.
7. McLaughlin MA, Orosz GM, Magaziner J, et al. Preoperative status and risk of complications in patients with hip fracture. J Gen Intern Med 2006; 21:219–225.

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Q: Is postoperative atrial fibrillation in patients undergoing noncardiothoracic surgery an important problem?

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A: Although the data on postoperative atrial fibrillation (AF) in patients undergoing noncardiothoracic surgery are sparse and largely observational, postoperative AF appears to have significant clinical and financial ramifications.

Burden is significant

The incidence of postoperative supraventricular arrhythmia (SVA), including atrial fibrillation (AF), appears highly variable and dependent on the population under study. The burden of this problem is considerable, however. Postoperative atrial arrhythmias affect about 1 million elderly Americans annually.[1] These events are associated with significantly longer hospital stays, increased morbidity, and inflated health care costs.

Despite a lower incidence, the overall burden of postoperative atrial tachyarrhythmias is higher with noncardiac surgery compared with cardiac surgery, due to larger volumes.

Findings from largest prospective study

The largest and most rigorously conducted prospective study on the incidence of all atrial arrhythmias in major, nonemergent, noncardiac surgery evaluated 4,181 patients aged 50 years or older who were in sinus rhythm preoperatively. This study included some patients undergoing thoracic surgery, which is associated with significantly higher rates of postoperative SVA than is noncardiothoracic surgery.[2] Serial electrocardiograms were obtained, preoperative clinical data were collected, and postoperative cardiac enzyme levels and clinical outcomes were measured.

Postoperative SVA occurred in 317 patients (7.6%). The incidence of AF was 3.7% in the postoperative period and 4.1% in the intraoperative and postoperative periods combined. SVA was associated with a 33% increase in the length of hospital stay.

Of the nonmodifiable factors identified preoperatively, male sex, age 70 years or older, significant valvular heart disease, history of SVA, asthma, congestive heart failure (CHF), premature atrial complexes on electrocardiography, American Stroke Association class III or IV, and type of procedure were independent predictors of new SVAs in the postoperative period. Of the surgical procedures, abdominal aortic aneurysm repair and abdominal, vascular, and intrathoracic procedures were particularly associated with an elevated risk of postoperative SVA.

Postoperative cardiac complications such as CHF, cardiac ischemia, myocardial infarction, ventricular tachycardia, cardiac arrest, and postoperative hypotension, as well as noncardiac events such as pneumonia, bacteremia, infection, urinary tract infection, stroke, pulmonary embolism, and gastrointestinal bleeding, were independently correlated with development of SVA. This study also suggested that the use of beta-blockers and calcium channel blockers appeared to have no effect on the development of SVA postoperatively.

Additional studies

In a prospective study of 462 patients in the intensive care unit (ICU) after noncardiothoracic surgery, the incidence of new-onset atrial arrhythmias was 10.2%.[3] Most arrhythmic events occurred in the first 2 days, and patients with arrhythmic events had a higher mortality rate, a longer ICU stay, and a longer hospital stay than those without arrhythmic events, although most deaths were the result of sepsis and cancer and not the rhythm disturbance per se.

One of the earliest studies on postoperative AF was conducted in patients undergoing cancer surgery.[4] AF appeared to be precipitated by sepsis, pneumonia, CHF, cardiac ischemia, pulmonary embolism, and hypokalemia. Advanced age and male sex were key risk factors, a finding that has been confirmed in subsequent studies. In this study, which appears to have major limitations (including a small sample size and being limited to a surgical ICU setting), AF did not have major clinical sequelae.

In a prospective study from the United Kingdom that included 226 patients undergoing colorectal surgery, 29 (13%) had significant arrhythmias on electrocardiographic monitoring,[5] with AF being the most common arrhythmia. Electrolyte disturbances were often present, and patients frequently required rapid administration of antiarrhythmic agents.

In another prospective study from the United

* Both authors reported that they have no commercial affiliations or financial interests that pose a potential conflict of interest with this article.

Kingdom, this one of 51 patients undergoing colorectal surgery, 13 (26%) developed a postoperative arrhythmia, most often AF.[6] Significant univariate correlates of AF in this study were age, hypertension, preoperative and postoperative potassium levels, and postoperative pulmonary edema. Thirty-one percent of all patients who developed the arrhythmia had sepsis, compared with 18% of controls ($P = .38$).

A retrospective study of 13,696 patients undergoing noncardiothoracic surgery over 2 years revealed an AF incidence of 0.37% (51 patients).[7] Most of those affected had cardiac risk factors at the time of surgery, a positive fluid balance, or electrolyte or arterial oxygen saturation abnormalities.

Bottom line on incidence and clinical predictors

The incidence of postoperative AF/SVA in patients undergoing major noncardiothoracic surgery is difficult to estimate but varies from approximately 0.37% to 26%, depending on the population studied and the rigor of postoperative monitoring. Advanced age, electrolyte imbalances, infection and sepsis, CHF, pulmonary embolism, and hypotension appear to predict the development of this arrhythmia quite consistently.

Effect on mortality unknown

The effect of AF/SVA on mortality is debatable. Most studies indicate that it appears to prolong the length of hospital stay and also contributes significantly to morbidity, although no definitive conclusions can be drawn since the majority of the data is retrospective. Larger prospective studies stratifying patients by surgical type, anesthesia type, and preoperative cardiac risk factors are required to better quantify this problem and perhaps develop reproducible risk indices.

REFERENCES

1. Maisel WH, Rawn JD, Stevenson WG. Atrial fibrillation after cardiac surgery. Ann Intern Med 2001; 135:1061–1073.
2. Polanczyk CA, Goldman L, Marcantonio ER, Orav EJ, Lee TH. Supraventricular arrhythmia in patients having noncardiac surgery: clinical correlates and effect on length of stay. Ann Intern Med 1998; 129:279–285.
3. Brathwaite D, Weissman C. The new onset of atrial arrhythmias following major non-cardiothoracic surgery is associated with increased mortality. Chest 1998; 114:462–468.
4. Gibbs HR, Swafford J, Nguyen HD, Ewer MS, Ali MK. Postoperative atrial fibrillation in cancer surgery: preoperative risks and clinical outcome. J Surg Oncol 1992; 50:224–227.
5. Batra GS, Molyneux J, Scott NA. Colorectal patients and cardiac arrhythmias detected on the surgical high dependency unit. Ann R Coll Surg Engl 2001; 83:174–176.
6. Walsh SR, Oates JE, Anderson JA, Blair SD, Makin CA, Walsh CJ. Post-operative arrhythmias in colorectal surgical patients: incidence and clinical correlates. Colorectal Dis 2006; 8:212–216.
7. Christians KK, Wu B, Quebbeman EJ, Brasel KJ. Postoperative atrial fibrillation in noncardiothoracic surgical patients. Am J Surg 2001; 182:713–715.

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Q: How can postoperative ileus be prevented and treated?

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A: A multifaceted approach that addresses the mechanical and chemical pathophysiology of ileus appears appropriate, although there is a paucity of prospective data to support it.

Postoperative ileus (POI) describes a period of impaired gastrointestinal (GI) motility without mechanical obstruction that occurs after surgery. It is characterized by abdominal distension, delayed passage of gas and bowel movement, lack of bowel sounds, and accumulation of gas and fluid in the bowel, creating symptoms of nausea and vomiting. Ileus can last from 2 days to more than 1 week, and contributes to delayed enteral nutrition. It is a common and clinically important problem that also contributes to prolonged patient discomfort and hospitalization.

Multimodal approach to treatment

Several contributors have been linked to inhibition of GI motility, including the nervous system, neurotransmitters, local factors, hormones, inflammation, anesthesia, and narcotic analgesia. Current research therefore suggests a multifaceted approach to prevention and treatment of POI.

Minimally invasive surgery, use of regional anes-

* Dr. Singh reported that she has no commercial affiliations or financial interests that pose a potential conflict of interest with this article.

thetic agents (specifically thoracic epidural anesthesia), treatment of prolonged electrolyte abnormalities (eg, hypokalemia, hyponatremia, and hypomagnesemia), and reduction of opioid use in the postoperative period have all been suggested to be beneficial in preventing POI.[1,2] Minimal manipulation of the intestines can help to reduce the inflammatory cascade of cytokines and prostaglandins in the bowel wall that has been associated with significant intestinal muscle dysfunction.

Individualize other options

In the past, early ambulation was thought to enhance intestinal motility, but study results are inconclusive, and the benefits are derived mostly from a reduction of other pulmonary and thromboembolic complications.[2,3]

Treatment of POI has usually been supportive, consisting of nasogastric decompression and intravenous fluids. Recent studies have also questioned the utility of nasogastric decompression, concluding that it does not shorten time to first bowel movement and, in fact, may contribute to postoperative complications such as fever, pneumonia, and atelectasis.[3] Although the findings from these studies do not support routine use of nasogastric decompression, the clinician must decide which patients may benefit from symptomatic relief.

A variety of pharmacologic agents has been tried as potential treatments for POI. Metoclopramide and other prokinetic agents decrease emesis and enhance motility by acting as dopamine antagonists and cholinergic stimulants. The macrolide antibiotic erythromycin also acts as a motilin agonist, and stimulates activity in the gut migrating motor complex, theoretically enhancing bowel activity. Although nonsteroidal anti-inflammatory drugs (NSAIDs) may reduce the inflammatory response to surgery as well as decrease the need for opiates, careful consideration should be given to their use in light of their effects on platelets and their association with GI bleeding. In early clinical trials, the investigative mu-opioid receptor antagonist alvimopan was shown to reduce opioid-induced bowel dysfunction in patients receiving chronic opioid therapy without disrupting centrally mediated opioid analgesia.[4] Studies evaluating other opioid antagonists (eg, naloxone), adrenergic blockers, parasympathetic agonists (eg, neostigmine), and laxatives as possible stimulators for the GI tract have been inconclusive; these agents have either been associated with prominent side effects or been shown to be ineffective in reducing POI.[2,3]

Early postoperative feeding, before ileus resolves, has been promoted as a way to decrease the duration of POI, and several studies have demonstrated that early postoperative nutrition reduces gut permeability, enhances immunocompetence, and decreases the stress response to surgery.[2,3]

Chewing gum in the postoperative setting three times a day has enhanced bowel motility, with earlier passage of flatus and defecation compared with controls.[5] The mechanisms appear to be vagal cholinergic stimulation and the release of gastrin, pancreatic polypeptide, and neurotensin, all of which affect GI motility.[2,3,5]

Massage of the abdominal wall daily after colectomy has been shown in a randomized trial to decrease postoperative pain and ileus.[6]

Other potential treatments being evaluated include electrical stimulation of the bowel wall, mechanical massage, acupuncture, and atilmotin, a synthetic human motilin.[2]

Bottom line: A core approach plus tailored supportive measures

Currently, treatment of POI can best be achieved by using a multimodal approach that combines several therapies. Minimizing the use of opioids and handling of intestines, as well as other supportive options (eg, gum chewing, early ambulation and/or feeding, use of NSAIDs) can be individualized at the physician's discretion to improve POI. There are currently no therapies approved for POI by the US Food and Drug Administration, but ongoing research is expected to define the potential of emerging pharmacotherapies to reduce the incidence and severity of POI.

REFERENCES

1. Luckey A, Livingston E, Tache Y. Mechanisms and treatment of postoperative ileus. Arch Surg 2003; 138:206–214.
2. Person B, Wexner SD. The management of postoperative ileus. Curr Probl Surg 2006; 43:12–65.
3. Behm B, Stollman N. Postoperative ileus: etiologies and interventions. Clin Gastroenterol Hepatol 2003; 1:71–80.
4. Paulson DM, Kennedy DT, Donovick RA, et al. Alvimopan: an oral, peripherally acting, mu-opioid receptor antagonist for the treatment of opioid-induced bowel dysfunction: a 21-day treatment-randomized clinical trial. J Pain 2005; 6:184–192.
5. Schuster R, Grewal N, Greaney GC, Waxman K. Gum chewing reduces ileus after elective open sigmoid colectomy. Arch Surg 2006; 141:174–176.
6. LeBlanc-Louvry I, Costaglioli B, Boulon C, et al. Does mechanical massage of the abdominal wall after colectomy reduce postoperative pain and shorten duration of ileus? Results of a randomized study. J Gastrointest Surg 2002; 6:43–49.

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Oral Abstracts

Is Discontinuation of Antiplatelet Therapy after 6 Months Safe in Patients with Drug-Eluting Stents Undergoing Noncardiac Surgery?

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Background: Drug-eluting stents (DES) pose a challenge in the perioperative setting. Sirolimus and paclitaxel not only inhibit neointimal hyperplasia, but may also inhibit re-endothelialization of the traumatized vessel, making it vulnerable to platelet-mediated thrombosis. Aspirin (ASA) and clopidogrel (CP) are recommended by the FDA for sirolimus stents and paclitaxel stents for 3 and 6 months, respectively. We conducted a retrospective cohort study to examine the safety of discontinuing antiplatelet therapy for elective noncardiac surgery in patients with recent DES placement.

Methods: We cross-matched the Cleveland Clinic (CC) Heart Center database with the CC Internal Medicine Preoperative Assessment, Consultation, and Treatment (IMPACT) Center database to identify all patients who underwent placement of a DES at CC and subsequently underwent elective noncardiac surgery at CC between July 2004 and July 2006. Outcome measures included 30-day rates of postoperative myocardial infarction (MI), DES thrombosis, major bleeding, and all-cause mortality.

Results: We identified 114 patients who underwent noncardiac surgery a median of 236 days [IQR, 125 to 354] after stent placement. Eighty-eight patients (77%) underwent discontinuation of all antiplatelet agents. ASA was stopped a median of 10 days [8 to 12] preoperatively, and CP was discontinued 10 days [8 to 13] preoperatively. Thirteen patients (11.4%) had CP discontinued within 90 days of the stenting and 35 patients (30.7%) had CP discontinued within 180 days of the stenting. No patients died. Two patients (1.75%; 95% CI, 0.48% to 6.17%) developed MI on postoperative days 3 and 7, respectively. Patient 1 had three DES placed and had ASA and CP stopped 33 days after stenting (17 days preoperatively). Patient 2 had one DES placed and had clopidogrel stopped 287 days after stenting (7 days preoperatively). Neither had DES thrombosis by postoperative catheterization. Another patient developed major bleeding (0.87%; 95% CI, 0.16% to 4.8%).

Conclusion: This is the first series to date looking at the safety of discontinuing antiplatelet therapy in patients with DES scheduled for noncardiac surgery. Our sample was small and most patients underwent surgery > 180 days from stenting. The absence of DES thrombosis and the low rate of postoperative MI may suggest that preoperative discontinuation of antiplatelet agents in patients with DES could be feasible after 6 months, in preparation for surgery. Larger trials are necessary, however.

Initiating a Preoperative Cardiac Risk Assessment Quality Improvement Program: The Hurdles to Changing Traditional Paradigms

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Background: Recent evidence indicates cardiac risk assessment (CRA) and perioperative beta-blockade improve outcomes in patients undergoing noncardiac surgery. Earlier analysis suggested 45% of eligible patients received beta-blockers at our hospital. We assessed surgeon knowledge, attitudes, and behaviors before initiating a quality improvement program in a diverse, tertiary-care surgical department.

Methods: Surgeons, surgical fellows, and surgical nurse practitioners at a single academic medical center received a questionnaire using the Transtheoretical Model framework. Questions asked about preoperative CRA, perioperative beta-blockers, and readiness to change current practice.

Results: The response rate was 25.1% (86/343; 59% staff surgeons; 11 surgical disciplines). Few respondents considered themselves very familiar with national recommendations (11%) or preferred performing CRA (8%) despite having large numbers of patients needing assessment (>25% of patients in 53% of practices). Surgeons differed in their intention to change CRA practices (50% considered themselves compliant, 18% planned changes, 15% might, and 18% did not intend changes). There was dissonance between perceptions of individual vs institutional intention to change (18% vs 40%). Respondents agreed that beta-blockers improve patient outcomes. Only 14% considered themselves familiar with prescription recommendations, while 4% preferred making prescription decisions.

Conclusion: Knowledge and practice regarding preoperative CRA and prescribing of beta-blockers varied. Despite acknowledging their importance, surgeons do not prefer performing CRAs or initiating perioperative beta-blockade. Individuals are less likely and less ready to change practices than they perceive themselves to be as a group. Successful quality improvement will require standardized institutional goals with significant resources and education.

Impact of a Preoperative Medical Clinic on Operating Room Cancellation Rates in Orthopedic Surgery

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Background: A preoperative medical clinic has been in effect for 2 years for patients undergoing surgery at a major academic medical center.

Purpose: To better understand the impact of a preoperative medical clinic on operating room (OR) cancellation rates and hospital costs.

Methods: A cancellation registry created by the OR for "same day" cancellations over a 25-month period was analyzed. "Same day" was defined as a cancellation that did not allow enough time to rebook the OR before the day of surgery. Only cancellations labeled as "medical/cardiac evaluation needed" were included in the study. Also analyzed were the billing records

for the hospital for each case performed by the selected orthopedic surgeons. Lastly, billing records for the preoperative clinic were used to identify which patients passed through the preoperative clinic and which of these patients actually met with a physician. The study was limited to select services within the orthopedic surgery department that most utilize the preoperative clinic.

Results: Twenty-one orthopedic surgeons were included in the analysis. From October 2003 to October 2005, 8,961 cases were performed in the OR. Of these, 5,333 (59.5%) utilized the preoperative clinic, 912 of whom had a medical evaluation. The average net revenue for the hospital for each case performed by these surgeons during this time was $9,821.58. There were 68 same-day cancellations due to medical/cardiac issues. Sixty-two of the 3,628 patients who did not utilize the preoperative clinic prior to surgery had a cancellation, yielding a cancellation rate of 1.7%. Six of the 5,333 patients who did utilize the preoperative clinic had a cancellation, yielding a rate of 0.1%. A total of $668,000 of hospital revenue was lost during this 25-month period due to cancellations among these 21 surgeons. If the cancellation rate of the patients who did not utilize the preoperative clinic (1.7%) was applied to the 5,333 patients who did utilize the preoperative clinic, the hospital would have lost an additional $832,000.

Conclusion: A preoperative clinic staffed by internists can effectively reduce the same-day cancellation rate due to medical issues in an academic medical center and significantly reduce lost revenue due to cancellations.

Innovations in Perioperative Medicine

1 Best Safety Practices to Prevent Postoperative Myocardial Infarction

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Background: Surgical complications are adverse outcomes that may occur after any surgical procedure. They include infection, deep vein thrombosis/pulmonary embolism, cardiac events, and ventilator-associated pneumonia. These complications lead to increased length of stay and increased morbidity, mortality, and patient suffering. This was the basis for the launch of the Surgical Infection Prevention Project (SIPP), which has evolved into the Surgical Care Improvement Project (SCIP). Aspects of SCIP are also part of the Institute for Healthcare Improvement's 100,000 Lives campaign and the Agency for Healthcare Research and Quality's Patient Safety Indicators. Postoperative myocardial infarction (POMI) is associated with a 25% mortality rate as well as increased costs ($14,000 per MI). One of the most effective strategies for preventing POMI is use of perioperative beta-blockade in eligible patients.

Purpose: To decrease rates of postoperative adverse cardiac events using a systems-level approach.

Description: Using a multidisciplinary approach and Plan-Do-Study-Act techniques, we developed standardized guideline and treatment recommendations for perioperative beta-blocker use. CPOE care sets were developed for preoperative, intraoperative, and postoperative use based on Mangano and ACP criteria. Moreover, we developed a formal preadmission evaluation beta-blocker eligibility guideline to screen at-risk patients during their PAE visit. In addition, a clinical effectiveness nurse screens patients for eligibility and prompts anesthesiologists and surgeons to prescribe beta-blockers for at-risk patients. Feedback is given to anesthesiologists and surgeons who do not prescribe beta-blockers for eligible patients. Finally, if a patient does suffer a POMI, the case is reviewed for correct coding and potential preventability. If an event is considered potentially preventable, the surgeon and/or anesthesiologist who cared for that patient is formally notified and reminded of the guidelines.

Results and Conclusions: Our continued efforts and focus on POMI have led to a sustained reduction from 0.55% (2003Q3) to 0.22% (2005Q4). This is associated with an increase in use of perioperative beta-blockade, especially in vascular patients (from 38% to 88%). Reduction of POMI by increasing the use of perioperative beta-blockade is a complex multistep process that fails due to multiple handoffs, lack of physician "ownership," and lack of education. By instituting a multidisciplinary approach at a systems level, we were able to increase perioperative use of beta-blockers and decrease the POMI rate.

2 Blog Web Site as a New Educational and Promotional Medium in Perioperative Medicine

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Background: A blog (web log) is a sequential collection of text and pictures posted on a web site. Blogs require only basic computer skills to create and maintain. A commenting feature allows authors to receive immediate feedback from readers. Due to the increased interaction between readers and authors and the decreased time to publication, blogs are more dynamic and interactive than conventional web pages. The collection of blogs on the Internet is called "the blogosphere" and is doubling in size every 5 months. A new web log is created every second. There are only a few studies exploring the effect of this new medium on medical education.

Purpose: Our goal was to evaluate the impact of a blog as an educational and promotional medium in perioperative medicine.

Description: "Clinical Cases and Images" (clinicalcases.org) was created in 2005 at an academic teaching hospital with the goal of furthering medical education by publishing cases in perioperative medicine and other specialties. The authors were members of the Section of Hospital Medicine at the Cleveland Clinic and faculty members at Case Western Reserve University. The blog was provided and hosted free of charge by Blogger.com, a service owned by Google, Inc. All clinical cases were published in strict compliance with HIPAA regulations.

Results and Conclusions: After 1 year, the blog received more than 500,000 page views and 200,000 visitors from more than 97 countries. The source and number of visits to the blog were recorded. Most of the visitors came from the *British Medical Journal* and Medscape.com, which reviewed the blog favorably; from searches on Google and other search engines; and from links posted on other medical web sites.

The blog web site ranks high on the major search engines for many search queries. It has been among the top search results for "Cleveland Clinic Perioperative Summit" for several months, ranking close to or even surpassing the official web site of the summit.

In conclusion, a blog is an easy-to-use medium for publishing that has the potential to enhance education and to promote medical education events in perioperative medicine.

3 Development of a Validated Questionnaire: The Satisfaction with General Anesthesia Scale

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Background: Outcomes in anesthesia have focused on objective measures of morbidity and mortality. Anesthesiologists are interested in measuring patient satisfaction with their perioperative care. Dexter published the Iowa Satisfaction with Anesthesia Scale (ISAS) for patients undergoing monitored anesthesia care (MAC). No comparable instrument exists for patients who have undergone major regional or general anesthesia.

Purpose: To develop a scale that would reflect patient satisfaction with anesthesia care after general or major regional anesthesia for use with patients in the hospital.

Description: As part of the development of a larger postoperative outcomes database, a literature search for a validated patient

satisfaction survey was completed. The ISAS instrument, while not validated in this population, was used to examine the feasibility of using such a questionnaire to assess patient satisfaction. The questionnaire was initially used for patients undergoing major joint replacement, bariatric, major vascular, or liver transplant surgery under either general or regional anesthesia. A nurse visited the patients postoperatively and, after a chart review, asked the patients several questions about their care and then gave the patients the ISAS. Initial data collection was targeted towards acceptance by the patient and successful administration.

Results and Conclusions: In the first 3 weeks, 223 patients were identified as potential candidates and 163 (73.0%) were available for interview. Initial attempts to complete postoperative visits on POD1 yielded a low response, as many patients were not yet able to be successfully interviewed. The visit was moved to POD2 with an increase in the number of successful interviews but a small loss (in this population) of subjects who were discharged prior to the visit. Of the subjects available for interview, 82% answered all the questions. The nurse administering the questions had the best response with the paper format as opposed to verbal presentation of the questions. The ISAS was validated for use by patients who had undergone MAC and were ready for discharge from the recovery room; as expected, some of the items were confusing to patients who had received a general anesthetic. The feasibility of using such a questionnaire has been established, and a questionnaire appropriate for general anesthesia care is being revised for subsequent validation.

4 Perioperative Medicine and Pain: A Required Advanced Core Clerkship for Third-Year Medical Students

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Background: In the context of clinical curriculum redesign for the Case School of Medicine, a multidisciplinary group of physicians at the Cleveland Clinic Lerner College of Medicine helped develop educational objectives and organizational structure for a 1-month Advanced Core Clerkship in Perioperative Medicine and Pain. The clerkship was designed to build upon the content and skills acquired during experience in core disciplines of internal medicine, surgery, family practice, obstetrics/gynecology, pediatrics, psychiatry, and neurology.

Purpose: To outline the design, learning objectives, and curriculum content for the Perioperative Medicine and Pain Advanced Core Clerkship.

Description: The overall goals of this rotation are to help medical students acquire, develop, and enhance cognitive and technical skills in the medical care of the surgical patient through active learning. This 4-week advanced core curriculum will provide each student with the knowledge, skills, and attitudes necessary for trainees to evaluate and medically manage patients perioperatively and to appreciate the evaluation of acute and chronic pain (Table).

Each student will spend 1 week in the Internal Medicine Preoperative Assessment, Consultation, and Treatment (IMPACT) Center and the Preanesthesia Evaluation Clinic (PACE); 1 week in the operating room and the PACU with anesthesiologists; 1 week on the internal medicine consult service, and 1 week on the acute pain service and the pain management clinic. Each week, students will meet for half a day with staff supervision to discuss cases on topics such as preoperative evaluation and testing, cardiac risk assessment, evidence-based risk reduction strategies, common postoperative complications (fever, VTE, MI, and wound infections), and management of acute and chronic pain. In addition, students will meet weekly to review an original article for journal club.

Results and Conclusions: We believe that by actively working with this multidisciplinary group of clinicians and teachers in managing medical problems of surgical patients, students will be better prepared for future resident training in any field. We expect this rotation to be valued highly by students and staff alike.

TABLE
LEARNING OBJECTIVES FOR THE PERIOPERATIVE MEDICINE AND PAIN ROTATION

1. Describe the role of the consultant and the principles and ethics surrounding medical consultation
2. Perform and document the complete preoperative assessment
3. Describe and demonstrate the elements of airway management
4. Describe the various intraoperative stressors
5. Demonstrate the ability to interpret hemodynamic monitoring
6. Apply principles of fluid management and blood resuscitation to the perioperative period
7. Evaluate and admit postoperative patients to the postanesthesia care unit (PACU) and the intensive care unit (ICU)
8. Describe the role of the ICU
9. Describe diagnosis/management of common postoperative complications (postoperative MI, pneumonia, VTE, delirium, and fever)
10. Perform a basic assessment of acute postoperative/procedural pain and develop an analgesic plan
11. Recognize and differentiate acute, chronic, malignant, and nonmalignant pain
12. Describe the principles of safe drug prescribing

5 Optimal Administration of Perioperative Antibiotics Using System Redesign

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Background: Surgical infection is a leading cause of injury, mortality, and excess costs. Of the nearly 30 million operations performed annually, 2.6% are complicated by infections. Fifty percent of these infections are thought to be preventable. In 2002 Baystate Medical Center was the Massachusetts representative for the national SIP Collaborative. The goal was to optimize outcomes by improving the use of evidence-based practices shown to reduce surgical infections. Practices included appropriate antibiotic use in terms of timing, correct antibiotic selection, and duration of therapy.

Purpose: To improve compliance with the SIP Collaborative national quality measures.

Description: After evaluation of our existing process improvement technique (Plan-Do-Study-Act [PDSA]), a complete process redesign of the perioperative system was completed. The system was (and is) continuously improved using small tests of change to ensure compliance and rate improvement. On-time antibiotic administration was defined as administration within 60 minutes prior to incision. Correct selection was based on national guide-

lines. Discontinuation was defined as stopping antibiotics within 24 hours of surgical end time.

Changes made included revised order sets in the CPOE system and the addition of prompts and standardized documentation in OR paperwork. Anesthesiologists were identified as most appropriate to administer the antibiotic. Preoperative booking forms were redesigned to simplify ordering. CPOE order sets were modified to limit antibiotic duration. Evidence-based education was provided to all "stakeholders." Physician "champions" were chosen to spread the science behind the measures. Results were displayed as a dashboard in all OR lounges, internal and external benchmarking was used to drive results, and physician report cards were used to identify and educate outliers.

Results and Conclusions: Our baseline rate of patients receiving prophylactic antibiotics within 60 minutes before incision was 29%. After redesign implementation, our most recent result is 97% (4th quarter 2005). The average baseline interval from antibiotic administration to incision was 71 minutes; the current interval is 23 minutes. Appropriate antibiotic selection was 95% at baseline and is now 100%. Discontinuation of antibiotics within 24 hours after surgery started was at 11% and is currently 82%. Use of rapid-cycle PDSA and other quality improvement techniques can improve compliance with evidence-based practices known to reduce surgical infection rates.

6 Blood Conservation Protocol with Erythropoietin in the Preoperative Period of Joint Replacement Surgery

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Background: Over 3,000 elective major joint replacements are performed at the Cleveland Clinic each year. Several methods to reduce allogenic blood transfusion are available, but utilization remains high. In 2004, 47,456 units of blood products were used in the perioperative period of various orthopedic surgeries at the Cleveland Clinic. Erythropoietin is approved by the FDA for treatment of anemic patients undergoing major joint replacement surgery, but its use has not been overwhelmingly embraced in clinical practice.

Purpose: Allogenic blood transfusions are associated with increases in the rate of postoperative complications and in length of stay. Our blood conservation protocol with erythropoietin provides a safe alternative to transfusion.

Description: We proposed a model of blood conservation using erythropoietin under the supervision of the Internal Medicine Preoperative Assessment, Consultation, and Treatment (IMPACT) Center with support from the Departments of Orthopaedic Surgery, Nephrology, and General Anesthesiology at the Cleveland Clinic.

The protocol for erythropoietin administration starts with a complete blood count ordered by the orthopedics office. If the hemoglobin level is 10 to 13 g/dL, an anemia panel is ordered (iron, total iron binding capacity, ferritin, vitamin B_{12}, and RBC–folate). Patients with iron deficiency anemia are referred to their primary care physician or a gastroenterologist for further evaluation. Patients with normochromic, normocytic anemia with a hemoglobin of 10 to 13 g/dL can benefit from treatment with erythropoietin in the perioperative period. These patients are then selected for the blood conservation protocol with erythropoietin injections on days 21, 14, 7, and 0 before surgery. Reticulocyte count, hemoglobin, and blood pressure should be checked prior to each injection. Patients with hemoglobin less than 10 g/dL, iron deficiency anemia, recent gastrointestinal bleed (within 3 months), uncontrolled hypertension, seizures, blood dyscrasias, or a history of thromboembolism are excluded from this protocol.

Results and Conclusions: Treatment of anemia in the perioperative period of major joint replacement surgery decreases the need for perioperative blood transfusion and improves outcomes. Erythropoietin use in this setting is FDA-approved and leads to significant benefit to qualified patients. Our blood conservation protocol using erythropoietin provides a well-defined framework that will be tested at the Cleveland Clinic shortly and can be further explored at other perioperative centers.

7 Evolution of the Nurse Practitioner (NP) Role in the Center for Preoperative Evaluation (CPE) at Brigham and Women's Hospital

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Background: The JCAHO requires that patients have a complete history and physical exam, nursing assessment, and anesthesia evaluation prior to surgery. It is the responsibility of the providers to make this process as efficient and smooth as possible.

Purpose: To fulfill all necessary preoperative requirements. To improve patient satisfaction, ensure quality, and improve efficiency. To increase the number of surgical services able to take advantage of the preoperative evaluation and preparation offered in the CPE by NP providers.

Description: Hired additional NP staff. Provided education and training to NP staff to care for new patient populations. Provided education to the NP staff in anesthesia assessment and evaluation. Restructured physical setting to improve patient access. Changed patient flow to allow patients to be seen in one location by all needed providers. Followed up with patient satisfaction survey.

Results and Conclusions: NP patients are seen by one provider rather than three. Increased patient satisfaction. Increased efficiency of patient flow. Provided preoperative assessment and evaluation to additional surgical services. Well-prepared patients. Critical and reliable information available at the time of surgery. Decrease in OR delays.

8 Development and Implementation of a Web Site for the Center for Preoperative Evaluation (CPE)

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Brigham and Women's Hospital, Boston, MA

Background: A number of patients with access to the Internet come to the CPE without vital information.

Purpose: To make the patient's visit to the CPE more efficient.

Description: Web site (Smartsleep/TM) created by Angela Bader, MD, and Margaret Pothier, CRNA. Web site address included in information sent to all patients with planned surgeries. Information supplied by patients is placed in patient chart prior to CPE visit.

Results and Conclusions: Use of web site allows patients to gather information at their convenience and provides a forum for patient to list questions or concerns. Information is available for review by staff prior to the patient visit. Positive feedback from patients and staff. Information from the web site currently populates the Cardiac Surgery web site and will populate others in the future. The Internet is a useful vehicle for communication for both patients and providers.

9 Patient Education Tool for the Preoperative Process and the Role of the Medical Consultant

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Background: The preoperative process is often confusing for patients and family members. Many physicians may be involved, often with the appearance of redundancy. Patients undergo preoperative testing without a clear understanding as to the rationale or utility. A patient education tool describing the preoperative process and the role of the medical consultant would be expected to ease anxiety in the preoperative period.

Purpose: Develop a patient education tool regarding the preoperative process.

Description: Our patient education tool compares surgery to a plane flight, and the patient is the plane. This comparison helps highlight the preoperative process and clarifies the role of the medical consultant

The surgeon is the pilot, and the anesthesiologist is the co-pilot. Together, the pilots and the plane will take off and reach a stable cruising altitude so that surgery can take place. Once the surgery is complete, the pilots will need to descend and land the plane safely into the recovery unit. The medical consulant is the chief mechanic for the flight. The job of the chief mechanic is to "check out" the plane and give a report to the pilots so that they may develop their flight plan. The history and physical examination is the preflight checklist. Many patients will have received a preflight evaluation from their local physician; however, our pilots fly different planes everyday, so it is important for our mechanics to review and confirm any prior preflight evaluation. In addition, the chief mechanic may have you see specialty mechanics so that we can "rev your engines" (stress testing). Ultimately, the final decision to fly is up to the patient and the surgeon. Mechanics never tell pilots when or how to fly!

Results and Conclusions: Our patient education tool helps to clarify the role of the medical consultant in the preoperative process. This tool may reduce anxiety and address some commonly asked questions we receive in our preoperative clinic. This allows the medical consultant to spend more time on the preflight checklist as opposed to explaining why we are seeing the patient in the first place.

10 The Internal Medicine Perioperative Assessment Center: An Innovation in the Perioperative Management of Medical Comorbidities at a Comprehensive Cancer Center

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Background: Cancer care has evolved from single-modality treatment to a multidisciplinary process that involves a team of providers from various oncologic specialties. The importance of medical comorbidities in cancer care is a subject of increasing awareness. In an effort to address the medical comorbidities that impact care of the surgical oncology patient, the Department of General Internal Medicine at the University of Texas M.D. Anderson Cancer Center developed the Internal Medicine Perioperative Assessment Center (IMPAC).

Purpose: We describe the goals, development, and structure of the IMPAC clinic. We also present data on the first 18 months of operation in regards to patient demographics and disease states.

Description: The IMPAC clinic was designed to facilitate the medical evaluation of cancer patients undergoing surgery. The current team consists of a physician, a nurse practitioner, a nurse, and a patient scheduler. Patients are referred for perioperative risk assessment and medical optimization prior to going to the operating room. Using clinical guidelines, patients are risk stratified and appropriate testing is done. Evidence-based risk-reduction strategies are employed such as perioperative beta-blockade and prophylaxis for postoperative venous thromboembolism. Perioperative anticoagulation issues are also addressed. Patients requiring close follow-up in the postoperative period by the inpatient internal medicine service are also identified.

Results and Conclusions: Based on review of billing data, 3,058 patient visits were recorded since inception of the program from November 2004 through May 2006. Of these 3,058 visits, 2,143 were new referrals to the program; the remainder were follow-up visits. Patient volumes increased steadily from 39 patients in November 2004 to 284 in May 2006. Overall, the average age was 67 years for men (46.6%) and 65 years for women (53.3%).

In regards to type of cancer, the analysis reflected the order in which the IMPAC clinic was rolled out to the institution, with head and neck cancer patients representing the largest share of referrals (36%), followed by patients with gastroenterologic (17.5%), breast (12%), and gynecologic (11%) cancers.

In terms of frequency of diagnosis, hypertension was the most frequent diagnosis at 63%, followed by dyslipidemia (24.9%), diabetes (22.5%), coronary atherosclerosis (16.4%), and obesity (10.7%).

Based on the initial success of the IMPAC program, we anticipate further growth in clinical and research activities.

11 PAC Collaborative Practice Model

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Background: The preoperative admission process was often rushed because of unnecessary delays in preoperative testing until the day of surgery for unidentified high-risk patients who had been booked for surgery 13 days in advance. This resulted in patient, surgeon, and anesthesia dissatisfaction due to delays, as well as cancellations on the day of surgery due to positive preoperative test results.

Poor communication of patient information between the surgeon's office and pre-admission department resulted in multiple telephone calls, high-risk patients not being identified at the time of booking, and consults not being done in a timely fashion.

Purpose: Our objective was implementation of a collaborative practice model that assures safe and positive patient outcomes.

Description: Process of implementation:

1. Internal assessment of present workflow processes
2. Identify roles for PAC and surgeon's office (as well as patient preparation)
3. Develop an action plan timeline
   a) Pilot program times 6-month duration
   b) Development of a surgical protocol sheet given to patients at time of booking; it directs patients to call us "on a hotline" if they have any high-risk diagnosis
   c) Development of preoperative testing guidelines
   d) Educational meetings with surgeon's office
   e) Each office assigned to PAC coordinator
   f) Develop internal process. Identify key functions for PAC coordinator.

After implementation as stated, testing on the day of surgery was limited to those patients added to the schedule 48 hours prior to surgery (as opposed to patients booked 13 days before surgery).

Results and Conclusions: Patients ready for surgery in a safe and timely fashion; patient, nurse, anesthesia, and surgeon satisfaction.

Development of an infrastructure that provides each patient with the preoperative preparation and testing appropriate to his or her scheduled surgery and medical history, thereby insuring practice standards.

12 Development and Implementation of Beta-Blocker Recommendation

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Background: We had no current policy or guidelines for the use of beta-blockers. Surgeons and anesthesiologists were not consistent with the use of beta-blockers; due to a lack of policy and changing data, there was even some inconsistency between preoperative NP.

Purpose: Create an updated, thorough, specific guideline on the use of beta-blockers and follow-up monitoring. Educate surgeons, anesthesia, and staff to have an understanding of the use of beta-blockers in the appropriate patient population.

Description: Provide an algorithm along the preprinted preop and postop orders for provider use. Educate appropriate providers, perianesthesia staff, and floor nurses about the guidelines:

—Taken to OR committee meeting for input from physicians
—Surgical service.

Results and Conclusions:

- Successful practice identified:
  —Decreased mortality/morbidity for high-risk patients
  —Feedback and recommendations received from providers as well staff nurses
- Positive outcome achieved:
  —Use of beta-blockers decreases mortality and morbidity in high-risk patients
- Implications for perianesthesia nursing:
  —Consistent use of guidelines/algorithm for preop, postop, and floor nurses to follow.

13 Development of Pre-Procedure Consult Services

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Pre-Procedure Service, University of Colorado Hospital, Denver, CO

Background: Lack of resources makes it difficult to see all surgical/anesthesia patients prior to surgery. Look at a way to be more efficient and cost-effective for the hospital.

Purpose:

- Increased appointments for those that need extensive work-up
- Decrease day-of-surgery work-up on complicated patients
- Convenience to healthy patients not having unnecessary appointment
- Be financially independent

Description:

- We developed a Self-Health Assessment (SHA) to be completed by patients at their clinic visit. The SHA reviews medical history related to cardiac and respiratory issues.
- The SHA is faxed to Pre-Procedure Services and reviewed by an RN.
- An algorithm was developed and evaluated for patients at greatest risk of perianesthesia complications.
- NPs order only pertinent labs, ECGs, and tests such as stress tests and cardiology consults.

Results and Conclusions:

- Successful practice identified:
  —Decreased delays on complicated patients
  —Increased satisfaction for healthy patients
- Positive outcome achieved:
  —Generated revenue that covers most of our clinic costs
  —Patients seen have very thorough work-up
  —Healthy patients appreciate consideration of their busy schedules
- Implications for perianesthesia nursing:
  —Decreased frustration for perianesthesia nurses who are trying to see too many patients in too little time.

Perioperative Clinical Vignettes

14 Isolated Left Bundle Branch Block in a Patient Undergoing Elective Noncardiac Surgery

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Case Presentation: A 55-year-old man with history of hyperlipidemia presents for a preoperative evaluation prior to left total knee replacement. He swims ten laps in an olympic pool three times a week. He denies a history of coronary artery disease (CAD). Family history is significant for hypertension. Physical examination reveals a temperature of 37°C, BP of 118/80 mm Hg, HR 60, RR 14, and a BMI of 22 kg/m^2. The remainder of the physical exam is normal, as are laboratory tests. His ECG shows a left bundle branch block (LBBB) with no prior ECGs for comparison.

What is the best way to proceed?

1. Perform an exercise thallium test
2. Start a beta-blocker perioperatively
3. Proceed with surgery
4. Refer for left heart catheterization

Discussion: The etiology of bundle brunch blocks (BBB) includes age-related degeneration of the conduction system, ischemia, valvular abnormalities, and cardiomyopathy. BBB in the absence of cardiac disease and hypertension may be called isolated BBB. The prevalence of BBB increases from 1.2% at age 50 to 17% at age 80. Isolated right BBB has an excellent long-term prognosis. However, isolated LBBB increases the risk of developing cardiac disease and warrants closer follow-up. Furthermore, in patients with established heart failure (HF) and CAD, LBBB is an independent risk factor for mortality.

The dilemma for clinicians when faced with an incidental finding of LBBB prior to elective surgery is whether to perform additional investigations. Our answer is "no" since the prevalence of ischemic heart disease in asymptomatic patients with BBB is low. As such, those without overt signs and symptoms of HF or CAD do not require extensive preoperative cardiac evaluation. In fact, the ACC/AHA guidelines consider BBB a minor clinical predictor. In patients with LBBB, rare symptomatic bradycardias can occur intraoperatively but can be managed medically. Temporary cardiac pacing is seldom needed since progression into complete heart block is rare.

Conclusion: Our patient has an isolated LBBB without HF or CAD. He has only a minor clinical predictor—ie, an abnormal ECG finding—in the setting of excellent functional class and is undergoing an intermediate-risk surgery. Therefore, additional stress testing would not be required and he can proceed to the planned surgery.

15 Avoiding Delirium

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Case Presentations: We discuss two elderly patients with severe prior delirium and mild dementia who began treatment with donepezil prior to their next surgery and avoided significant confusion. We believe this can augment other protocols that require added nursing and therapy effort and for which compliance is more difficult to assure.

An 82-year-old male experienced 10 days of severe delirium after CABG. Multifactorial delirium was treated by reducing analgesics, maintaining supplemental oxygen, titrating hydration, and providing low-dose intravenous haloperidol. The patient, family, physicians, and nurses were all concerned about the likelihood of a second prolonged delirium when a valve replacement was recommended. The patient's mini-mental status exam (MMSE) score was 26/30 after the delirium cleared. Anesthesia was notified and donepezil 5 mg was given for 3 days. He was mildly confused on postoperative day 1 but had cleared by the morning and was able to return home with his wife on postoperative day 5.

A 75-year-old female had a history of two prior episodes of delirium postoperatively after CABG. This retired teacher had a MMSE score of 25/30 and was started on donepezil 3 days prior to valve replacement. She did not experience delirium and was discharged on postoperative day 7.

Discussion: Rates of postoperative delirium are reported to range from 11% to 44%. Delirium increases the likelihood of nursing home placement and overall mortality. Aspiration pneumonia, skin breakdown, and falls are common sequelae of delirium that further increase length of stay and costs. Elderly patients with dementia or prior delirium are at particularly high risk. APOe4 polymorphism is less effective in reducing inflammatory responses in the brain and increases risk for dementia and delirium. Specific protocols reduce the frequency and length of mild to moderate cases but are less successful in preventing severe delirium. Although cholinesterase inhibitors are controversial prior to intraoperative succinylcholine, they may help selected patients.

Conclusion: In addition to appropriate levels of mental and physical stimulation, supplemental oxygen, careful monitoring of hydration, nutrition, and sleep, and the use of glasses and hearing aids, cholinesterase inhibitors may be useful to reduce the risk for delirium in patients on a delirium-dementia spectrum. Anti-inflammatory agents may also benefit these patients.

16 Cardiac Sarcoma—The Role of Multimodality Cardiovascular Imaging

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Case Presentation: The patient is a 43-year-old Caucasian female who presented with new onset of frequent palpitations for 3 weeks. There was no known history of cardiovascular disease, smoking, or alcohol or intravenous drug abuse. An echocardiogram revealed multiple echo-densities in left and right atria, as well as attached to the mitral valve. Initial concern was possible infective endocarditis.

On examination, the patient was moderately built and in no distress. Her heart rate was 76 beats per minute and regular, and

a 3/6 holosystolic murmur was heard in the mitral area with no "plop." There was no jugular venous distention or extremity edema noted. The rest of the clinical examination was unremarkable. Chest x-ray was normal and electrocardiogram showed normal sinus rhythm.

Discussion: Multimodality imaging is performed for better preoperative definition of tumors. Transthoracic and transesophageal echocardiography remains the primary test done in the diagnosis of tumors of the heart. This is because of its wide availability and its superior temporal resolution and real-time imaging capability with superior identification of valvular structures.

Cardiac MRI provides clinically relevant anatomic and functional information noninvasively and with minimal risk. A distinct advantage of MRI is its superior tissue characterization. The advantage of cardiac CT scanning is its superior spatial resolution and the ability to reconstruct the 3-D data set along any desired plane, almost like performing exploratory surgery on a computer screen. Positron emission tomography (PET) of the heart allows the study and quantification of various aspects of heart tissue function. Its use in research has provided novel observations in cardiac physiology and pathophysiology.

In our patient, an initial echocardiogram suggested the possibility of a tumor but also considered the diagnosis of possible endocarditis. Subsequent multimodality imaging with cardiac MRI, CT, and PET scans provided improved anatomic and physiologic characteristics of the tumor that were suspicious of a malignant process. These findings were confirmed by the operative findings.

Conclusion: A thorough preoperative evaluation of cardiac tumors with the use of echocardiography and cardiac MRI, CT, and PET scans guided us in choosing subsequent treatment.

17 Asymptomatic Bacteriuria before Nonprosthetic Joint Surgery

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Case Presentation: A 73-year-old female is undergoing a preoperative evaluation for right hip arthroscopy scheduled in 3 days. The urinalysis (UA) ordered by her orthopedic surgeon reveals asymptomatic bacteriuria without leukocyturia. She has has normal vital signs and a normal physical examination, and the rest of the laboratory results are unremarkable.

What is the best approach to asymptomatic bacteriuria in this patient?

1. Start antibiotic treatment and proceed with surgery as scheduled
2. Start antibiotic treatment and postpone surgery until she completes her treatment course, then repeat UA to ensure that the bacteriuria has resolved
3. Proceed with surgery without any further treatment

Discussion: In most surgical centers, orthopedic surgeons routinely order preoperative UA to detect urinary tract infections (UTI) in the preoperative period of joint surgery. Approximately $7 million is spent annually in the United States on preoperative UA and consequent treatment of bacteriuria and/or UTI. A retrospective study of 200 patients undergoing clean-wound, orthopedic nonprosthetic knee procedures found that 15% of UA results were abnormal. Twenty-nine percent of patients with UA suggestive of UTI were treated. The study found no difference in frequency of wound infections between patients with normal UA and those with abnormal results. A review of the medical literature shows that routine antimicrobial therapy is not justified in asymptomatic patients with bacteriuria, except before urologic surgery, during pregnancy, and possibly in surgeries involving prosthetics.

Conclusion: There is no clinical evidence that preoperative asymptomatic bacteriuria is associated with infective complications in the postoperative period of nonprosthetic joint surgery. Routine preoperative UA in non–urinary tract surgeries seems both unnecessary and cost-ineffective. Our recommendation to this patient was to proceed with surgery without antibiotic treatment.

18 Negative T Waves on the Preoperative Electrocardiogram—A Cause for Worry?

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Case Presentation: A 48-year-old male was seen for preoperative evaluation prior to knee replacement surgery for osteoarthritis. He denied symptoms of coronary artery disease. He had well-controlled systemic hypertension and gastroesophageal reflux disease, as well as a family history of premature atherosclerotic heart disease. His medications included hydrochlorothiazide and lansoprazole. Physical exam was significant only for obesity, with a BMI of 32 kg/m^2. His blood pressure was normal. A preoperative 12-lead resting electrocardiogram (ECG) displayed a sinus rhythm with a rate of 79 bpm with marked negative T waves in the V1–V4 leads. Cardiology was consulted and coronary angiography was performed in view of his cardiac risk factors, which revealed normal coronary arteries. Left ventriculography demonstrated normal function. Repeat ECG a few hours following the cardiac catheterization revealed sinus rhythm at a rate of 100 bpm with a left bundle branch block (LBBB) pattern. The negative T waves on his initial ECG were explained by cardiac memory in the setting of his intermittent LBBB. He was started on beta-blocker therapy and had an uneventful surgery and postoperative course.

Discussion: An ECG is a common feature of the preoperative evaluation. In asymptomatic patients without known coronary artery disease, T-wave abnormalities usually portend cardiovascular morbidity and mortality. An important but underrecognized cause of T-wave abnormalities is the phenomenon of cardiac memory, characterized by persistent but reversible negative T waves on ECG that occur after resumption of normal atrioventricular conduction following a period of altered ventricular activation. Prolonged alteration of the activation sequence has a variety of causes, including intermittent LBBB, ventricular pacing, ventricular tachycardia, ventricular extrasystoles, and ventricular pre-excitation. It is important to identify negative T waves of cardiac memory because they have no clinical or pathological significance and do not predict worse cardiovascular outcome. Cardiac memory is not associated with hypertrophy, hemodynamic abnormalities, or reduction in myocardial perfusion.

Conclusion: Negative T waves on preoperative ECGs in asymptomatic patients without known coronary artery disease should be interpreted keeping in mind the phenomenon of cardiac memory. Causes of altered activation sequence—such as intermittent LBBB—should be excluded before investigating for coronary artery disease, especially in low-risk patients.

19 Preoperative Hypokalemia

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Case Presentation: A 70-year-old female with history of hypertension, coronary artery disease, and a myocardial infarction (MI) 2 years ago is being seen for preoperative evaluation for open cholecystectomy scheduled for the next day. She exercises on a treadmill for 30 minutes every day. Her last stress test 2 months ago was negative for ischemia. Current medications include metoprolol, hydrochlorothiazide, and aspirin. Physical examination, including vital signs, is unremarkable. Her electrocardiogram shows NSR with Q waves in the inferior leads consistent with a prior inferior MI. Labs are normal except for potassium level of 3.3 mmol/L.

What is the best way to proceed?

1. Give oral potassium replacement and recheck levels before surgery
2. Give intravenous potassium before induction of anesthesia
3. Proceed with surgery
4. Postpone surgery

Discussion: The incidence of perioperative hypokalemia varies depending on definition criteria, comorbidities, and medications, with a prevalence of 2.9% in patients undergoing cardiac bypass surgery. Low potassium (K) levels are thought to predispose to dysrhythmia during anesthesia. After MI, the incidence of ventricular fibrillation increases from 3.5% to 8% in the presence of K levels below 3.5 mmol/L. Wahr et al looked at more than 2,400 cardiac patients undergoing cardiac bypass surgery, showing that K values less than 3.5 mmol/L increase the risk of perioperative and intraoperative arrhythmias and postoperative atrial fibrillation/flutter. Similarly, Shah et al have shown hypokalemia to be an independent risk factor for mortality in patients undergoing noncardiac surgery. No studies have been done to determine if preoperative K replenishment reduces complications.

In a smaller study of 150 patients undergoing cardiac or noncardiac surgery, Vitez et al did not find significant dysrhythmia among hypokalemic patients. Hirsch et al looked at 447 patients and also failed to show an association between hypokalemia and cardiac complications.

Conclusion: Hypertension, diuretic use, female sex, and a history of arrhythmias are commonly associated with hypokalemia. Given that our patient had significant hypokalemia and oral K replacement has minimal risks, we chose to hold her diuretic, replace K orally, and recheck electrolytes.

20 Preoperative Evaluation Can Aid in the Diagnosis of CAD and Risk Assessment and Management

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Case Presentation: A 50-year-old physician with hypertension was seen in the perioperative clinic for laparoscopic cholecystectomy. He denied personal or family history of cardiac disease or smoking and had an exercise tolerance of 8 METs. He was taking lisinopril. He had a BMI of 28.8, BP of 132/83 mm Hg, and HR of 79 beats per minute. ECG revealed a right bundle branch block and inferior infarct of undetermined age. During a subsequent stress test he achieved 16 METs without chest pain, but SPECT imaging showed abnormal wall motion at rest in the RCA distribution, partially reversible exercise-induced ischemia in a multivessel distribution, and a fixed apical inferior defect. Cardiac catheterization showed no significant epicardial disease and an ejection fraction of 45% with posterobasal hypokinesis. His lipid panel was abnormal. Therapy with a beta-blocker, a statin, and aspirin was initiated.

Discussion: This patient had no intermediate or high risk factors, had excellent exercise tolerance, and was scheduled for an intermediate-risk procedure. According to the ACC/AHA guidelines for preoperative testing, he would not need further cardiac work-up. The ECG showed a myocardial infarction—an intermediate or high risk factor, depending on the timing. Further testing would identify myocardium at risk and the need for risk modification. The evidence of a prior cardiac event and of abnormal function prompted the initiation of aggressive medical management.

Reduction in morbidity and mortality associated with ischemia can be achieved with therapy directed at disease progression and at neurohormonal activation with remodeling. Reduction of blood pressure has resulted in a decrease in the risk of death from coronary artery disease or stroke by 30% to 50%. Normalization of lipids and the effects of statins on endothelial function contribute to improved outcomes. ACE inhibitors and angiotensin II receptor blockers attenuate ventricular remodeling in patients with myocardial ischemia. Beta-blockers result in reversal of remodeling and have significant impact on cardiac function and mortality.

Conclusion: The role of the perioperative evaluation is not limited to the optimization of patients for a surgical procedure. It provides an opportunity for risk assessment and interventions extending beyond the immediate anesthetic and surgical issues. The preoperative visit of this patient revealed unsuspected cardiac disease and resulted in appropriate steps for risk stratification and modification with significant potential for reduction in morbidity and mortality.

Research in Perioperative Medicine

21 Needs Analysis for the Development of a Preoperative Clinic Protocol for Perioperative Beta-Blockade

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Background: Successful institutional implementation of perioperative beta-blockade involves the development of an interdisciplinary hospital protocol that is likely to be most effective when implemented prior to the day of the surgical procedure. This can be difficult, however, as it requires education across a number of provider disciplines in the institution, review of preoperative prescriptive privileges, standardization of preoperative processes that may be currently left to individual providers, monitoring, and accountability. Our hypothesis was that a significant number of patients who are candidates for perioperative beta-blockers would not be receiving them adequately in the perioperative period. This study describes a needs analysis for perioperative beta-blockade based on evaluation of consecutive elective noncardiac surgical patients presenting to a preoperative clinic.

Methods: An algorithm of indications and contraindications for beta-blockade felt to be consistent with the existing literature was designed by multidisciplinary group consensus (Table). Complete data were collected prospectively on 1,000 consecutive patients seen between June 1, 2004, and August 31, 2004. Data collected included patient demographics, medication history, risk factors, indications and contraindications to beta-blockade, as well as surgical risk stratification and postoperative complications.

Results: Of the 1,000 patients studied in the preoperative clinic, 960 underwent surgery and had complete information collection; 169 patients (17.5%) were already receiving beta-blockade therapy. Of the patients having high-risk surgery, 89% (42/47) had indications for beta-blockade; 31 (74%) of these did not have contraindications. Of the other patients, 60% (450/744) had indications for beta-blockade; 380 (84%) of these did not have contraindications. Overall, 71% (411/580) of the patients who were candidates for perioperative beta-blockade were not receiving it. Of the 38 patients with postoperative cardiac complications, 23 (61%) who were not on beta-blockers ($P < .001$) would have qualified for therapy.

Conclusion: Development, implementation, and monitoring of perioperative beta-blockade protocols is necessary, as a significant number of appropriate patients were not receiving this therapy. The use of such algorithms requires education, organizational strategies, and study of quality-related outcomes.

TABLE
INDICATIONS FOR PERIOPERATIVE BETA-BLOCKADE

Major indicators	Minor indicators
History of angina	Age > 65 yr
History of coronary artery disease	History of renal insufficiency (Cr > 2)
History of congestive heart failure	Current smoking history
History of cerebrovascular accident	History of hypertension
History of diabetes	History of hypercholesterolemia

22 Improving Efficiency in a Preoperative Clinic

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Background: Preoperative assessment testing clinics coordinate preoperative surgical, anesthesia, nursing, and laboratory care and allow for medical optimization of patients preoperatively and transmission of information to the operating room team. Performance of this evaluation is ideally practiced in the setting of high patient and family satisfaction. Previously we demonstrated higher satisfaction scores among patients evaluated by a nurse practitioner (NP) than among patients seen by other providers.[1] As a follow-up we hypothesized that having NPs perform all the preoperative assessment, including the anesthesia component, would increase efficiency.

Methods: A change in provider function was implemented so that a single NP performed the surgical, nursing, and anesthesia assessments in one room while also having the laboratory technician do blood work and ECGs in the same room. Concurrently, we introduced sessions on patient relations and teamwork for our staff. We developed a one-page questionnaire, consisting of questions on satisfaction with clinical and nonclinical providers, and distributed it to all patients in the clinic during two different cycles in 2005 and 2006.

Results: Analysis of results for 2005 revealed that patients reported a high level of overall satisfaction for visits with clinical providers; satisfaction was lowest for nonclinical aspects of the visits, with waiting time having the lowest satisfaction rating, rated fair or poor by 16% and 24% of patients, respectively. Reasons for prolonged waiting times included multiple providers performing assessments in different rooms with waiting periods between each provider.

After implementation of the change, we compared these 2005 data with new questionnaire data from 2006. Waiting time was reduced from 92 minutes to 41 minutes ($P \leq .0001$). Responses to all questions shifted in the positive direction. Questions directly addressing waiting time and receptionist interaction with patients demonstrated substantial improvement. The most striking change was in response to the question about waiting time; the percentage of "excellent/good" responses increased from 59.7% to 69.2% (Table).

Conclusion: Analysis of patient flow and clinic operations led to alterations in operational patterns, which resulted in continued high clinical effectiveness and reduced waiting time, characteristics that are likely to improve patient satisfaction and overall efficiency of preoperative assessment testing clinics.

1. *Hepner DL, Bader AM, Hurwitz S, et al. Patient satisfaction with preoperative assessment in a preoperative assessment testing clinic. Anesth Analg 2004; 98:1099–1105.*

TABLE
PERCENTAGE OF PATIENTS REPORTING HIGH SATISFACTION SCORES

Question	2005	2006
Efficiency of receptionist	96.6	99.5*
Length of time waiting	59.7	69.2*
Overall care received	98	98.5†

* $P < .01$; † P = NS

23 Formalized Preoperative Assessment for Noncardiac Surgery at a Large Tertiary Care Medical Center Leads to Higher Rates of Perioperative Beta-Blocker Use

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Background: Several randomized and observational trials in the past decade and the more recent ACC/AHA guidelines support the use of preoperative beta-blockers in select patients. National patient quality and safety groups continue to advocate for the administration of preoperative beta-blockers (PBB) for noncardiac surgery (NCS) and measure its use as a marker of quality. We sought to determine the prescription of PBB and the predictors of use in preparation for NCS at a large tertiary care academic medical center.

Methods: We performed a retrospective cohort study of 12,848 patients from January to December 2005 who had an elective NCS requiring at least an overnight admission to the hospital. Patients were identified from the surgery scheduling system. The following data were abstracted from hospital information systems and combined into a single data set for analysis: demographics; preoperative outpatient assessment, functional status, and anesthesia risk; laboratory results; prescribed medications; type of surgery; and hospitalization data . A multilevel model examined factors associated with the probability of preoperative patient assessment in the IMPACT (Internal Medicine Preoperative Assessment, Consultation, and Treatment) Center and, secondly, factors associated with perioperative prescription of beta-blockers.

Results: Overall, the rate of preoperative patient assessment in the IMPACT Center run by hospitalists was 56.2%. The crude rate of PBB use was 25.4%. Patient age, gender, higher anesthesia risk (assessed by our computerized program called Health Quest), and surgical specialty were significant independent predictors of preoperative patient assessment in the IMPACT Center. A formal preoperative assessment in the IMPACT Center was a significant independent predictor of PBB use controlling for patient age, beta-blocker eligibility, and surgical specialty (adjusted OR, 19.4 [$P < .001$]).

Conclusion: PBB are significantly more likely to be prescribed to patients undergoing NCS when patients are evaluated in formalized preoperative assessment centers staffed by hospitalists or internists such as ours. Further research is under way to investigate whether the higher use of PBB actually translates into better clinical outcomes (with fewer cardiac events) and decreased length of stay.

24 Insulin Errors in Hospitalized Patients

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Background: Insulin errors are among the most common medication errors among hospitalized patients. Few data exist on analyses of the type and impact of such insulin errors on patient care. With increasing efforts at intensive glycemic control in the hospital setting, any variable that compromises glucose control must be evaluated.

Aims: To analyze the rate, types, and effects of insulin administration errors on hospital units.

Methods: A diabetes nurse practitioner prospectively reviewed records of diabetic patients recieving insulin on hospital units at a tertiary care center for up to 5 days after endocrine service consultation. Nine types of insulin errors (eg, omission, wrong dose, wrong time) and associated levels of harm were studied. We conducted five surveys of 30 consecutive patients per survey over a 2-year period. Through close collaboration with the Department of Nursing Education, lunchtime in-services were provided on the nursing units and a formal 16-hour diabetes education program for nurses was offered following the first survey.

Results: A total of 150 patients were followed for an average of 4.2 days. The most common type of insulin error was omission error. Through nursing floor focus group discussion, we discovered that the most common reason for omission error was nutrition interruption and fear of hypoglycemia. The Table presents the total number of errors, total number of insulin injections, and percentage of injections that involved an error for each of the five surveys.

Conclusion: Careful monitoring of insulin errors and nursing education may reduce the risk for insulin errors on hospital units. Our survey indicates that the most common insulin error on hospital units is omission error due to nutrition interruption and the fear of hypoglycemia. Most insulin errors resulted in no harm or required only temporary monitoring.

TABLE
FINDINGS FROM THE FIVE SURVEYS

	Survey				
	1	2	3	4	5
No. patients	30	30	30	30	30
No. insulin errors	12	16	9	11	9
Duration of survey (days)	3.56	4.46	4.36	3.8	4.76
Total no. of insulin injections	427	535	523	456	571
Percentage error (%)	2.8	3	1.7	2.4	1.6

25 A Survey of Perioperative Beta-Blockade at a Comprehensive Cancer Center

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Background: This study seeks to determine the number of cancer patients who qualify for perioperative beta-blockade but for whom the opportunities to prescribe are missed. Additionally, this study will attempt to determine the extent to which preoperative assessment by an internal medicine physician is successful in addressing this problem.

Methods: This retrospective chart review included 300 medical records from the University of Texas M.D. Anderson Cancer Center. Patients were eligible if they attended a preoperative anesthesia consultation during May 2005 and met the following clinical guidelines for perioperative beta-blockade: two or more

minor risk factors (age > 65 years, hypertension, tobacco use, hypercholesterolemia, and non–insulin-dependent diabetes) or one or more major risk factors (high-risk surgery, coronary artery disease, ischemic heart disease, stroke, insulin-dependent diabetes, creatinine > 2.0 mg/dL). The electronic medical record was used to determine whether patients were on beta-blockers at the time of anesthesia assessment and whether they attended a preoperative consultation with Cardiology or with the Internal Medicine Perioperative Assessment Center (IMPAC). The study was approved by the institutional review board at the University of Texas M.D. Anderson Cancer Center.

Results: Overall, 52.7% of patients determined to be eligible for beta-blockade received this therapy. Within this percentage 73.4% were prescribed beta-blockade prior to becoming a candidate for surgery and 26.6% were specifically prescribed perioperative beta-blockade. Patients who attended IMPAC were 49% more likely to have beta-blockade at the time of anesthesia assessment than patients who did not attend IMPAC (OR, 1.49; 95% CI: 1.32 to 1.70).

Conclusion: The percentage of patients in this study who received perioperative beta-blockade was higher than predicted by the literature. However, many of the patients who received beta-blockers at the time of assessment were taking them for long-term treatment of other comorbid conditions. Only 22.8% of the patients who were eligible for perioperative beta-blockade and who were not already on beta-blockers were prescribed such prior to surgery. Among patients who attended IMPAC and who were not previously on beta-blockade, 80.4% were prescribed perioperative beta-blockade by IMPAC. These results strongly suggest that preoperative assessment by an internal medicine physician may increase a patient's chances of receiving therapies known to reduce risk during surgery.

26 Risk Factors for Long-Term Mortality among Heart Failure Patients after Elective Major Noncardiac Surgery

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Background: We sought to investigate risk factors for perioperative mortality among heart failure (HF) patients undergoing elective major noncardiac surgery because determinants of poor surgical outcomes for this patient population have not been well studied.

Methods: We reviewed data for consecutive patients who underwent a systematic perioperative risk evaluation and treatment by hospitalists at a preoperative clinic between January 2003 and March 2006. Patients were subdivided into those with systolic heart failure (SHF) (EF ≤ 40%) or heart failure with preserved systolic function (HFPSF) (EF > 40%). Multivariable logistic regression and propensity analyses of matched cohorts with Cox regression as the final model were used to identify preoperative variables associated with HF mortality.

Results: Five hundred sixty-four HF patients (194 with SHF and 370 with HFPSF) and 10,701 control patients without HF were followed for a median of 1.9 years postoperatively. In univariable analysis, patients with a diagnosis of either HF, SHF, or HFPSF had higher mortality than controls (Table).

In propensity-matched analysis, only SHF but not overall HF or HFPSF was significantly associated with increased mortality (Table). Compared with HFPSF, SHF was associated with increased mortality risk, which persisted after adjusting for age, sex, race, and surgery type (Table). Independent predictors of increased mortality in overall HF were coexisting cancer (P = .001), advanced age (P = .018), and absence of diuretic use (P = .009).

Conclusion: With adjustment for possible confounders, SHF but not HFPSF was significantly associated with increased long-term mortality. Advanced age and cancer, but not the type of surgery, were independent predictors of mortality in HF. Diuretic use was an independent predictor of reduced mortality.

TABLE
COX PROPORTIONAL HAZARDS ANALYSIS FOR MORTALITY IN HEART FAILURE PATIENTS AFTER NONCARDIAC SURGERY

Group	Unmatched hazard ratio (95% CI)	Propensity-matched hazard ratio (95% CI)
HF vs control	2.91 (2.28–3.65)**	1.23 (0.87–1.74)
SHF vs control	4.23 (3.01–5.80)**	1.86 (1.07–3.31)*
HFPSF vs control	2.27 (1.64–3.06)**	1.27 (0.80–2.30)
SHF vs HFPSF	1.86 (1.20–2.88)**	1.60 (1.01–2.52)*†

* $P \leq .05$; ** $P < .001$; † Hazard ratio adjusted for age, sex, race, and surgery type

INDEX OF AUTHORS AND PRESENTERS

OA = oral abstract
P = poster (followed by poster number)