

2012 Society for Ambulatory Anesthesia  
**Educational  
Bibliography**

## Introduction

This document is the compilation of contributions by several members of the SAMBA Education Committee. The purpose is to provide to the SAMBA membership and other visitors to the SAMBA website a contemporary reference list covering many important topics in Ambulatory Anesthesia.

## Overview

Several concise texts are available at reasonable cost covering Ambulatory Anesthesia, edited by outstanding teachers and containing contributed chapters by experts in this field. Recommended comprehensive reading texts are: Handbook of Ambulatory Anesthesia (2nd Ed.) Twersky and Phillip, Editors; 2008 Springer, New York.; and Ambulatory Anesthesia and Perioperative Analgesia; Steele, Nielson and Klein, Editors; 2005 McGraw-Hill, New York. Brian Williams edited a compendium of "Regional Anesthesia for Ambulatory Surgery" in International Anesthesiology Clinics, Vol. 43, Number 3, 2005 Lippincott Williams & Wilkins. More recently a concise single authored text, Clinical Ambulatory Anesthesia, Cambridge University Press, 2010, by Johan Raeder, Oslo, Norway, provides a readable overview with emphasis on pharmacology and TIVA as well as patient selection and management. The third chapter, "Procedure, Patient Selection and Pre-admittance Preparation" in Professor Raeder's text, precisely distinguishes the characteristics that make operative care and perioperative care unique in a Day Surgery Unit.

## Contributors

Shireen Ahmad, M.D.; Steven Butz, M.D.; Gordon Kerr, M.D.; Jeannette Kierce, M.D.; Audrice Francis, M.D.; Matt Kurek, M.D., FRCP<sup>©</sup>; Roger Mattison, M.D.; Ana Pappas, M.D.; Connie Tran, M.D.; BobbieJean Sweitzer, M.D.

Revised 4/2012 by Ana Pappas M.D., Steven Butz, M.D.

2012 Revisions compiled and edited by David M. Dickerson, M.D.

# Contents

- 1. General Abstracts**
- 2. Pre-Anesthesia Evaluation**
  - a. Cardiac
  - b. Obstructive Sleep Apnea
  - c. Obesity
- 3. Patient Management Issues**
  - a. Obstructive Sleep Apnea
  - b. Diabetes
- 4. Office Based Anesthesia (OBA)**
- 5. Pediatrics**
- 6. Geriatrics**
- 7. General Anesthesia**
  - a. TIVA
  - b. Airway Management Devices
- 8. Regional Anesthesia**
  - a. Techniques
  - b. Adverse Advents
  - c. Continuous Catheters
- 9. Procedural Sedation (outside the O.R.)**
- 10. Post Anesthesia Recovery (PACU)**
  - a. Analgesia
  - b. PONV
- 11. Professionalism and Facility Management**

# 1. General Abstracts

## Surgical Outcomes for Patients Aged 80 and Older: Morbidity and Mortality from Major Noncardiac Surgery

Mary Beth Hamel, M.D., M.P.H.; William G. Henderson, Ph.D.; Shukri F. Khuri, M.D.; Jennifer Daley, M.D.

**Objectives:** To gather information about surgical outcomes for patients in their 80s and 90s.

**Design:** Prospective cohort study.

**Setting:** Veterans Affairs Medical Centers.

**Participants:** Patients (26,648 aged  $\geq 80$ ; 568,263 aged  $< 80$ ) enrolled in the Veterans Affairs National Surgical Quality Improvement Project (NSQIP) who had noncardiac surgery between 1991 and 1999.

**Methods:** Data were collected prospectively from medical records and healthcare providers. Detailed information was collected about patients' preoperative status, intraoperative experience, and postoperative outcomes. Postoperative outcomes were survival status at 30 days (deaths from any cause occurring during hospitalization and after hospital discharge were captured) and the occurrence of 21 selected surgical complications within 30 days postoperatively: wound complications (3 types), respiratory complications (4), urinary tract complications (3), nervous system complications (3), cardiac complications (3), and other complications (5).

**Measurements:** Mortality and the occurrence of 21 surgical complications within 30 days of surgery.

**Results:** Thirty-day all-cause mortality rates varied widely across operations and were higher for patients aged 80 and older than for younger patients (8% vs 3%,  $P < .001$ ). Mortality rates for those aged 80 and older were less than 2% for many commonly performed operations (e.g., transurethral prostatectomy, hernia repair, knee replacement, carotid endarterectomy). Of patients aged 80 and older, 20% had one or more postoperative complications, and patients who suffered complications had higher 30-day mortality than those who did not (26% vs 4%,  $P < .001$ ). For 11 of the 21 complications, mortality for patients aged 80 and older was greater than 33%. The risk factors for poor outcomes were the same for older and younger patients, and the NSQIP Mortality Risk model performed well on patients aged 80 and older (C statistic 0.83).

**Conclusion:** A substantial minority of patients aged 80 and older died or suffered a complication within 30 days of surgery, but for many operations mortality rates were extremely low. Postoperative complications were associated with high 30-day mortality in patients aged 80 and older.

*J Am Geriatr Soc 53:424–429, 2005*

## Risk Associated with Preoperative Anemia in Noncardiac Surgery: A Single-Center Cohort Study

W. Scott Beattie, M.D., Ph.D., F.R.C.P.C.; Keyvan Karkouti, M.D., M.Sc., F.R.C.P.C.; Duminda N. Wijeyesundera, M.D., F.R.C.P.C.; Gordon Tait, Ph.D.

**Background:** Preoperative anemia is an important risk factor for perioperative red blood cell transfusions and has been shown to be independently associated with adverse outcomes after noncardiac surgery. The objective of this observational study was to measure the prevalence of preoperative anemia and assess the relationship between preoperative anemia and postoperative mortality.

**Methods:** Data were retrospectively collected on 7,759 consecutive noncardiac surgical patients at the University Health Network between 2003 and 2006. Preoperative anemia was defined as a hemoglobin concentration less than 12.0 g/dl for women and less than 13.0 g/dl for men. The unadjusted and adjusted relationship between preoperative anemia and mortality was assessed using logistic regression and propensity analyses.

**Results:** Preoperative anemia was common and equal between genders (20.5% for men and 20.0% for women) and

was associated with a nearly five-fold increase in the odds of postoperative mortality. After adjustment for major confounders using logistic regression, anemia was still associated with increased mortality (odds ratio, 2.36; 95% confidence interval, 1.57–3.41). This relationship was unchanged after elimination of patients with severe anemia and patients who received transfusions. In a propensity-matched cohort of patients, anemia was associated with increased mortality (odds ratio, 2.29; 95% confidence interval, 1.45–3.63).

**Conclusions:** Anemia is a common condition in surgical patients and is independently associated with increased mortality. Although anemia increases mortality independent of transfusion, it is associated with increased requirement for transfusion, which is also associated with increased mortality. Treatment of preoperative anemia should be the focus of investigations for the reduction of perioperative risk.

*Anesthesiology, V 110, No 3, Mar 2009*

# Evidence-Based Patient Safety Advisory: Patient Selection and Procedures in Ambulatory Surgery

Phillip C. Haeck, M.D.; Jennifer A. Swanson, B.S., M.Ed.;  
Ronald E. Iverson, M.D.; Loren S. Schechter, M.D.;  
Robert Singer, M.D.; C. Bob Basu, M.D., M.P.H.;  
Lynn A. Damitz, M.D.; Scot Bradley Glasberg, M.D.;  
Lawrence S. Glassman, M.D.; Michael F. McGuire, M.D.;  
and the ASPS Patient Safety Committee, Arlington Heights, Ill.

**Summary:** Despite the many benefits of ambulatory surgery, there remain inherent risks associated with any surgical care environment that have the potential to jeopardize patient safety.

This practice advisory provides an overview of the preoperative steps that should be completed to ensure appropriate patient selection for ambulatory surgery settings. In conjunction, this advisory identifies several physiologic stresses commonly associated with surgical procedures, in addition to potential postoperative recovery problems, and provides recommendations for how best to minimize these complications.

*Plast Reconstr Surg. 124 (Suppl.): 6S, 2009.*

## Elimination of Preoperative Testing in Ambulatory Surgery

Frances Chung, FRCP; Hongbo Yuan, Ph.D.; Ling Yin, M.Sc.;  
Santhira Vairavanathan, M.B.B.S.; David T. Wong, M.D.

**Background:** Preoperative testing has been criticized as having little impact on perioperative outcomes. We conducted a randomized, single-blind, prospective, controlled pilot study to determine whether indicated preoperative testing can be eliminated without increasing the perioperative incidence of adverse events in selected patients undergoing ambulatory surgery.

**Methods:** One thousand sixty-one eligible patients were randomized either to have indicated preoperative testing or no preoperative testing. In the indicated testing group, patients received indicated preoperative testing: a complete blood count, electrolytes, blood glucose, creatinine, electrocardiogram, and chest radiograph according to the Ontario Preoperative Testing Grid as per current practice, whereas in the no testing group, no testing was ordered. The investigators, data collectors, and patient outcome reviewers were blinded to the group assignment. The primary outcome measures were the rate of perioperative

adverse events and the rates of adverse events within 7 and 30 days after surgery.

**Results:** Patients' age, gender, American Society of Anesthesiologists status, type of surgery, and anesthesia were similar between the two groups. There were no significant differences in the rates of perioperative adverse events and the rates of adverse events within 30 days after surgery between the no testing group and the indicated testing group. Hospital revisits  $\leq 7$  days were higher in the indicated testing group ( $P = 0.05$ ). None of the adverse events were related to the indicated testing or no testing.

**Conclusions:** This pilot study showed that there was no increase in the perioperative adverse events as a result of no preoperative testing in our study population. A larger study is needed to demonstrate that indicated testing may be safely eliminated in selected patients undergoing ambulatory surgery without increasing perioperative complications.

*Anesth Analg 2009;108:467-75*

# 2. Pre-Anesthesia Evaluation

## a. Cardiac

### Hypertension, Hypertensive Heart Disease and Perioperative Cardiac Risk<sup>2</sup>

S. J. Howell(1), J. W. Sear(2) and P. FoeËx(2)

1) Academic Unit of Anaesthesia, University of Leeds, Leeds General In@rmary, Leeds, UK.; 2) Nuf@eld Department of Anaesthetics, University of Oxford, John Radcliffe Hospital, Headley Way, Headington, Oxford, UK

The evidence for an association between hypertensive disease, elevated admission arterial pressure, and perioperative cardiac outcome is reviewed. A systematic review and meta-analysis of 30 observational studies demonstrated an odds ratio for the association between hypertensive disease and perioperative cardiac outcomes of 1.35 (1.17±1.56). This association is statistically but not clinically significant. There is little evidence for an association between admission arterial pressures of less than 180 mm Hg systolic or 110 mm Hg diastolic and perioperative complications. The position is less clear in patients with admission arterial pressures above this level. Such patients are more prone to perioperative ischaemia, arrhythmias, and

cardiovascular lability, but there is no clear evidence that deferring anaesthesia and surgery in such patients reduces perioperative risk. We recommend that anaesthesia and surgery should not be cancelled on the grounds of elevated preoperative arterial pressure. The intraoperative arterial pressure should be maintained within 20% of the best estimate of preoperative arterial pressure, especially in patients with markedly elevated preoperative pressures. As a result, attention should be paid to the presence of target organ damage, such as coronary artery disease, and this should be taken into account in preoperative risk evaluation. The anaesthetist should be aware of the potential errors in arterial pressure measurements and the impact of white coat hypertension on them. A number of measurements of arterial pressure, obtained by competent staff (ideally nursing staff), may be required to obtain an estimate of the 'true' preoperative arterial pressure.

*Br J Anaesth 2004; 92: 570-83*

### Perioperative Cardiac Evaluation: Novel Interventions and Clinical Challenges

Donna L. Mercado, M.D.; David Y. Ling, M.D.;  
Gerald W. Smetana, M.D.

Cardiac complications are one of the most important sources of morbidity and mortality after noncardiac surgery. In this review, we discuss the pathophysiology of postoperative cardiac complications and published risk indices and guidelines that allow an estimation of preoperative risk. Recent evidence has challenged the primary role of perioperative beta blockers as a risk reduction strategy. The highest level of evidence for their use is for patients with coronary artery disease or multiple risk factors undergoing vascular surgery. Beta blockers may provide

no benefit or may be potentially harmful for low- and intermediate-risk patients and surgeries. For patients with contraindications to beta blockers, diltiazem and clonidine are alternative agents that reduce cardiac risk. Statins are emerging as another potential strategy to reduce cardiac risk, although the evidence is based primarily on retrospective analyses. Coronary artery revascularization does not reduce cardiac complications after noncardiac surgery among patients with stable coronary artery disease.

*Southern Medical Journal • Volume 100, Number 5, May 2007*

# Perioperative Antiplatelet Therapy: The Case for Continuing Therapy in Patients at Risk of Myocardial Infarction

P.-G. Chassot; A. Delabays; D. R. Spahn

Recent clinical data show that the risk of coronary thrombosis after antiplatelet drugs withdrawal is much higher than that of surgical bleeding if they are continued. In secondary prevention, aspirin is a lifelong therapy and should never be stopped. Clopidogrel is regarded as mandatory until the coronary stents are fully endothelialized, which takes 3 months for bare metal stents, but up to 1 yr for drug-eluting stents. Therefore, interruption of antiplatelet therapy 10 days before surgery should be revised. After reviewing the data on the use of antiplatelet drugs in cardiology and in surgery, we propose an algorithm for

the management of patients, based on the risk of myocardial ischaemia and death compared with that of bleeding, for different types of surgery. Even if large prospective studies with a high degree of evidence are still lacking on different antiplatelet regimens during non-cardiac surgery, we propose that, apart from low coronary risk situations, patients on antiplatelet drugs should continue their treatment throughout surgery, except when bleeding might occur in a closed space. A therapeutic bridge with shorter-acting antiplatelet drugs may be considered.

*British Journal of Anaesthesia* 99 (3): 316–28 (2007)

## Surgical Outcomes for Patients Aged 80 and Older: Morbidity and Mortality from Major Noncardiac Surgery

Mary Beth Hamel, M.D., M.P.H.; William G. Henderson, Ph.D.; Shukri F. Khuri, M.D.; Jennifer Daley, M.D.

**Objectives:** To gather information about surgical outcomes for patients in their 80s and 90s.

**Design:** Prospective cohort study.

**Setting:** Veterans Affairs Medical Centers.

**Participants:** Patients (26,648 aged  $\geq$  80; 568,263 aged  $\geq$  80) enrolled in the Veterans Affairs National Surgical Quality Improvement Project (NSQIP) who had noncardiac surgery between 1991 and 1999.

**Methods:** Data were collected prospectively from medical records and healthcare providers. Detailed information was collected about patients' preoperative status, intraoperative experience, and postoperative outcomes. Postoperative outcomes were survival status at 30 days (deaths from any cause occurring during hospitalization and after hospital discharge were captured) and the occurrence of 21 selected surgical complications within 30 days postoperatively: wound complications (3 types), respiratory complications (4), urinary tract complications (3), nervous system complications (3), cardiac complications (3), and other complications (5).

**Measurements:** Mortality and the occurrence of 21 surgical complications within 30 days of surgery.

**Results:** Thirty-day all-cause mortality rates varied widely across operations and were higher for patients aged 80 and older than for younger patients (8% vs 3%,  $P < .001$ ). Mortality rates for those aged 80 and older were less than 2% for many commonly performed operations (e.g., transurethral prostatectomy, hernia repair, knee replacement, carotid endarterectomy). Of patients aged 80 and older, 20% had one or more postoperative complications, and patients who suffered complications had higher 30-day mortality than those who did not (26% vs 4%,  $P < .001$ ). For 11 of the 21 complications, mortality for patients aged 80 and older was greater than 33%. The risk factors for poor outcomes were the same for older and younger patients, and the NSQIP Mortality Risk model performed well on patients aged 80 and older (C statistic 0.83).

**Conclusion:** A substantial minority of patients aged 80 and older died or suffered a complication within 30 days of surgery, but for many operations mortality rates were extremely low. Postoperative complications were associated with high 30-day mortality in patients aged 80 and older.

*J Am Geriatr Soc* 53:424–429, 2005

# Prevention of Infective Endocarditis Guidelines From the American Heart Association A Guideline From the American Heart Association Rheumatic Fever, Endocarditis, and Kawasaki Disease Committee, Council on Cardiovascular Disease in the Young, and the Council on Clinical Cardiology, Council on Cardiovascular Surgery and Anesthesia, and the Quality of Care and Outcomes Research Interdisciplinary Working Group

Walter Wilson, M.D., Chair; Kathryn A. Taubert, Ph.D., FAHA; Michael Gewitz, M.D., FAHA; Peter B. Lockhart, D.D.S.; Larry M. Baddour, M.D.; Matthew Levison, M.D.; Ann Bolger, M.D., FAHA; Christopher H. Cabell, M.D., M.H.S.; Masato Takahashi, M.D., FAHA; Robert S. Baltimore, M.D.; Jane W. Newburger, M.D., M.P.H., FAHA; Brian L. Strom, M.D.; Lloyd Y. Tani, M.D.; Michael Gerber, M.D.; Robert O. Bonow, M.D., FAHA; Thomas Pallasch, D.D.S., M.S.; Stanford T. Shulman, M.D., FAHA; Anne H. Rowley, M.D.; Jane C. Burns, M.D.; Patricia Ferrieri, M.D.; Timothy Gardner, M.D., FAHA; David Goff, M.D., Ph.D., FAHA; David T. Durack, M.D., Ph.D.

The Council on Scientific Affairs of the American Dental Association has approved the guideline as it relates to dentistry. In addition, this guideline has been endorsed by the American Academy of Pediatrics, Infectious Diseases Society of America, the International Society of Chemotherapy for Infection and Cancer,\* and the Pediatric Infectious Diseases Society.

**Background:** The purpose of this statement is to update the recommendations by the American Heart Association (AHA) for the prevention of infective endocarditis that were last published in 1997.

**Methods and Results:** A writing group was appointed by the AHA for their expertise in prevention and treatment of infective endocarditis, with liaison members representing the American Dental Association, the Infectious Diseases Society of America, and the American Academy of Pediatrics. The writing group reviewed input from national and international experts on infective endocarditis. The recommendations in this document reflect analyses of relevant literature regarding procedure-related bacteremia and infective endocarditis, in vitro susceptibility data of the most common microorganisms that cause infective endocarditis, results of prophylactic studies in animal models of experimental endocarditis, and retrospective and prospective studies of prevention of infective endocarditis. MEDLINE database

searches from 1950 to 2006 were done for English-language papers using the following search terms: endocarditis, infective endocarditis, prophylaxis, prevention, antibiotic, antimicrobial, pathogens, organisms, dental, gastrointestinal, genitourinary, streptococcus, enterococcus, staphylococcus, respiratory, dental surgery, pathogenesis, vaccine, immunization, and bacteremia. The reference lists of the identified papers were also searched. We also searched the AHA online library. The American College of Cardiology/AHA classification of recommendations and levels of evidence for practice guidelines were used. The paper was subsequently reviewed by outside experts not affiliated with the writing group and by the AHA Science Advisory and Coordinating Committee.

**Conclusions:** The major changes in the updated recommendations include the following: (1) The Committee concluded that only an extremely small number of cases of infective endocarditis might be prevented by antibiotic prophylaxis for dental procedures even if such prophylactic therapy were 100% effective. (2) Infective endocarditis prophylaxis for dental procedures is reasonable only for patients with underlying cardiac conditions associated with the highest risk of adverse outcome from infective endocarditis. (3) For patients with these underlying cardiac conditions, prophylaxis is reasonable for all dental procedures that involve manipulation of gingival tissue or the periapical region of teeth or perforation of the oral mucosa. (4) Prophylaxis is not recommended based solely on an increased lifetime risk of acquisition of infective endocarditis. (5) Administration of antibiotics solely to prevent endocarditis is not recommended for patients who undergo a genitourinary or gastrointestinal tract procedure. These changes are intended to define more clearly when infective endocarditis prophylaxis is or is not recommended and to provide more uniform and consistent global recommendations.

*Circulation. 2007;116:1736-1754*

## Coronary Artery Stents: II. Perioperative Considerations and Management

Lisa T. Newsome, M.D., D.M.D.; Robert S. Weller, M.D.; J. C. Gerancher, M.D.; Michael A. Kutcher, M.D.; Roger L. Royster, M.D.

The management of patients with coronary artery stents during the perioperative period is one of the most important patient safety issues clinicians confront. Perioperative stent thrombosis is a life-threatening complication for patients with either bare-metal or drug-eluting stents. Noncardiac surgery appears to increase the risk of stent thrombosis, myocardial infarction, and death, particularly when patients undergo surgery early after stent implantation. The incidence of complications is further increased when dual-antiplatelet therapy is discontinued preoperatively. It is generally agreed that aspirin must be continued throughout

the perioperative period, except in circumstances when the risk of bleeding significantly outweighs the benefit of continued anticoagulation, such as procedures performed in a closed space. We present considerations for regional anesthesia, as well as postoperative recommendations as the occurrence of perioperative stent thrombosis appears to be greatest during this period. Immediate percutaneous coronary intervention is the definitive treatment for perioperative stent thrombosis, and 24-h access to an interventional cardiology suite should be readily available. Algorithms for perioperative management of patients with bare-metal and drug-eluting stents are proposed.

*Anesth Analg 2008;107:570-90*

# Practice Advisory for Preanesthesia Evaluation An Updated Report by the American Society of Anesthesiologists Task Force on Preanesthesia Evaluation

Updated by the Committee on Standards and Practice Parameters, Jeffrey L. Apfelbaum, M.D. (Chair), Chicago, Illinois; Richard T. Connis, Ph.D., Woodinville, Washington; David G. Nickinovich, Ph.D., Bellevue, Washington. The original document was developed by the American Society of Anesthesiologists Task Force on Preanesthesia Evaluation: L. Reuven Pasternak, M.D. (Chair), Baltimore, Maryland; James F. Arens, M.D., Houston, Texas; Robert A. Caplan, M.D., Seattle, Washington; Richard T. Connis, Ph.D., Woodinville, Washington; Lee A. Fleisher, M.D., Baltimore, Maryland; Richard Flowerdew, M.B., Portland, Maine; Barbara S. Gold, M.D., Minneapolis, Minnesota; James F. Mayhew, M.D., League City, Texas; David G. Nickinovich, Ph.D., Bellevue, Washington; Linda Jo Rice, M.D., St. Petersburg, Florida; Michael F. Roizen, M.D., Chicago, Illinois; Rebecca S. Twersky, M.D., Brooklyn, New York.

## Appendix 1: Summary of Advisory Statements

### I. Preanesthesia History and Physical Examination

#### Impact

The assessment of anesthetic risks associated with the patient's medical conditions, therapies, alternative treatments, surgical and other procedures, and of options for anesthetic techniques is an essential component of basic anesthetic practice.

- *Benefits may include, but are not limited to, the safety of perioperative care, optimal resource use, improved outcomes, and patient satisfaction.*

#### Timing

An assessment of readily accessible, pertinent medical records with consultations, when appropriate, should be performed as part of the preanesthetic evaluation before the day of surgery for procedures with high surgical invasiveness.

- *For procedures with low surgical invasiveness, the review and assessment of medical records may be done on or before the day of surgery by anesthesia staff.*
- *The information obtained may include, but should not be limited to, (1) a description of current diagnoses; (2) treatments, including medications and alternative therapies used; and (3) determination of the patient's medical condition(s).*
- *The timing of such assessments may not be practical with the current limitation of resources provided in specific healthcare systems or practice environments.*

An initial record review, patient interview, and physical examination should be performed before the day of surgery for patients with high severity of disease.

- *For patients with low severity of disease and undergoing procedures with high surgical invasiveness, the interview and physical exam should also be performed before the day of surgery.*
- *For patients with low severity of disease undergoing procedures with medium or low surgical invasiveness, the initial interview and physical exam may be performed on or before the day of surgery.*
- *At a minimum, a focused preanesthetic physical examination should include an assessment of the airway, lungs, and heart, with documentation of vital signs.*

It is the obligation of the healthcare system to, at a minimum, provide pertinent information to the anesthesiologist for the appropriate assessment of the severity of the medical condition of the patient and invasiveness of the proposed surgical procedure well in advance of the anticipated day of procedure for all elective patients.

## II. Selection and Timing of Preoperative Tests

### Routine Preoperative Testing

- *Preoperative tests should not be ordered routinely.*

Preoperative tests may be ordered, required, or performed on a selective basis for purposes of guiding or optimizing perioperative management.

- *The indications for such testing should be documented and based on information obtained from medical records, patient interview, physical examination, and type and invasiveness of the planned procedure.*

### Preoperative Testing in the Presence of Specific Clinical Characteristics

There is insufficient evidence to identify explicit decision parameters or rules for ordering preoperative tests on the basis of specific clinical characteristics.

Consideration of selected clinical characteristics may assist the anesthesiologist when deciding to order, require, or perform preoperative tests. The following clinical characteristics may be of merit, although the anesthesiologist should not limit consideration to the characteristics suggested below.

#### Electrocardiogram

- *Important clinical characteristics may include cardiocirculatory disease, respiratory disease, and type or invasiveness of surgery.*
- *The Task Force recognizes that ECG abnormalities may be higher in older patients and in patients with multiple cardiac risk factors.*
- *An ECG may be indicated for patients with known cardiovascular risk factors or for patients with risk factors identified in the course of a preanesthesia evaluation. Age alone may not be an indication for ECG.*

#### Preanesthesia Cardiac Evaluation Other than ECG

- *Preanesthesia cardiac evaluation may include consultation with specialists and ordering, requiring, or performing tests that range from noninvasive passive or provocative screening tests (e.g., stress testing) to noninvasive and invasive assessment of cardiac structure, function, and vascularity (e.g., echocardiogram, radionuclide imaging, cardiac catheterization).*
- *Anesthesiologists should balance the risks and costs of these evaluations against their benefits.*
- *Clinical characteristics to consider include cardiovascular risk factors and type of surgery.*

#### Preanesthesia Chest Radiographs

- *Clinical characteristics to consider include smoking, recent upper respiratory infection, COPD, and cardiac disease.*

The Task Force recognizes that chest radiographic abnormalities may be higher in such patients but does not believe that extremes of age, smoking, stable COPD, stable cardiac disease, or resolved recent upper respiratory infection should be considered unequivocal indications for chest radiography.

### **Preanesthesia Pulmonary Evaluation Other than Chest X-ray**

• *Preanesthesia pulmonary evaluation other than chest x-ray may include consultation with specialists and tests that range from noninvasive passive or provocative screening tests (e.g., pulmonary function tests, spirometry, pulse oximetry) to invasive assessment of pulmonary function (e.g., arterial blood gas).*

Anesthesiologists should balance the risks and costs of these evaluations against their benefits.

Clinical characteristics to consider include type and invasiveness of the surgical procedure, interval from previous evaluation, treated or symptomatic asthma, symptomatic COPD, and scoliosis with restrictive function.

### **Preanesthesia Hemoglobin or Hematocrit**

• *Routine hemoglobin or hematocrit is not indicated.*  
• *Clinical characteristics to consider as indications for hemoglobin or hematocrit include type and invasiveness of procedure, patients with liver disease, extremes of age, and history of anemia, bleeding, and other hematologic disorders.*

### **Preanesthesia Coagulation Studies**

• *Clinical characteristics to consider for ordering selected coagulation studies include bleeding disorders, renal dysfunction, liver dysfunction, and type and invasiveness of procedure.*

The Task Force recognizes that anticoagulant medications and alternative therapies may present an additional perioperative risk.

The Task Force believes that there were not enough data to comment on the advisability of coagulation tests before regional anesthesia.

### **Preanesthesia Serum Chemistries (i.e., Potassium, Glucose, Sodium, Renal and Liver Function Studies)**

• *Clinical characteristics to consider before ordering preanesthesia serum chemistries include likely perioperative therapies, endocrine disorders, risk of renal and liver dysfunction, and use of certain medications or alternative therapies.*

The Task Force recognizes that laboratory values may differ from normal values at extremes of age.

### **Preanesthesia Urinalysis**

• *Urinalysis is not indicated except for specific procedures (e.g., prosthesis implantation, urologic procedures) or when urinary tract symptoms are present.*

### **Preanesthesia Pregnancy Testing**

• *Patients may present for anesthesia with early undetected pregnancy.*

The Task Force believes that the literature is inadequate to inform patients or physicians on whether anesthesia causes harmful effects on early pregnancy.

Pregnancy testing may be offered to female patients of childbearing age and for whom the result would alter the patient's management.

### **Timing of Preoperative Testing**

• *The current literature is not sufficiently rigorous to permit an unambiguous assessment of the clinical benefits or harms of the timing for preoperative tests.*

There is insufficient evidence to identify explicit decision parameters or "rules" for ordering preoperative tests on the basis of specific patient factors.

• *Test results obtained from the medical record within 6 months of surgery generally are acceptable if the patient's medical history has not changed substantially.*

More recent test results may be desirable when the medical history has changed, or when a test results may play a role in the selection of a specific anesthetic technique (e.g., regional anesthesia in the setting of anticoagulation therapy).

### **III. Summary and Conclusions**

• Content of the preanesthetic evaluation includes, but is not limited to, (1) readily accessible medical records, (2) patient interview, (3) a directed preanesthesia examination, (4) preoperative tests when indicated, and (5) other consultations when appropriate. At a minimum, a directed preanesthetic physical examination should include an assessment of the airway, lungs, and heart.

• Timing of the preanesthetic evaluation can be guided by considering combinations of surgical invasiveness and severity of disease, as shown in table 2 (appendix 2).

Limitations in resources available to a specific healthcare system or practice environment may affect the timing of the preanesthetic evaluation.

The healthcare system is obligated to provide pertinent information to the anesthesiologist for the appropriate assessment of the invasiveness of the proposed surgical procedure and the severity of the patient's medical condition well in advance of the anticipated day of procedure for all elective patients.

• Routine preoperative tests (i.e., tests intended to discover a disease or disorder in an asymptomatic patient) do not make an important contribution to the process of perioperative assessment and management of the patient by the anesthesiologist.

• Selective preoperative tests (i.e., tests ordered after consideration of specific information obtained from sources such as medical records, patient interview, physical examination, and the type or invasiveness of the planned procedure and anesthesia) may assist the anesthesiologist in making decisions about the process of perioperative assessment and management.

• Decision-making parameters for specific preoperative tests or for the timing of preoperative tests cannot be unequivocally determined from the available scientific literature.

Specific tests and their timing should be individualized and based upon information obtained from sources such as the patient's medical record, patient interview, physical examination, and the type and invasiveness of the planned procedure.

## 2. Pre-Anesthesia Evaluation

### b. Obstructive Sleep Apnea

#### STOP Questionnaire: A Tool to Screen Patients for Obstructive Sleep Apnea

Frances Chung, F.R.C.P.C.; Balaji Yegneswaran, M.B.B.S.; Pu Liao, M.D.; Sharon A. Chung, Ph.D.; Colin M. Shapiro, F.R.C.P.C.

**Background:** Obstructive sleep apnea (OSA) is a major risk factor for perioperative adverse events. However, no screening tool for OSA has been validated in surgical patients. This study was conducted to develop and validate a concise and easy-to-use questionnaire for OSA screening in surgical patients.

**Methods:** After hospital ethics approval, preoperative patients aged 18 yr or older and without previously diagnosed OSA were recruited. After a factor analysis, reliability check, and pilot study; four yes/no questions were used to develop this screening tool. The four questions were respectively related to snoring, tiredness during daytime, observed apnea, and high blood pressure (STOP). For validation, the score from the STOP questionnaire was evaluated versus the apnea–hypopnea index from monitored polysomnography.

**Results:** The STOP questionnaire was given to 2,467 patients, 27.5% classified as being at high risk of OSA. Two hundred eleven patients underwent polysomnography, 34 for the pilot test and 177 for validation. In the validation group, the apnea–hypopnea index was  $20 \pm 6$ . The sensitivities of the STOP questionnaire with apnea–hypopnea index greater than 5, greater than 15, and greater than 30 as cutoffs were 65.6, 74.3, and 79.5%, respectively. When incorporating body mass index, age, neck circumference, and gender into the STOP questionnaire, sensitivities were increased to 83.6, 92.9, and 100% with the same apnea–hypopnea index cutoffs.

**Conclusions:** The STOP questionnaire is a concise and easy-to-use screening tool for OSA. It has been developed and validated in surgical patients at preoperative clinics. Combined with body mass index, age, neck size, and gender, it had a high sensitivity, especially for patients with moderate to severe OSA.

*Anesthesiology, V 108, No 5, May 2008*

## 2. Pre-Anesthesia Evaluation

### c. Obesity

#### Obesity as a Risk Factor for Unanticipated Admissions After Ambulatory Surgery

Roger E. Hofer, M.D.; Tetsuya Kai, M.D., Ph.D.; Paul A. Decker, M.S.; David O. Warner, M.D.

**Objective:** To test the hypothesis that obesity is an independent risk factor for unplanned hospital admission or readmission among patients scheduled for ambulatory surgery in a tertiary medical center.

**Patients and Methods:** Existing databases were used to identify 235 obese patients (body mass index [BMI]  $>40$ ) scheduled for ambulatory surgery from January 2, 2002, through December 31, 2003, at Mayo Clinic's site in Rochester, MN. Each patient was matched to a normal-weight control (BMI  $<25$ ) by age, sex, surgical procedure, type of anesthesia, and date of surgery, and the medical records of all patients were reviewed. Conditional logistic regression analysis was performed to assess whether obesity is an independent risk factor for unplanned postoperative

hospital admission. In all cases, 2-sided tests were performed.  $P < .05$  was considered statistically significant.

**Results:** Obese patients (mean  $\pm$  SD BMI,  $44 \pm 4$ ) were matched with control patients (mean  $\pm$  SD BMI,  $23 \pm 2$ ). Comorbidity was more frequent in the obese cohort. The frequency of unplanned hospital admission did not differ between groups: 61 obese patients (26.0%) and 52 control patients (22.1%) were admitted (odds ratio, 1.3; 95% confidence interval, 0.8–2.0;  $P = .30$ ).

**Conclusion:** Obesity is not a significant independent risk factor for unplanned admission after ambulatory surgery, suggesting that obesity per se should not prevent ambulatory surgery from being scheduled.

*Mayo Clinic Proceedings 2008, Vol 83:*

# Postoperative Complications in Obese and Nonobese Patients

Olumuyiwa Bamgbade; Timothy Rutter; Olubukola Nafiu; Pema Dorje

Postoperative complications are undesirable and potentially common in the increasing obese population of surgical patients. There is a scarcity of recent and reliable studies comparing postoperative morbidity and mortality in obese and nonobese patients. The aim of this study was to evaluate the prevalence, pattern, and severity of postoperative complications in obese and nonobese surgical patients.

A retrospective review and analysis of adult postoperative complications recorded on an electronic database was conducted. The database covered a period of 4 years and consisted of 7,271 cases of postoperative complications that occurred within 30 days of noncardiac moderate or major surgery. Appropriate data and variables were compared between obese and nonobese patients using the SPSS program.

The rate of postoperative complications was 7.7%. Obese patients had a higher prevalence of myocardial infarction ( $P = 0.001$ ), peripheral nerve injury ( $P = 0.039$ ), wound infection ( $P = 0.001$ ), and urinary tract infection ( $P = 0.004$ ). Morbidly obese patients had a higher mortality rate of 2.2% compared with 1.2%; for all other patients ( $P = 0.034$ ) and a higher prevalence of tracheal reintubation ( $P = 0.009$ ) and cardiac arrest ( $P = 0.015$ ). Obese patients had higher American Society of Anesthesiologists (ASA) physical status scores than other patients ( $P = 0.001$ ).

Obese patients have a significantly higher risk of postoperative myocardial infarction, wound infection, nerve injury, and urinary infection. Obesity is an independent risk factor for perioperative morbidity, and morbid obesity is a risk factor for mortality.

*World Journal of Surgery, Volume 31, Number 3, March 2007, pp. 556-560(5)*

## Obesity in Surgery Review

**Purpose of Review:** Obese, morbidly obese and ultra-obese patients have multiple surgical procedures. Although they can have an acute abdomen, obstetric procedures, trauma-related procedures and many others, morbidly obese patients are most consistently cared for in the bariatric surgery operating room. The lessons from that group of patients can, could and, usually, should be applied in all patients who are morbidly obese and present for anesthetic care.

**Recent Findings:** There is a paucity of recent evidence-based studies that investigate this patient population. Many recommendations in this review are based on experience of the bariatric anesthesia group at this university hospital. The current review period shows an impressive study that indicates

the possibility of predicting sleep apnea fairly accurately by using a few easily answered questions instead of the 'gold standard' polysomnography. Another study showed that, in the morbidly obese, nasal ventilation might be advantageous over oronasal ventilation prior to induction.

**Summary:** The number of patients with obesity and morbid obesity continues to increase. Following certain guidelines will ease the management and improve outcomes of the morbidly obese patient presenting for any surgery.

*Current Opinion in Anaesthesiology: June 2009 - Volume 22 - Issue 3 - p 442-446*

# 3. Patient Management Issues

## a. Obstructive Sleep Apnea

### Perioperative Management of Children with Obstructive Sleep Apnea

Schwengel D.; Sterni L.; Tunkel D.; Heitmiller E.

Obstructive sleep apnea is a disease process that presents features in children that are distinct from those in adults. It is also, unfortunately, becoming recognized to be far more prevalent than it had been thought to be. We expect to see these children coming

in for tonsillectomies – we also need to be aware that they may be showing up for that out-patient MRI or dental procedure. This is a review article presenting current understanding of management of obstructive sleep apnea in children in the perioperative period.

*Anesth Analg* 2009; 109: 60-75

# 3. Patient Management Issues

## b. Diabetes

### Scientific Principles and Clinical Implications of Perioperative Glucose Regulation and Control

Shamsuddin Akhtar, M.B.B.S.; Paul G. Barash, M.D.; Silvio E. Inzucchi, M.D.

Development of hyperglycemia after major operations is very common and is modulated by many factors. These factors include perioperative metabolic state, intraoperative management of the patient, and neuroendocrine stress response to surgery. Acute insulin resistance also develops perioperatively and contributes significantly to hyperglycemia. Hyperglycemia is associated with poor outcomes in critically ill and postsurgical patients. A majority of the investigations use the term “hyperglycemia” very loosely and use varying thresholds for initiating treatment. Initial studies demonstrated improved outcomes in critically ill, postsurgical patients who received intensive glycemic control (IGC) (target serum glucose <110 mg/dL). These results were quickly

extrapolated to other clinical areas, and IGC was enthusiastically recommended in the perioperative period. However, there are few studies investigating the value of intraoperative glycemic control. Moreover, recent prospective trials have not been able to show the benefit of IGC; neither an appropriate therapeutic glycemic target nor the true efficacy of perioperative glycemic control has been fully determined. Practitioners should also appreciate technical nuances of various glucose measurement techniques. IGC increases the risk of hypoglycemia significantly, which is not inconsequential in critically ill patients. Until further specific data are accumulated, it is prudent to maintain glucose levels <180 mg/dL in the perioperative period, and glycemic control should always be accompanied by close glucose monitoring.

*Anesthesia Analgesia*; 2010; 110:478

# Society for Ambulatory Anesthesia Consensus Statement on Perioperative Blood Glucose Management in Diabetic Patients Undergoing Ambulatory Surgery

Girish P. Joshi, MB, BS, MD, FFARSCI,\* Frances Chung, MD, FRCPC,† Mary Ann Vann, MD,‡ Shireen Ahmad, MD,§ Tong J. Gan, MD, FRCA, Daniel T. Goulson, MD,¶ Douglas G. Merrill, MD,# and Rebecca Twersky, MD, MPH\*\*

Optimal evidence-based perioperative blood glucose control in patients undergoing ambulatory surgical procedures remains controversial. Therefore, the Society for Ambulatory Anesthesia has developed a consensus statement on perioperative glycemic management in patients undergoing ambulatory surgery. A systematic review of the literature was conducted according to the protocol recommended by the Cochrane

Collaboration. The consensus panel used the Grading of Recommendations, Assessment, Development, and Evaluation (GRADE) system for providing suggestions. It was revealed that there is insufficient evidence to provide strong recommendations for the posed clinical questions. In the absence of high-quality evidence, recommendations were based on general principles of blood glucose control in diabetics, drug pharmacology, and data from inpatient surgical population, as well as clinical experience and judgment. In addition, areas of further research were also identified.

*Anesthesia Analgesia* 2010; 111 (6): 1378-1387

## American Association of Clinical Endocrinologists and American Diabetes Association Consensus Statement on Inpatient Glycemic Control

Etie S. Moghissi; Mary T. Korytkowski; Monica DiNardo; Daniel Einhorn; Richard Hellman; Irl B. Hirsch; Silvio E. Inzucchi; Faramarz Ismail-Beigi; M. Sue Kirkman; Guillermo E. Umpierrez

People with diabetes are more likely to be hospitalized and to have longer durations of hospital stay than those without diabetes. A recent survey estimated that 22% of all hospital inpatient days were incurred by people with diabetes and that hospital inpatient care accounted for half of the 174 billion USD total U.S. medical expenditures for this disease (1). These findings are due, in part, to the continued expansion of the worldwide epidemic of type 2 diabetes. In the U.S. alone, there are 1.6 million new cases of diabetes each year, with an overall prevalence of 23.6 million people (7.8% of the population, with one-fourth of the cases remaining undiagnosed). An additional 57 million American adults are at high risk for type 2 diabetes (2). Although the costs of illness-related stress hyperglycemia are not known, they are likely to be considerable in light of the poor prognosis of such patients (3–6).

There is substantial observational evidence linking hyperglycemia in hospitalized patients (with or without diabetes) to poor outcomes. Cohort studies as well as a few early randomized controlled trials (RCTs) have suggested that intensive treatment of hyperglycemia improved hospital outcomes (5–8). In 2004, this evidence led the American College of Endocrinology (ACE) and the American Association of Clinical Endocrinologists (AACE), in collaboration with the American Diabetes Association (ADA) and other medical organizations, to develop recommendations for treatment of inpatient hyperglycemia (9). In 2005, the ADA added recommendations for treatment of hyperglycemia in the hospital to its annual Standards of Medical Care (10). Recommendations from the ACE and the ADA generally endorsed tight glycemic control in critical care units. For patients in general medical and surgical units, where RCT evidence regarding treatment targets was lacking, glycemic goals similar to those advised for outpatients were advocated.

*Diabetes Care* June 2009 32:1119-1131

## Effect of Perioperative Insulin Infusion on Surgical Morbidity and Mortality: Systematic Review and Meta-analysis of Randomized Trials

Gunjan Y. Gandhi; M. Hassan Murad; David N. Flynn; Patricia J. Erwin; Alexandre B. Cavalcante; Henning Bay Nielsen; Sarah E. Capes; Kristian Thorlund; Victor M. Montori; P. J. Devereaux

**Objective:** To conduct a systematic review and meta-analysis of randomized controlled trials (RCTs) to evaluate the effect of perioperative insulin infusion on outcomes important to patients. **Patients and Methods:** We used 6 search strategies including an electronic database search of MEDLINE, EMBASE, and Cochrane CENTRAL, from their inception up to May 1, 2006, and included RCTs of perioperative insulin infusion (with or without glucose targets) measuring outcomes in patients undergoing any surgery. Pairs of reviewers working independently assessed the methodological quality and characteristics of included trials and abstracted data on perioperative outcomes (ie, outcomes that occurred during hospitalization or within 30 days of surgery). **Results:** We identified 34 eligible trials. In the 14 trials that assessed mortality, there were 68 deaths among 2192 patients

pooled relative risk, 0.69; 95% confidence interval [CI], 0.51-0.94; 99% CI, 0.46-1.04; I<sup>2</sup>, 0%; 95% CI, 0.0%-47.4%). Hypoglycemia increased in the intensively treated group (20 trials, 119/1470 patients in insulin infusion vs 48/1476 patients in control group; relative risk, 2.07; 95% CI, 1.29-3.32; 99% CI, 1.09-3.88; I<sup>2</sup>, 31.5%; 95% CI, 0.0%-59.0%). No significant effect was seen in any other outcomes. The available mortality data represent only 40% of the optimal information size required to reliably detect a plausible treatment effect; potential methodological and reporting biases weaken inferences.

**Conclusion:** Perioperative insulin infusion may reduce mortality but increases hypoglycemia in patients who are undergoing surgery; however, mortality results require confirmation in large and rigorous RCTs.

*Mayo Clin Proc.* April 2008 83(4):418-430

# 4. Office Based Anesthesia (OBA)

## Office-Based Anesthesia: How to Start an Office-Based Practice

Matt M. Kurrek, M.D., FRCP(C); Rebecca S. Twersky, M.D., M.P.H.

Ambulatory, office-based anesthesia (OBA) has experienced an exponential growth in the last decade. In the United States between 1995 and 2005, there has been a 100% increase in the number of elective procedures performed in offices, to approximately 10 million procedures per year. It is estimated that between 17% and 24% of all elective ambulatory procedures are currently being performed in an office-based setting.<sup>1</sup> With the evolution of newer surgical and anesthetic techniques, ever more invasive procedures will be done outside of hospitals. This tremendous growth is primarily motivated by the perceived economic advantages as well as the personal attention, care, service, aftercare, ease of scheduling, greater privacy, increased efficiency, decreased nosocomial infection, and consistency in nursing personnel associated with OBA.<sup>2</sup>

Despite its appeal, OBA is not for every provider, nor is it appropriate for every patient or procedure. Special considerations must be made when comparing OBA to a hospital setting, particularly with respect to facility and environment, administration, and accreditation. In an OBA setting, an anesthesiologist must often provide care without significant backup resources and support, and needs to ensure personally that established policies and procedures regarding issues such as fire, safety, drugs, emergencies, staffing, training, and unanticipated patient transfer are in place. While office surgery standards vary depending on specific regulatory statutes, it must be continuously emphasized that the standard of anesthesia care in an office is no different than that of a hospital.

## Inpatient Hospital Admission and Death After Outpatient Surgery in Elderly Patients: Importance of Patient and System Characteristics and Location of Care

Lee A. Fleisher, M.D.; L. Reuven Pasternak, M.D., M.B.A., M.P.H.; Robert Herbert, B.S.; Gerard F. Anderson, Ph.D.

**Hypothesis:** Surgery at different outpatient care locations in the higher-risk elderly (age 65 years) population is associated with similar rates of inpatient hospital admission and death.

**Design:** Claims analysis of patients undergoing 16 different surgical procedures in a nationally representative (5%) sample of Medicare beneficiaries for the years 1994 through 1999.

**Setting:** Hospital-based outpatient centers, freestanding ambulatory surgery centers (ASCs), and physicians' office facilities.

**Patients:** Medicare beneficiaries older than 65 years.

**Main Outcome Measures:** Rate of death, emergency department risk, and admission to an inpatient hospital within 7 days of outpatient surgery.

**Results:** We studied 564267 outpatient surgical procedures: 360780 at an outpatient hospital, 175288 at an ASC, and 28199 at a physician's office. There were no deaths the day of surgery at a physician's office, 4 deaths the day of surgery at an ASC (2.3 per 100000 outpatient procedures), and 9 deaths the day of surgery at an outpatient hospital (2.5 per 100000 outpatient procedures). The 7-day mortality rate was 35 per 100000 outpatient procedures at a physician's office, 25 per 100000 outpatient procedures at an ASC, and 50 per 100000 outpatient procedures at an outpatient hospital. The rate of admission to an inpatient hospital within 7 days of outpatient surgery was 9.08 per 1000 outpatient procedures at a physician's office, 8.41 per 1000 outpatient procedures at an ASC, and 21 per 1000 outpatient procedures at an outpatient hospital. In multivariate models, more advanced age, prior inpatient hospital admission within 6 months, surgical performance at a physician's office or outpatient hospital, and invasiveness of surgery identified those patients who were at increased risk of inpatient hospital admission or death within 7 days of surgery at an outpatient facility.

**Conclusion:** This study represents an initial effort to demonstrate the risk associated with outpatient surgery in a large, diverse population of elderly individuals.

*Arch Surg. 2004;139:67-72*

# Evidence-Based Patient Safety Advisory: Patient Selection and Procedures in Ambulatory Surgery

Phillip C. Haeck, M.D.; Jennifer A. Swanson, B.S., M.Ed.; Ronald E. Iverson, M.D.; Loren S. Schechter, M.D.; Robert Singer, M.D.; C. Bob Basu, M.D., M.P.H.; Lynn A. Damitz, M.D.; Scot Bradley Glasberg, M.D.; Lawrence S. Glassman, M.D.; Michael F. McGuire, M.D.; and the ASPS Patient Safety Committee Arlington Heights, Ill.

**Summary:** Despite the many benefits of ambulatory surgery, there remain inherent risks associated with any surgical care environment that have the potential to jeopardize patient safety.

This practice advisory provides an overview of the preoperative steps that should be completed to ensure appropriate patient selection for ambulatory surgery settings. In conjunction, this advisory identifies several physiologic stresses commonly associated with surgical procedures, in addition to potential postoperative recovery problems, and provides recommendations for how best to minimize these complications.

*Plast. Reconstr. Surg. 124 (Suppl.): 6S, 2009*

# 5. Pediatrics

## Epidemiology of Ambulatory Anesthesia for Children in the United States: 2006 and 1996

Jennifer A. Rabbitts, MB, ChB,\* Cornelius B. Groenewald, MB, ChB,\* James P. Moriarty, MSc,† and Randall Flick, MD, MPH\*

**BACKGROUND:** There are few data that describe the frequency, anesthetic type, provider, or disposition of children requiring outpatient anesthesia in the United States (US). Since the early 1980s, the frequency of ambulatory surgery has increased dramatically because of advances in medical technology and changes in payment arrangements. Our primary aim in this study was to quantify the number of ambulatory anesthetics for children that occur annually and to study the change in utilization of pediatric anesthetic care over a decade.

**METHODS:** The US National Center for Health Statistics performed the National Survey of Ambulatory Surgery in 1994 through 1996 and again in 2006. The survey is based on data abstracted from a national sample of ambulatory surgery centers and provides data on visits for surgical and nonsurgical procedures for patients of all ages. We abstracted data for children who had general anesthesia, regional anesthesia, or monitored anesthesia care during the ambulatory visit. We

obtained the information from the 2006 and 1996 databases and used population census data to estimate the annual utilization of ambulatory anesthesia per 1000 children in the US.

**RESULTS:** In 2006, an estimated 2.3 million ambulatory anesthesia episodes of care were provided in the US to children younger than 15 years (38 of 1000 children). This amount compares with 26 per 1000 children of the same age group in 1996. In most cases, an anesthesiologist was involved in both time periods (74% in 2006 and 85% in 1996). Of the children, 14,200 were admitted to the hospital postoperatively, a rate of 6 per 1000 ambulatory anesthesia episodes.

**CONCLUSION:** The number and rate of ambulatory anesthesia episodes for US children increased dramatically over a decade. This study provides an example of how databases can provide useful information to health care policy makers and educators on the utilization of ambulatory surgical centers by children.

*Anesthesia Analgesia 2010; 111(4): 1011-5*

## Pro-Con Debate: The Place of Premedication in Pediatric Practice

Rosenbaum A.; Kain Z.; Larsson P.; Lonnqvist P.

Attitudes of parents and anesthesia providers toward premedication of children before procedures vary sharply (and sometimes heatedly). This is a pro-con presentation of the

arguments for both sides that can be used to aid the practitioner in making an informed decision about how they handle the issue in their own practice.

*Pediatric Anesthesia 2009; 19: 817-828*

## Anesthesia for the Child with an Upper Respiratory Tract Infection: Still a Dilemma?

Tait A.; Malviya S.

How do you handle the child that comes in for an elective outpatient procedure with an upper respiratory tract infection? The answer in the past was to cancel the case and reschedule when the child was symptom free. This review article presents

the state of knowledge in regards to risk of URI vs. anesthesia, as well as a practical guide to decision making for outpatient elective surgery.

*Anesth Analg 2005; 100(1): 59-65*

# Dexmedetomidine in Children: Current Knowledge and Future Applications

Keira P. Mason, MD,\* and Jerrold Lerman, MD, FRCPC, FANZCA†

More than 200 studies and reports have been published regarding the use of dexmedetomidine in infants and children. We reviewed the English literature to summarize the current state of knowledge of this drug in children for the practicing anesthesiologist. Dexmedetomidine is an effective sedative for infants and children that only minimally depresses the respiratory system while maintaining a patent airway. However, dexmedetomidine does depress the cardiovascular system. Specifically, bradycardia, hypotension, and hypertension occur to varying degrees depending on the age of the child. Hypertension is more prevalent when larger doses of dexmedetomidine are given to infants. Consistent with its 2-hour

elimination half-life, recovery after dexmedetomidine may be protracted in comparison with other sedatives. Dexmedetomidine provides and augments analgesia and diminishes shivering as well as agitation postoperatively. The safety record of dexmedetomidine suggests that it can be used effectively and safely in children, with appropriate monitoring and interventions to manage cardiovascular sequelae.

*Anesthesia Analgesia 2011; 113: 1129–42*

# Creation of a Guide for the Transfer of Care of the Malignant Hyperthermia Patient from Ambulatory Surgery Centers to Receiving Hospital Facilities

Marilyn Green Larach, MD, FAAP,\* Sharon J. Hirshey Dirksen, PhD,† Kumar G. Belani, MBBS, MS,‡  
Barbara W. Brandom, MD,\*§ Keith M. Metz, MD, JD, MSA,  
Michael A. Policastro, MD, FACEP,¶  
Henry Rosenberg, MD,†#\*\* Arnaldo Valedon, MD,††‡‡ and  
Charles B. Watson, MD, FCCM§§

**CLINICAL PROBLEM:** Volatile anesthetics and/or succinylcholine may trigger a potentially lethal malignant hyperthermia (MH) event requiring critical care crisis management. If the MH triggering anesthetic is given in an ambulatory surgical center (ASC), then the patient will need to be transferred to a receiving hospital. Before May 2010, there was no clinical guide regarding the development of a specific transfer plan for MH patients in an ASC.

**MECHANISM BY WHICH THE STATEMENT WAS GENERATED:** A consensual process lasting 18 months among 13 representatives of the Malignant Hyperthermia Association of the United States, the Ambulatory Surgery Foundation, the Society for Ambulatory Anesthesia, the Society for Academic Emergency Medicine, and the National Association of

Emergency Medical Technicians led to the creation of this guide.

**EVIDENCE FOR THE STATEMENT:** Most of the guide is based on the clinical experience and scientific expertise of the 13 representatives. The list of representatives appears in Appendix 1. The recommendation that IV dantrolene should be initiated pending transfer is also supported by clinical research demonstrating that the likelihood of significant MH complications doubles for every 30-minute delay in dantrolene administration (*Anesth Analg* 2010;110:498–507).

**STATEMENT:** This guide includes a list of potential clinical problems and therapeutic interventions to assist each ASC in the development of its own unique MH transfer plan. Points to consider include receiving health care facility capabilities, indicators of patient stability and necessary report data, transport team considerations and capabilities, implementation of transfer decisions, and coordination of communication among the ASC, the receiving hospital, and the transport team. See Appendix 2 for the guide.

*Anesthesia Analgesia 2012; 114 (1): 94–100*

# A Meta-Analysis of the Use of Nonsteroidal Antiinflammatory Drugs for Pediatric Postoperative Pain

Daphne Michelet, MD, Juliette Andreu-Gallien, MD, PhD, Tarik Bensalah, MD, Julie Hilly, MD, Chantal Wood, MD, Yves Nivoche, MD, PhD, Jean Mantz, MD, PhD, and Souhayl Dahmani, MD, PhD

**BACKGROUND:** Opioid side effects are a great concern during the postoperative period in children. Nonsteroidal antiinflammatory drugs (NSAIDs) have been shown to effectively decrease postoperative pain, but their opioid-sparing effect is still controversial. In this present meta-analysis, we investigated the postoperative opioid-sparing effect of NSAIDs in children.

**METHODS:** A comprehensive literature search was conducted to identify clinical trials using NSAIDs and opioids as perioperative analgesic compounds in children and infants. Outcomes measured were opioid consumption, pain intensity, postoperative nausea and vomiting (PONV), and urinary retention. All outcomes were studied during postanesthesia care unit (PACU) stay and the first 24 postoperative hours. Data from each trial were combined to calculate the pooled odds ratios (ORs) or standardized mean difference (SMD) and their 95% confidence interval.

**RESULTS:** Twenty-seven randomized controlled studies were analyzed. Perioperative administration of NSAIDs decreased postoperative opioid requirement (both in the PACU and during the first 24 postoperative hours; SMD 0.66 [0.84, 0.48] and 0.83 [1.11, 0.55], respectively), pain intensity in the PACU (SMD 0.85 [1.24, 0.47]), and PONV during the first 24 postoperative hours (OR 0.75 [0.57–0.99]). NSAIDs did not decrease pain intensity during the first 24 postoperative hours (OR 0.56 [0.26–1.2]) and PONV during PACU stay (OR 1.02 [0.73–1.44]). Subgroup analysis according to the timing of NSAID administration (intraoperative versus postoperative), type of surgery, or coadministration of paracetamol did not show any influence of these factors on the studied outcomes except the reduction of pain intensity and the incidence of PONV during the first 24 postoperative hours, which were influenced by the coadministration of paracetamol and the type of surgery, respectively.

**CONCLUSION:** This meta-analysis shows that perioperative NSAID administration reduces opioid consumption and PONV during the postoperative period in children.

*Anesth Analg 2012; 114(2):393–406*

## Emergence Delirium in Children: Many Questions, Few Answers

Vlajkovic G.; Sindjelic R.

Emergence delirium is a not uncommon phenomenon in the pediatric outpatient surgical patient. This review article is a summary of current thinking about the etiology and epidemiology of this persistent problem. Effective prediction of which children will experience it remains elusive, but some suggestions are made about that - as well as possible treatments/prophylaxis.

*Anesth Analg 2007;104(1): 84-91*

*Maxwell and Yaster. Perioperative Management Issues in Pediatric Patients. Anesthesiology Clinics of North America. Volume 18, Issue 3 (Sept 2000)*

# 6. Geriatrics

## Preoperative Frailty in Older Surgical Patients Is Associated with Early Postoperative Delirium

Jacqueline M. Leung, MD, MPH,\* Tiffany L. Tsai, BA,\* and Laura P. Sands, PhD†

We investigated whether preoperative frailty among older noncardiac surgical patients provides information about the development of postoperative delirium that is in addition to traditional geriatric risk factors. One-third of patients had a frailty score 3, which is considered “frail” in others’ research. Twenty-five percent of patients developed postoperative delirium, which was measured using the confusion assessment method.

Multivariable logistic regression showed that age, activities of daily living dependence, instrumental activities of daily living dependence, and cognitive functioning did not contribute significantly to the prediction of postoperative delirium. Only preoperative symptoms of depression (odds ratio 1.42; 95% confidence interval 1.06–1.91; P 0.018) and the frailty score (odds ratio 1.84; 95% confidence interval 1.07–3.1; P 0.028) were independently associated with the development of postoperative delirium.

*Anesth Analg* 2011; 112(5): 1199–2011

# 7. General Anesthesia

## a. TIVA

## Early Phase Pharmacokinetics but Not Pharmacodynamics Are Influenced by Propofol Infusion Rate

Kenichi Masui, M.D., Ph.D.; Marimo Kira, D.D.S.; Tomiei Kazama, M.D., Ph.D.; Satoshi Hagihira, M.D., Ph.D.; Eric P. Mortier, M.D., D.Sc.; Michel M. R. F. Struys, M.D., Ph.D.

**Background:** Conventional compartmental pharmacokinetic models wrongly assume instantaneous drug mixing in the central compartment, resulting in a flawed prediction of drug disposition for the first minutes, and the flaw affects pharmacodynamic modeling. This study examined the influence of the administration rate and other covariates on early phase kinetics and dynamics of propofol by using the enlarged structural pharmacokinetic model.

**Methods:** Fifty patients were randomly assigned to one of five groups to receive 1.2 mg/kg propofol given with the rate of 10 to 160 mg · kg<sup>-1</sup> · h<sup>-1</sup>. Arterial blood samples were taken frequently, especially during the first minute. The authors compared four basic pharmacokinetic models by using presystemic compartments and the time shift of dosing, LAG time. They also examined a sigmoidal maximum possible drug effect pharmacodynamic model. Patient characteristics and dose rate were obtained to test the model structure.

**Results:** Our final pharmacokinetic model includes two conventional compartments enlarged with a LAG time and six presystemic compartments and includes following covariates: dose rate for transit rate constant, age for LAG time, and weight for central distribution volume. However, the equilibration rate constant between central and effect compartments was not influenced by infusion rate.

**Conclusions:** This study found that a combined pharmacokinetic-dynamic model consisting of a two-compartmental model with a LAG time and presystemic compartments and a sigmoidal maximum possible drug effect model accurately described the early phase pharmacology of propofol during infusion rate between 10 and 160 mg · kg<sup>-1</sup> · h<sup>-1</sup>. The infusion rate has an influence on kinetics, but not dynamics. Age was a covariate for LAG time.

*Anesthesiology*: October 2009 - Volume 111 - Issue 4 - pp 805-817

# Population Pharmacokinetics of Propofol: A Multicenter Study

Jürgen Schüttler, M.D.; Harald Ihmsen, M.Sc.

**Background:** Target-controlled infusion is an increasingly common type of administration for propofol. This method requires accurate knowledge of pharmacokinetics, including the effects of age and weight. The authors performed a multicenter population analysis to quantitate the effects of covariates.

**Methods:** The authors analyzed 4,112 samples of 270 individuals (150 men, 120 women, aged 2-88 yr, weighing 12-100 kg). Population pharmacokinetic modeling was performed using NONMEM (NONMEM Project Group, University of California, San Francisco, CA). Inter- and intraindividual variability was estimated for clearances and volumes. The effects of age, weight, type of administration and sampling site were investigated.

**Results:** The pharmacokinetics of propofol were best described by a three-compartment model. Weight was found to be a significant covariate for elimination clearance, the two intercompartmental clearances, and the volumes of the central compartment, the shallow peripheral compartment, and the deep peripheral compartment; power functions with exponents smaller than 1 yielded the best results. The estimates of these

parameters for a 70-kg adult were 1.44 l/min, 2.25 l/min, 0.92 l/min, 9.3 l, 44.2 l, and 266 l, respectively. For patients older than 60 yr the elimination clearance decreased linearly. The volume of the central compartment decreased with age. For children, all parameters were increased when normalized to body weight. Venous data showed a decreased elimination clearance; bolus data were characterized by increases in the volumes of the central and shallow peripheral compartments and in the rapid distribution clearance (Cl<sub>2</sub>) and a decrease in the slow distribution clearance (Cl<sub>3</sub>).

**Conclusions:** Pharmacokinetics of propofol can be well described by a three-compartment model. Inclusion of age and weight as covariates significantly improved the model. Adjusting pharmacokinetics to the individual patient should improve the precision of target-controlled infusion and may help to broaden the field of application for target-controlled infusion systems.

*Anesthesiology: 2000 - Volume 92 - Issue 3 - pp 727-738*

## 7. General Anesthesia

### b. Airway Management Devices

# 8. Regional Anesthesia

## Regional Anesthesia Practice Abstracts:

### Practice Guidelines for Acute Pain Management in the Perioperative Setting

An Updated Report by the American Society of Anesthesiologists Task Force on Acute Pain Management

Updated by the American Society of Anesthesiologists (ASA) Committee on Standards and Practice Parameters, Jeffrey L. Apfelbaum, M.D. (Committee Chair), Chicago, Illinois; Michael A. Ashburn, M.D., M.P.H. (Task Force Chair), Philadelphia, Pennsylvania; Richard T. Connis, Ph.D., Woodinville, Washington; Tong J. Gan, M.D., Durham, North Carolina; and David G. Nickinovich, Ph.D., Bellevue, Washington. The previous update was developed by the ASA Task Force on Acute Pain Management: Michael A. Ashburn, M.D., M.P.H. (Chair), Salt Lake City, Utah; Robert A. Caplan, M.D., Seattle, Washington; Daniel B. Carr, M.D., Boston, Massachusetts; Richard T. Connis, Ph.D., Woodinville, Washington; Brian Ginsberg, M.D., Durham, North Carolina; Carmen R. Green, M.D., Ann Arbor, Michigan; Mark J. Lema, M.D., Ph.D., Buffalo, New York; David G. Nickinovich, Ph.D., Bellevue, Washington; and Linda Jo Rice, M.D., St. Petersburg, Florida.

#### **Appendix 1: Summary of Recommendations**

##### **I. Institutional Policies and Procedures for Providing Perioperative Pain Management**

- Anesthesiologists offering perioperative analgesia services should provide, in collaboration with other healthcare professionals as appropriate, ongoing education and training to ensure that hospital personnel are knowledgeable and skilled with regard to the effective and safe use of the available treatment options within the institution.
  - Educational content should range from basic bedside pain assessment to sophisticated pain management techniques (e.g., epidural analgesia, PCA, and various regional anesthesia techniques) and nonpharmacologic techniques (e.g., relaxation, imagery, hypnotic methods).
  - For optimal pain management, ongoing education and training are essential for new personnel, to maintain skills, and whenever therapeutic approaches are modified.
- Anesthesiologists and other healthcare providers should use standardized, validated instruments to facilitate the regular evaluation and documentation of pain intensity, the effects of pain therapy, and side effects caused by the therapy.
- Anesthesiologists responsible for perioperative analgesia should be available at all times to consult with ward nurses, surgeons, or other involved physicians.
  - They should assist in evaluating patients who are experiencing problems with any aspect of perioperative pain relief.
- Anesthesiologists providing perioperative analgesia services should do so within the framework of an Acute Pain Service.
  - They should participate in developing standardized institutional policies and procedures.

##### **II. Preoperative Evaluation of the Patient**

- A directed pain history, a directed physical examination, and a pain control plan should be included in the anesthetic preoperative evaluation.

##### **III. Preoperative Preparation of the Patient**

- Patient preparation for perioperative pain management should include appropriate adjustments or continuation of medications to avert an abstinence syndrome, treatment of preexistent pain, or preoperative initiation of therapy for postoperative pain management.

patient and family education regarding their important roles in achieving comfort, reporting pain, and in proper use of the recommended analgesic methods.

- Common misconceptions that overestimate the risk of adverse effects and addiction should be dispelled.
- Patient education for optimal use of PCA and other sophisticated methods, such as patient-controlled epidural analgesia, might include discussion of these analgesic methods at the time of the preanesthetic evaluation, brochures and videotapes to educate patients about therapeutic options, and discussion at the bedside during postoperative visits.
  - Such education may also include instruction in behavioral modalities for control of pain and anxiety.

##### **IV. Perioperative Techniques for Pain Management**

- Anesthesiologists who manage perioperative pain should use therapeutic options such as epidural or intrathecal opioids, systemic opioid PCA, and regional techniques after thoughtfully considering the risks and benefits for the individual patient.
  - These modalities should be used in preference to intramuscular opioids ordered “as needed.”
- The therapy selected should reflect the individual anesthesiologist’s expertise, as well as the capacity for safe application of the modality in each practice setting.
  - This capacity includes the ability to recognize and treat adverse effects that emerge after initiation of therapy.
- Special caution should be taken when continuous infusion modalities are used because drug accumulation may contribute to adverse events.

##### **V. Multimodal Techniques for Pain Management**

- Whenever possible, anesthesiologists should use multimodal pain management therapy.
  - Unless contraindicated, patients should receive an around the-clock regimen of NSAIDs, COXIBs, or acetaminophen.
  - Regional blockade with local anesthetics should be considered.
- Dosing regimens should be administered to optimize efficacy while minimizing the risk of adverse events.
- The choice of medication, dose, route, and duration of therapy should be individualized.

##### **VI. Patient Subpopulations**

- Pediatric patients
  - Aggressive and proactive pain management is necessary to overcome the historic undertreatment of pain in children.
  - Perioperative care for children undergoing painful procedures or surgery requires developmentally appropriate pain assessment and therapy.
    - Analgesic therapy should depend upon age, weight, and comorbidity, and unless contraindicated should involve a multimodal approach.
    - Behavioral techniques, especially important in addressing the emotional component of pain, should be applied whenever feasible.
    - Sedative, analgesic, and local anesthetics are all important components of appropriate analgesic regimens for painful procedures.

appropriate monitoring be used during the procedure and recovery.

- Geriatric patients

- Pain assessment and therapy should be integrated into the perioperative care of geriatric patients.
  - Pain assessment tools appropriate to a patient's cognitive abilities should be used. Extensive and proactive evaluation and questioning may be necessary to overcome barriers that hinder communication regarding unrelieved pain.
  - Anesthesiologists should recognize that geriatric patients may respond differently than younger patients to pain and analgesic medications, often because of comorbidity.
  - Vigilant dose titration is necessary to ensure adequate treatment while avoiding adverse effects such as somnolence in this vulnerable group, who are often taking other

medications (including alternative and complementary agents).

- Other subpopulations

- Anesthesiologists should recognize that patients who are critically ill, cognitively impaired, or have communication difficulties may require additional interventions to ensure optimal perioperative pain management.
- Anesthesiologists should consider a therapeutic trial of an analgesic in patients with increased blood pressure and heart rate or agitated behavior when causes other than pain have been excluded.

*Anesthesiology 2012;116:248-73*

## The ASRA Evidence-Based Medicine Assessment of Ultrasound-Guided Regional Anesthesia and Pain Medicine: Executive Summary

Joseph M. Neal; Richard Brull; Vincent W. S. Chan; Stuart A. Grant; Jean-Louis Horn; Spencer S. Liu; Colin J.L. McCartney; Samer N. Narouze; Anahi Perlas; Francis V. Salinas; Brian D. Sites; Ban Chi-ho Tsui

**Objectives:** The American Society of Regional Anesthesia and Pain Medicine charged an expert panel to examine the evidence basis for ultrasound guidance as a nerve localization tool in the clinical practices of regional anesthesia and interventional pain medicine.

**Methods:** The panel searched, examined, and assessed the literature of ultrasound-guided regional anesthesia (UGRA) from the past 20 years. The qualities of studies were graded using the Jadad score. Strength of evidence and recommendations were graded using an accepted rating tool.

**Results:** The panel made specific literature-based assessments concerning the relative advantages and limitations of UGRA relative to traditional nerve localization methods as they pertained to block characteristics and complications. Assessments and recommendations were made for upper and lower extremity, neuraxial, and truncal blocks and include pediatrics and interventional pain medicine.

**Conclusions:** Ultrasound guidance improves block characteristics (particularly performance time and surrogate measures of success) that are often block specific and that may impart an efficiency advantage depending on individual practitioner circumstances. Evidence for UGRA impacting patient safety is currently limited to the demonstration of improvements in the frequency of surrogate events for serious complications.

*Regional Anesthesia & Pain Medicine. 35(2):S1-S9, March/April 2010.*

## Fifteen Years of Ultrasound Guidance in Regional Anaesthesia: Part 1

P. Marhofer<sup>1</sup>; W. Harrop-Griffiths<sup>2</sup>; S. C. Kettner<sup>1</sup>; L. Kirchmair<sup>3</sup>  
<sup>1</sup>Department of Anaesthesia, Intensive Care Medicine and Pain Therapy, Medical University of Vienna, Waehringer Guertel 18-20, A-1090 Vienna, Austria; <sup>2</sup>Department of Anaesthesia, St Mary's Hospital, Praed Street, London W2 1NY, UK; <sup>3</sup>Department of Anaesthesia, Intensive Care Medicine and Pain Therapy, Medical University of Innsbruck, A-6020 Innsbruck, Austria

Ultrasound guidance for regional anaesthesia has gained enormous popularity in the past decade. The use of ultrasound guidance for many regional anaesthetic techniques is common in daily clinical practice, and the number of practitioners using it is increasing. However, alongside the enthusiasm, there should be a degree of informed scepticism. The widespread use of the various techniques of ultrasound-guided regional blocks without adequate training raises the danger of malpractice and subsequent impaired outcome. Adequate education in the use of regional block techniques under ultrasound guidance is essential. This review

article addresses ultrasound guidance for regional anaesthesia, and is divided into two parts because of the size of the topic and the number of issues covered. This first part includes a review and preview of ultrasound guidance in regional anaesthesia and discusses all aspects of ultrasound for regional anaesthesia with a focus on recent technical developments, the positive implications in economics, further potential advantages (e.g. detection of anatomical variants, painless performance of blocks) and education. It also attempts to define a 'gold standard' in regional anaesthesia with the most recent findings in adequate volumes of local anaesthetics for peripheral nerve blocks. This standard should include an extraneural needle position, a high success rate, and wide application of ultrasound guidance in regional anaesthesia. The second part describes the impact of ultrasound on the development of nerve block techniques in the past 5 yr.

*Br J Anaesth 2010; 104: 538-46*

# Fifteen Years of Ultrasound Guidance in Regional Anaesthesia: Part 2 - Recent Developments in Block Techniques

P. Marhofer<sup>1</sup>; W. Harrop-Griffiths<sup>2</sup>; H. Willschke<sup>1</sup>; L. Kirchmair<sup>1</sup>

<sup>1</sup>Department of Anaesthesia, Intensive Care Medicine, and Pain Therapy, Medical University of Vienna, Waehringer Guertel 18-20, A-1090 Vienna, Austria; <sup>2</sup>Department of Anaesthesia, St Mary's Hospital, Praed Street, London W2 1NY, UK; <sup>3</sup>Department of Anaesthesia, Intensive Care Medicine, and Pain Therapy, Medical University of Innsbruck, A-6020 Innsbruck, Austria

The use of ultrasound guidance for regional anaesthesia has gained enormous popularity in the last 10 yr. The first part of this review article provided information on safety, technical developments, economic aspects, education, advantages, needle guidance techniques, and future developments in ultrasound. The second part focuses on practical and technical details of

individual ultrasound-guided nerve blocks in adults. We present a comprehensive review of the relevant literature of the last 5 yr with a commentary based on our own clinical experience in order to provide information relevant to patient management. Upper limb blocks, including interscalene, supra- and infraclavicular, and axillary approaches, are described and discussed. For the lower limb, psoas compartment, femoral, obturator, sciatic, and lateral cutaneous nerve blocks are described, as are some abdominal wall blocks. The potential role of ultrasound guidance for neuraxial block is addressed. The need for further large-scale studies of the role of ultrasound is emphasized.

*Br J Anaesth* 2010; 104: 673–83

# 8. Regional Anesthesia

## a. Techniques

### A Practical Guide to Commonly Performed Ultrasound-Guided Peripheral-Nerve Blocks

Mitchell Fingermana; James G. Benonisb; Gavin Martinc

**Introduction:** In this article, we will describe the most commonly employed ultrasound-guided peripheral-nerve block techniques at our institution. The information presented herein assumes that the reader has an inherent understanding of the anatomy of the brachial and lumbosacral plexus. In addition, it is expected that the reader has a general comprehension of the basics of ultrasound physics and technique. It is our belief that knowing the following blocks (interscalene, supraclavicular, femoral, and popliteal) will enable clinicians to take care of the majority of peripheral extremity surgeries commonly presenting to the surgical arena. For each block, a step-by-step approach to ultrasound placement will be given as well as the most common risks involved. This section is by no means an all-inclusive guide to ultrasound-guided regional anesthesia (USGRA). It is meant to act as a foundation of skills for the burgeoning regional anesthesiologist.

**Purpose of Review:** Regional anesthesia has experienced a tremendous renaissance of interest over the past several years. Much of this renewed enthusiasm among clinicians is due to the increased usage of ultrasound guidance for peripheral-nerve blocks. This review serves as a useful foundation for the most commonly employed ultrasound-guided blocks utilized by the clinician.

**Recent Findings:** With recent advances in both sonographic capability and access for anesthesia providers, many peripheral-nerve blocks have become quite amenable to being placed with ultrasound guidance. In addition, the subspecialty of ultrasound-guided regional anesthesia is being further pioneered via both anatomical and pharmacological studies.

**Summary:** With ultrasound guidance, the regional anesthesiologist has yet another tool to enhance both the accuracy and success of peripheral-nerve blockade. This article serves to display the most clinically relevant nerve blocks utilized in the perioperative setting. It is meant to be used as a clinical starting point for the development of regional anesthesia skills.

**Basic Principles for Clinicians Learning Ultrasound-Guided Regional Anesthesia:** The following tips are key to having success in both the acquisition and refinement of skills in USGRA. These concise rules serve as an initial guide for our residents and other trainees precepting in the division of regional anesthesia.

Ten points for ultrasound-guided regional block success are as follows.

1. Position the ultrasound machine, probe, and bed height appropriately (your arms will get tired quickly without proper ergonomics).
2. Optimize your image of the structure before proceeding.
3. Insert the needle 'in-plane' to the probe (recommended as the primary technique for beginners).
4. Do not advance the needle unless you visualize the tip at all times (shadows do not count).
5. Move one hand at a time (this helps with orientation).
6. Rest the ultrasound hand on the patient; hold the probe close to the base for better control.
7. When you cannot see the needle, look at your hands, the needle and the probe and their orientation before you reposition.
8. If you think something is a nerve, try to follow its course both proximally and distally (you should be able to track the entire course of the nerve).
9. Know the anatomy (both gross and applied); do not rely on pattern recognition, using a nerve stimulator when starting out is a wise idea.
10. Before you inject local anesthetic, be sure you see the needle tip and other pertinent structures (i.e. blood vessels). If tissues do not move upon local anesthetic injection, stop (you may be injecting into a blood vessel). Frequent aspirations, injection pressure, and patient response (both subjective and objective) are all important factors.

*Current Opinion in Anaesthesiology* 2009; 22:600–607

*Ultrasound Guidance and Peripheral Nerve Injury: Is Our Vision as Sharp as We Think It Is?* Neal, Joseph M.; Wedel, Denise J. *Regional Anesthesia & Pain Medicine*. 35(4):335-337, July/August 2010.

# A Dose-Ranging Study of the Effect of Transversus Abdominis Block on Postoperative Quality of Recovery and Analgesia After Outpatient Laparoscopy

Gildasio S. De Oliveira, Jr., MD, Paul C. Fitzgerald, MS, RN, R-Jay Marcus, MD, Shireen Ahmad, MD, and Robert J. McCarthy, PharmD

**BACKGROUND:** Postoperative pain can delay functional recovery after outpatient surgery. Multimodal analgesia can improve pain and possibly improve quality of recovery. In this study, we evaluated the dose-dependent effects of a preoperative transversus abdominis plane (TAP) block on patient recovery using the Quality of Recovery 40 (QoR-40) questionnaire after ambulatory gynecological laparoscopic surgery. Global QoR-40 scores range from 40 to 200, representing very poor to outstanding quality of recovery, respectively.

**METHODS:** Healthy women undergoing outpatient gynecological laparoscopy were randomly allocated to receive a preoperative TAP block using saline, ropivacaine 0.25%, or ropivacaine 0.5%. Needle placement for the TAP blocks was performed using ultrasound guidance and 15 mL of the study solution was injected bilaterally by a blinded investigator. QoR-40 score and analgesic use were assessed 24 hours postoperatively. The primary outcome was global QoR-40 score at 24 hours after surgery. Data were analyzed using the Kruskal-Wallis test. Post hoc pairwise comparisons were made using the Dunn test with *P* values and 95% confidence intervals Bonferroni corrected for 6 comparisons.

**RESULTS:** Seventy-five subjects were enrolled and 70 subjects completed the study. The median (range) for the QoR-40 score after the TAP block was 157 (127–193), 173 (133–195), and 172 (130–196) for the saline group and 0.25% and 0.5% ropivacaine groups, respectively. The median difference (99.2% confidence interval) in QoR-40 score for 0.5% bupivacaine (16 [1–30], *P* = 0.03) and 0.25% bupivacaine (17 [2–31], *P* = 0.01) was more than saline but not significantly different between ropivacaine groups (–1 [–16 to 12], *P* = 1.0). Increased global QoR-40 scores correlated with decreased area under the pain score time curve during postanesthesia recovery room stay (–0.56, 99.2% upper confidence limit [UCL] –0.28), 24-hour opioid consumption (–0.61, 99.2% UCL –0.34), pain score (0–10 scale) at 24 hours (–0.53, 99.2% UCL –0.25), and time to discharge readiness (–0.65, 99.2% UCL –0.42). The aforementioned variables were lower in the TAP block groups receiving ropivacaine compared with saline.

**CONCLUSIONS:** The TAP block is an effective adjunct in a multimodal analgesic strategy for ambulatory laparoscopic procedures. TAP blocks with ropivacaine 0.25% and 0.5% reduced pain, decreased opioid consumption, and provided earlier discharge readiness that was associated with better quality of recovery.

*Anesth Analg* 2011;113:1218–25

# 8. Regional Anesthesia

## b. Adverse Adverts

### Combination of Intraneural Injection and High Injection Pressure Leads to Fascicular Injury and Neurologic Deficits in Dogs

Admir Hadzic; Faruk Dilberovic; Shruti Shah; Amela Kulenovic; Eldan Kapur; Asija Zaciragic; Esad Cosovic; Ilvana Vuckovic; Kucuk-Alija Divanovic; Zakira Mornjakovic; Daniel M. Thys; Alan C. Santos

**Background:** Unintentional intraneural injection of local anesthetics may cause mechanical injury and pressure ischemia of the nerve fascicles. One study in small animals showed that intraneural injection may be associated with higher injection pressures. However, the pressure heralding an intraneural injection and the clinical consequences of such injections remain controversial. Our hypothesis is that an intraneural injection is associated with higher pressures and an increase in the risk of neurologic injury as compared with perineural injection.

**Methods:** Seven dogs of mixed breed (15-18 kg) were studied. After general endotracheal anesthesia, the sciatic nerves were exposed bilaterally. Under direct microscopic guidance, a 25-gauge needle was placed either perineurally (into the epineurium) or intraneurally (within the perineurium), and 4 mL of lidocaine 2% (1:250,000 epinephrine) was injected by using an automated infusion pump (4 mL/min). Injection pressure data were acquired by using an in-line manometer coupled to a computer via an analog digital conversion board. After injection,

the animals were awakened and subjected to serial neurologic examinations. On the 7th day, the dogs were killed, the sciatic nerves were excised, and histologic examination was performed by pathologists blinded to the purpose of the study.

**Results:** Whereas all perineural injections resulted in pressures  $\leq 4$  psi, the majority of intraneural injections were associated with high pressures (25-45 psi) at the beginning of the injection. Normal motor function returned 3 hours after all injections associated with low injection pressures ( $\leq 11$  psi), whereas persistent motor deficits were observed in all 4 animals having high injection pressures ( $\geq 25$  psi). Histologic examination showed destruction of neural architecture and degeneration of axons in all 4 sciatic nerves receiving high-pressure injections.

**Conclusions:** High injection pressures at the onset of injection may indicate an intraneural needle placement and lead to severe fascicular injury and persistent neurologic deficits. If these results are applicable to clinical practice, avoiding excessive injection pressure during nerve block administration may help to reduce the risk of neurologic injury.

*Regional Anesthesia & Pain Medicine. 29(5):417-423, September/October 2000*

### ASRA Practice Advisory on Local Anesthetic Systemic Toxicity

Joseph M. Neal; Christopher M. Bernards; John F. Butterworth, IV; Guido Di Gregorio; Kenneth Drasner; Michael R. Hejtmanek; Michael F. Mulroy; Richard W. Rosenquist; Guy L. Weinberg

The American Society of Regional Anesthesia and Pain Medicine Practice Advisory on Local Anesthetic Systemic Toxicity assimilates and summarizes current knowledge regarding the prevention, diagnosis, and treatment of this potentially fatal complication. It offers evidence-based and/or expert opinion-based recommendations for all physicians and advanced practitioners who routinely administer local anesthetics in potentially toxic doses. The advisory does not address issues

related to local anesthetic-related neurotoxicity, allergy, or methemoglobinemia. Recommendations are based primarily on animal and human experimental trials, case series, and case reports. When objective evidence is lacking or incomplete, recommendations are supplemented by expert opinion from the Practice Advisory Panel plus input from other experts, medical specialty groups, and open forum. Specific recommendations are offered for the prevention, diagnosis, and treatment of local anesthetic systemic toxicity.

*Regional Anesthesia & Pain Medicine. 35(2):152-161, March/April 2010*

## Treatment of Local Anesthetic Systemic Toxicity (LAST)

Weinberg GL.

The use of lipid emulsion has been shown to be successful in resuscitation of local anesthetic systemic toxicity in animal studies and case reports appeared to validate the efficacy of lipid treatment. 20% lipid emulsion should be administered at the first sign of LAST, after airway management. Seizures should be treated with benzodiazepines, small doses of thiopental or

propofol. Cardiac arrest should be managed by advance cardiac resuscitation with the following recommendations, using only small doses of epinephrine, avoid vasopressin, calcium channel blockers and beta-adrenergic receptor blockers. Consider cardiopulmonary bypass if not responded to lipid emulsion and vasopressor therapy.

*Reg Anesth Pain Med.2010;35(2): 188-193.*

## ASRA Practice Advisory on Local Anesthetic Systemic Toxicity

Neal JM, Bernardis CM, Butterworth JF, Di Gregorio G, Drasner K, Hejmanek MR, Mulroy MF, Rosenquist RW, Weinberg GL.

The American Society of Regional Anesthesia and Pain Medicine Practice Advisory Panel reviewed the issues of local anesthetic systemic toxicity (LAST) and published its recommendations for its prevention which include using the least dose of local anesthetic necessary, knowing patient risk factors, using pharmacologic marker such as epinephrine, aspirating before injecting, giving fractionated doses and frequent assessment for signs and symptoms of LAST. The Panel recommended that patient should be monitored with standard ASA monitors during and after the

procedure as clinical toxicity can be delayed up to 30 minutes. Consider the diagnosis of LAST in any patient with altered mental status, neurological symptoms, or cardiovascular instability following a regional anesthesia. The Panel recommended that in the treatment of LAST to call for help, manage the airway, suppress seizure activities and institute basic and advanced cardiac life support. The early use of 20% lipid emulsion has been shown facilitate resuscitation. The article included a nice appendix which has the summarized recommendations which can be printed and placed in areas where local anesthetics are used.

*Reg Anesth Pain Med.2010;35(2): 152-161.*

# 8. Regional Anesthesia

## c. Continuous Catheters

### Ambulatory Perineural Infusion: The Patients' Perspective

Brian M. Ilfeld; Dasia E. Esener; Timothy E. Morey; Kayser F. Enneking

**Background and Objectives:** Ambulatory perineural local anesthetic infusion is a relatively new method for providing postoperative analgesia, and many aspects of this technique remain in the domain of conjecture and speculation. This retrospective chart review and survey was undertaken to investigate patients' opinions on various aspects of their ambulatory perineural infusion experience.

**Methods:** Patients who had received an ambulatory perineural infusion from the University of Florida were identified via pharmacy records. Patients were contacted by phone and were asked various questions regarding their experiences and preferences during and after their perineural infusion.

**Results:** Of 217 patients identified, 215 charts were located and retrieved. Of these, 137 (64%) were successfully contacted and 131 (61%) consented to take part in the survey. More than 97% of patients reported that they felt "safe" during home infusion, that one physician telephone call each night was optimal contact, and that they were comfortable removing the catheter with instructions given over the phone. Only 4% would have preferred to return for catheter removal, and 43% felt that they would have been comfortable with only written instructions for catheter removal.

**Conclusion:** This investigation suggests that perineural local anesthetic infusion is generally well tolerated by ambulatory patients.

*Regional Anesthesia & Pain Medicine. 28(5):418-423, September/October 2003.*

# Continuous Peripheral Nerve Block for Ambulatory Surgery

Stuart A. Grant; Karen C. Nielsen; Roy A. Greengrass;  
Susan M. Steele; Stephen M. Klein

**Background and Objectives:** Continuous peripheral nerve block (CPNB) can provide surgical anesthesia, prolonged postoperative analgesia, and acceptable side effects. Despite these advantages, CPNB is not in widespread use. Recently a new CPNB catheter system (Contiplex, B. Braun, Bethlehem, PA) was developed based on an insulated Tuohy needle, which allows for injection of local anesthetic and catheter insertion without disconnection or needle movement. At present, no clinical studies exist describing this system.

**Methods:** Data were prospectively gathered for 1 year from 228 patients in an ambulatory surgery center. All CPNB were performed using the Contiplex system to provide anesthesia and postoperative analgesia. CPNB were performed using 5 upper and lower extremity techniques. Postsurgery local anesthetic

was infused and at 24 hours, a rebolus of local anesthetic was performed. The CPNB catheter was removed and patients were examined for loss of sensation. Patients were then discharged.

**Results:** Initial peripheral block was successful in 94% of patients. Failed nerve block requiring general anesthesia occurred in 6%. The catheter was patent and functional in 90% of patients at 24 hours, and 8% of patients required more than 10 mg of intravenous morphine by 24 hours postsurgery. In the postanesthesia care unit (PACU), only 4 patients (1.7%) required treatment for nausea. At 24 hours and 7 days postsurgery, no patient reported a dysesthesia.

**Conclusions:** CPNB using the insulated Tuohy catheter system offered acceptable anesthesia and prolonged pain relief postsurgery. There were few side effects.

*Reg Anesth Pain Med 2001;26:209-214.*

## Continuous Peripheral Nerve Blocks: A Review of the Published Evidence

Brian M. Ilfeld, MD, MS

A continuous peripheral nerve block, also termed “perineural local anesthetic infusion,” involves the percutaneous insertion of a catheter adjacent to a peripheral nerve, followed by local anesthetic administration via the catheter, providing anesthesia/analgesia for multiple days or even months. Continuous peripheral nerve blocks may be provided in the hospital setting, but the use of lightweight, portable pumps permits ambulatory infusion as well. This technique’s most common application is providing analgesia after surgical procedures. However, additional indications include treating intractable hiccups; inducing a sympathectomy and vasodilation to increase blood flow after a vascular accident, digit transfer/replantation, or limb salvage; alleviating vasospasm of Raynaud disease; and treating peripheral embolism and chronic pain such as complex regional pain syndrome, phantom limb pain, trigeminal neuralgia, and cancer-induced pain. After trauma, perineural infusion can provide analgesia during transportation to a distant treatment center, or while simply awaiting surgical repair. Catheter insertion may be accomplished using many possible modalities, including nerve stimulation, ultrasound guidance, paresthesia induction, fluoroscopic imaging, and simple tactile perceptions (“facial

click”). Either a nonstimulating epidural-type catheter may be used, or a “stimulating catheter” that delivers electrical current to its tip. Administered infusate generally includes exclusively long-acting, dilute, local anesthetic delivered as a bolus only, basal only, or basal-bolus combination. Documented benefits appear to be dependent on successfully improving analgesia, and include decreasing baseline/breakthrough/dynamic pain, supplemental analgesic requirements, opioid-related side effects, and sleep disturbances. In some cases, patient satisfaction and ambulation/functioning may be improved; an accelerated resumption of passive joint range-of-motion realized; and the time until discharge readiness as well as actual discharge from the hospital or rehabilitation center achieved. Lastly, postoperative joint inflammation and inflammatory markers may be decreased. Nearly all benefits occur during the infusion itself, but several randomized controlled trials suggest that in some situations there are prolonged benefits after catheter removal as well. Easily rectified minor complications occur somewhat frequently, but major risks including clinically relevant infection and nerve injury are relatively rare. This article is an evidence-based review of the published literature involving continuous peripheral nerve blocks.

*Anesthesia Analgesia 2011;113:904–25*

# Long-Axis Ultrasound imaging of the Nerves and Advancement of Perineural Catheters Under Direct Vision: A Preliminary Report of Four Cases

Zbigniew J. Koscielniak-Nielsen; Henrik Rasmussen;  
Lars Hesselbjerg

**Background and Objectives:** Ultrasound allows visualization of in plane needle insertion toward a nerve and the perineural spread of local anesthetic (LA) solution. However, advancement and final positioning of perineural catheters is difficult to visualize. We assessed the feasibility of long axis nerve scans for controlling perineural catheter placement.

**Methods:** Four orthopedic patients scheduled for continuous peripheral nerve blocks (interscalene, femoral, midfemoral sciatic, and popliteal sciatic), had perineural catheters inserted under ultrasound guidance. After obtaining adequate short axis images of the target nerves, the high frequency linear transducer was rotated 90[degrees] to obtain long axis views. An 18-gauge epidural Tuohy needle was inserted tangentially to the nerve and the correct tip position was confirmed visually by small volume injections of LA. A rigid epidural catheter was inserted under the

transducer's long plane and advanced into the desired perineural position. LA was then injected through the catheter and the spread was confirmed both on long axis and short axis scans.

**Results:** The catheters were captured on the long axis scans in all 4 patients, both exiting the needle tip, and during further advancement. They remained in situ for 3 to 5 days providing adequate postoperative analgesia and were removed uneventfully.

**Conclusions:** This short case series suggests that long axis imaging of the nerve, the needle, and the catheter allows visualization of a catheter's advancement. Using to-and-fro movements, and slight rotation the needle's bevel, the catheter may be maneuvered under the ultrasound beam, which facilitates correct positioning.

*Regional Anesthesia & Pain Medicine. 33(5):477-482, September/October 2008*

## Continuous Peripheral Nerve Blocks With Stimulating Catheters

Charles Pham-Dang; Ottmar Kick; Thuriel Collet; François Gouin; Michel Pinaud

**Background and Objectives:** This study evaluated the efficacy of stimulating catheters used for continuous peripheral nerve blocks as a means of immediate verification and confirmation of correct catheter position.

**Methods:** This observational study presents our experience with 130 stimulating catheters used in 40 intersternocleidomastoid, 24 axillary, 47 femoral, and 19 lateral midfemoral sciatic nerve blocks. Placement characteristics (amperage, depth of introducer needle or catheter insertion, elicited motor responses), subsequent postoperative analgesia, and catheter position evaluated with the radiopaque dye analysis were all studied.

**Results:** Except in femoral blocks, characteristics of motor responses elicited (1 Hz, 0,1 ms) by the introducer assembly and catheter differed. The amperage required to elicit motor responses typically was higher with the catheter than with the introducer needle (1.6 [0.2 to 4 mA] v 0.5 [0.4 to 1 mA] P <

.0001). The ability to elicit a motor response with the stimulating catheter correlated with successful clinical anesthesia in 124 cases. Opacified radiography showed no aberrant position in these cases. Three catheters for upper limb block failed to stimulate, provided poor anesthesia, and had radiologic evidence of aberrant position.

Even though they failed to stimulate, 3 catheters for sciatic block functioned well, and the opacified radiography showed correct position.

**Conclusion:** The ability to electrostimulate nerves using an in situ catheter increases success rate in catheter placement for continuous peripheral nerve blocks. Further controlled investigations are necessary to compare this technique with more conventional methods in terms of cost and utility for various peripheral nerve blocks.

*Regional Anesthesia & Pain Medicine. 28(2):83-88, March/April 2003*

# 9. Procedural Sedation (outside the O.R.)

## Anesthesia for Gastrointestinal Endoscopic Procedures

Daniel T. Goulson, M.D.; Regina Y. Fragneto, M.D.

Traditionally, sedation for gastrointestinal endoscopic procedures was provided by the gastroenterologist. Increasingly, however, complex procedures are being performed on seriously ill patients. As a result, anesthesiologists now are providing anesthesia and sedation in the gastrointestinal endoscopy suite for many of

these patients. This article reviews the challenges encountered in this environment and anesthetic techniques that can be used successfully for these procedures.

*Anesthesiology Clinics Volume 27, Issue 1, Pages 71-85 (March 2009)*

## Sedating the Child with Congenital Heart Disease

Laura K. Diaz, M.D.; Lisa Jones, CRNA

The number of pediatric patients requiring sedation for procedures performed outside the operating room environment continues to grow yearly, as does the number of patients surviving to adulthood with the residua and sequelae of congenital heart disease. Ongoing efforts to develop guidelines to enhance the safety of these pediatric sedative encounters have resulted in great strides in the prevention of adverse events. In addition, the Society for Pediatric Sedation, associated with the Pediatric Sedation

Research Consortium, provides an important forum for practitioner education and the promotion of safe care for infants and children undergoing sedative experiences. Care of the subset of patients with congenital heart disease or pulmonary hypertension remains especially demanding. The additional safety challenges posed by remote locations make the highest level of vigilance essential when planning and performing sedation for these *children*.

*Anesthesiology Clinics Volume 27, Issue 2, Pages 301-319 (June 2009)*

## Pediatric Sedation/Anesthesia Outside the Operating Room

David Gozal; Yaacov Gozal

**Purpose of Review:** The demand of procedures performed on children outside the operating room setting often exceeds the capacity of anesthesia services. The number of children requiring sedation outside the traditional operating room is rapidly approaching the number of children requiring anesthesia in the operating room. We address some of the major issues and controversies in this continuously evolving field.

**Recent Findings:** Pediatric sedation continues to be a challenging field. Recently, the Society of Pediatric Sedation has been created. In the last year, important issues have been raised among pediatric sedation providers, keeping on feeding the debate within all the recognized experts.

Why worry about nihil per os status? Is bispectral index useful as a sedation monitor? Should there be standards for simulation-based training of nonanesthesiologists for delivery of sedation? Is propofol well tolerated? Is dexmedetomidine a good choice for painful procedures? What is the role of etomidate?

**Summary:** A standard approach (adequate preparation, clinical assessment of the child, fasting as required and right sedation plan) is mandatory to provide safety and efficiency. Sedation is a continuum, and it can be easy to advance from one level to the next and even reach a state of general anesthesia. Newer modalities such as end-tidal CO<sub>2</sub> and, maybe, bispectral index monitoring are indeed enhancing the safety of procedural sedation and analgesia.

*Current Opinion in Anaesthesiology: August 2008 - Volume 21 - Issue 4 - p 494-498*

# Risks of Anesthesia or Sedation Outside the Operating Room: The Role of the Anesthesia Care Provider

Julia Metzner; Karen B. Domino

**Purpose of Review:** Our goal is to review the recent year's novel and relevant literature on the practice of sedation/anesthesia in the nonoperating room setting. Risk factors and outcomes were evaluated related to locations, providers, and anesthetic regimens.

**Recent Findings:** Administration of sedation/anesthesia for patients undergoing uncomfortable or painful interventions outside the operating room is an expanding practice involving a wide variety of practitioners. With a growing emphasis on cost, efficiency, and patient satisfaction, propofol alone or in combination with other sedatives/analgesics has become popular for procedural sedation among nonanesthesiologists. Although major adverse events are rare in this setting, potentially risky complications, such as respiratory depression and desaturation, still occur and their importance cannot be neglected. In this

context, the American Society of Anesthesiologists Closed Claims and the Pediatric Sedation Research Consortium databases convey some valuable data. The bulk of reported complications are related to anesthetic drug-induced respiratory depression or airway obstruction leading to hypoxemia or hypoventilation. There are several new studies highlighting the importance of capnography in detecting impending airway or respiratory adverse events.

**Summary:** The current incidence of complications associated with sedation in the nonoperating room environment remains irrefutable. Although there are many studies on sedation practices in the out-of-operating room setting, high-quality studies are lacking. There are no data comparing practice outcomes between different practitioners and specialties.

*Current Opinion in Anaesthesiology: August 2010 - Volume 23 - Issue 4 - p 523-531*

# 10. Post Anesthesia Recovery (PACU)

## a. Analgesia

### Perioperative Single Dose Ketorolac to Prevent Postoperative Pain: A Meta-Analysis of Randomized Trials

Gildasio S. De Oliveira, Jr., MD, MSCI, Deepti Agarwal, MD, and Honorio T. Benzon, MD

Anesthesia Analgesia 2012; 114:424-33

**BACKGROUND:** Preventive analgesia using non-opioid analgesic strategies is recognized as a pathway to improve postoperative pain control while minimizing opioid-related side effects. Ketorolac is a nonsteroidal antiinflammatory drug frequently used to treat postoperative pain. However, the optimal dose and route of administration for systemic single dose ketorolac to prevent postoperative pain is not well defined. We performed a quantitative systematic review to evaluate the efficacy of a single dose of perioperative ketorolac on postoperative analgesia.

**METHODS:** We followed the PRISMA statement guidelines. A wide search was performed to identify randomized controlled trials that evaluated the effects of a single dose of systemic ketorolac on postoperative pain and opioid consumption. Meta-analysis was performed using a random-effects model. Effects of ketorolac dose were evaluated by pooling studies into 30- and 60-mg dosage groups. Asymmetry of funnel plots was examined using Egger regression. The presence of heterogeneity was assessed by subgroup analysis according to the route of systemic administration (IV versus IM) and the time of drug administration (preincision versus postincision).

**RESULTS:** Thirteen randomized clinical trials with 782 subjects were included. The weighted mean difference (95% confidence interval [CI]) of combined effects showed a difference for ketorolac over placebo for early pain at rest of -0.64 (-1.11 to -0.18) but not at late pain at rest, -0.29 (-0.88 to 0.29) summary point (0-10 scale). Opioid consumption was decreased by the 60-mg dose, with a mean (95% CI) IV morphine equivalent consumption of -1.64 mg (-2.90 to -0.37 mg). The opioid-sparing effects of ketorolac compared with placebo were greater when the drug was administered IM compared with when the drug was administered IV, with a mean difference (95% CI) IV morphine equivalent consumption of -2.13 mg (-4.1 to -0.21 mg). Postoperative nausea and vomiting were reduced by the 60-mg dose, with an odds ratio (95% CI) of 0.49 (0.29-0.81).

**CONCLUSIONS:** Single dose systemic ketorolac is an effective adjunct in multimodal regimens to reduce postoperative pain. Improved postoperative analgesia achieved with ketorolac was also accompanied by a reduction in postoperative nausea and vomiting. The 60-mg dose offers significant benefits but there is a lack of current evidence that the 30-mg dose offers significant benefits on postoperative pain outcomes.

# The Effects of Oral Ibuprofen and Celecoxib in Preventing Pain, Improving Recovery Outcomes and Patient Satisfaction After Ambulatory Surgery

Paul F. White, PhD, MD, FANZCA,\*‡ Jun Tang, MD,\* Ronald H. Wender, MD,\* Manxu Zhao, MD,\* Michael Time, MS,\* Alan Zaentz, MD,\* Roya Yumul, MD, PhD,\* Alexander Sloninsky, MD,\* Robert Naruse, MD,\* Robert Kariger, MD,\* Tom Webb, MD,\* David E. Fermelia, MD,† and Gregory K. Tsushima, MD†

**BACKGROUND:** Nonsteroidal antiinflammatory drugs have become increasingly popular as part of multimodal analgesic regimens for pain management in the ambulatory setting. We designed this randomized, double-blind, placebo-controlled study to evaluate the effect of postoperative administration of either a nonselective nonsteroidal antiinflammatory drug (ibuprofen) or the cyclooxygenase-2 selective inhibitor (celecoxib when administered as part of a multimodal analgesic regimen) on the severity of pain, the need for rescue analgesics, and clinically relevant patient outcomes after ambulatory surgery. The primary end point was the time to resumption of normal activities of daily living.

**METHODS:** One hundred eighty patients undergoing outpatient surgery were randomly assigned to 1 of 3 treatment groups: group 1 (control) received either 2 placebo capsules (matching celecoxib) or 1 placebo tablet (matching ibuprofen) in the recovery room and 1 placebo tablet at bedtime on the day of surgery, followed by 1 placebo capsule or tablet 3 times a day for 3 days after discharge; group 2 (celecoxib) received celecoxib 400 mg (2 capsules) orally in the recovery room and 1 placebo capsule and tablet at bedtime on the day of surgery, followed by celecoxib 200 mg (1 capsule) twice a day placebo capsule every day at bedtime for 3 days after surgery; or group 3 (ibuprofen) received ibuprofen 400 mg (1 tablet) orally in the recovery

room and 400 mg orally at bedtime on the day of surgery, followed by 400mg orally 3 times a day for 3 days after surgery. Recovery times, postoperative pain scores, and the need for rescue analgesics were recorded before discharge. Follow-up evaluations were performed at 24 hours, 48 hours, 72 hours, 7 days, and 30 days after surgery to assess post discharge pain, analgesic requirements, resumption of normal activities, opioid-related side effects, as well as quality of recovery and patient satisfaction with their postoperative pain management using a 5-point verbal rating scale.

**RESULTS:** The 3 groups did not differ with respect to their demographic characteristics. Compared with the placebo treatment, both celecoxib and ibuprofen significantly decreased the need for rescue analgesic medication after discharge ( $P < 0.05$ ). The effect sizes (celecoxib and ibuprofen versus control group) were 0.73 to 1 and 0.3 to 0.8, respectively. Quality of recovery scores and patient satisfaction with their postoperative pain management were also improved in the celecoxib and ibuprofen groups compared with the control group ( $P < 0.05$ , effect size [vs control group] 0.67). The incidence of post-operative constipation was significantly higher in the control group (28%) compared with the celecoxib (5%) and ibuprofen (7%) groups, respectively ( $P < 0.05$ ). Both active treatments were well tolerated in the postdischarge period. However, the time to resumption of normal activities of daily living was similar among the 3 groups.

**CONCLUSIONS:** Both ibuprofen (1200 mg/d) and celecoxib (400 mg/d) significantly decreased the need for rescue analgesic medication in the early postdischarge period, leading to an improvement in the quality of recovery and patient satisfaction with their pain management after outpatient surgery.

*Anesth Analg* 2011;112:323–9

# 10. Post Anesthesia Recovery (PACU)

## b. PONV

### Society for Ambulatory Anesthesia Guidelines for the Management of Postoperative Nausea and Vomiting

Tong J. Gan, M.D.; Tricia A. Meyer, Ph.D., MS; Christian C. Apfel, M.D., Ph.D.; Frances Chung, F.R.C.P.C.; Peter J. Davis, M.D.; Ashraf S. Habib, M.B., FRCA; Vallire D. Hooper, M.S.N., RN, CPAN, FAAN; Anthony L. Kovac, M.D.; Peter Kranke, M.D., Ph.D., M.B.A.; Paul Myles, M.D.; Beverly K. Philip, M.D.; Gregory Samsa, Ph.D.; Daniel I. Sessler, M.D.; James Temo, CRNA, M.S.N., M.B.A.; Martin R. Tramer, M.D., DPhil; Craig Vander Kolk, M.D.; Mehernoor Watcha, M.D.

The present guidelines were compiled by a multidisciplinary international panel of individuals with interest and expertise in postoperative nausea and vomiting (PONV) under the auspices of The Society of Ambulatory Anesthesia. The panel critically

evaluated the current medical literature on PONV to provide an evidencebased reference tool for the management of adults and children who are undergoing surgery and are at increased risk for PONV. In brief, these guidelines identify risk factors for PONV in adults and children; recommend approaches for reducing baseline risks for PONV; identify the most effective antiemetic monotherapy and combination therapy regimens for PONV prophylaxis; recommend approaches for treatment of PONV when it occurs; and provide an algorithm for the management of individuals at increased risk for PONV.

*(Anesth Analg 2007;105:1615)*

*Institution: University of Colorado Health Sciences Center*

### A Randomized, Double-Blind, Multicenter Trial Comparing Transdermal Scopolamine Plus Ondansetron to Ondansetron Alone for the Prevention of Postoperative Nausea and Vomiting in the Outpatient Setting

Tong J. Gan, M.D.; Ashish C. Sinha, M.D., Ph.D.; Anthony L. Kovac, M.D.; R. Kevin Jones, M.D., CPI; Stephen A. Cohen, M.D., M.B.A.; Jean P. Battikha, M.S.; Jonathan S. Deutsch, M.D.; Joseph V. Pergolizzi, Jr., M.D.; the TDS Study Group; Peter S. A. Glass, Section Editor

**Background:** Postoperative nausea and vomiting (PONV) are common complications after ambulatory surgery. We sought to determine whether the use of transdermal scopolamine (TDS) in combination with IV ondansetron (OND) is more effective than one alone for reducing PONV in outpatient settings.

**Methods:** In a randomized, double blind, multicenter trial, 620 at-risk female patients undergoing outpatient laparoscopic or breast augmentation surgery received either an active TDS patch or a similar appearing sham 2 h before entering the operating room. All patients received IV OND (4 mg) 2–5 min before induction of anesthesia followed by a general anesthetic regimen. Complete antiemetic response, defined as no vomiting/retching or rescue medication use, was measured through 24 h and 48 h after surgery. The proportion of patients with vomiting/retching, nausea, or use of rescue medication, the time from the end of surgery to the first episode of these events and the time to discharge from the hospital/surgery center, as well as the number and severity of vomiting/retching and nausea episodes, and patient satisfaction with antiemetic therapy were also collected.

**Results:** The combination of TDS + OND statistically significantly reduced nausea and vomiting/retching compared with OND alone 24 h after surgery but not at 48 h. The proportion of patients who did not experience vomiting/retching and did not use rescue medication was 48% for TDS + OND and 39% for OND alone ( $P < 0.02$ ). Total response (no nausea, no vomiting/retching, and no use of rescue medication) was also statistically higher for the TDS + OND group compared with the OND-only group (35% vs 25%,  $P < 0.01$ ). The time to first nausea, vomiting/retching, or rescue episode was statistically significantly longer for the TDS + OND group compared with the OND-only group ( $P < 0.05$ ). The cumulative overall incidence of adverse events was lower in the TDS + OND group compared with the OND group (36.7% vs 49%,  $P < 0.01$ ).

**Conclusions:** TDS + OND reduces PONV compared with OND alone. This is achieved with a reduction in adverse events.

**Implications:** Transdermal scopolamine in combination with ondansetron reduces postoperative nausea and vomiting and improves patient satisfaction compared with ondansetron alone without increasing the anticholinergic-related side effects

*Anesthesia Analgesia 2009; 108:1498*

# 11. Professionalism and Facility Management

## Physicians' Professional Responsibility to Improve the Quality of Care

Troyen A. Brennan, M.D.

Physicians have long recognized a professional responsibility to improve the quality of care. However, that responsibility should be evolving in light of developments in both the science of quality improvement and the ethical base of professionalism. Over the last 30 years, quality science has moved from static/structural measures to a much more sophisticated set of outcome and process issues. It has also self-consciously integrated notions of continuous improvement. The ethical base of professionalism is also more dynamic, today emphasizing the policy activist attributes of so-called civic professionalism.

The combination of modern quality measurement/improvement and activist professionalism is a virtual call to arms for the profession to advocate care that is systematically better. Recent developments in the domain of quality dealing with medical errors can be used to illustrate this synergy, and provide a set of mandates for the new professional commitment to quality.

*Academic Medicine 2002; 77: 973-980.*

## Professionalism: An Ideal to be Sustained

Richard L. Cruess; Sylvia R. Cruess; Sharon E. Johnston

A gulf has developed between the medical profession and the society it serves. As one observer noted, "A better informed community is asking for accountability, transparency, and sound professional standards," whereas medicine feels that "the professional's autonomy is severely restricted by budgets, bureaucracy, guidelines, and peer review." The concept of professionalism bridges the interests of physicians and society as society's need for the healer and its belief in the inherent virtue and morality of professionalism have served as the basis of modern medicine. They are the source of the rights and privileges granted to the medical profession and of the values that physicians feel contribute to what is noble and good in

their calling. Recently, a series of highly publicized events has encouraged the view that the medical profession fails to meet many of the obligations required to sustain its professionalism. In all countries, irrespective of the structure of the health-care system, threats to the values of professionalism are seen. As physicians and society try to bridge the gap widened by perceived lapses in professional standards, a redefinition of expectations and roles is taking place. To prevent medicine from becoming a commodity in a market-oriented world, physicians must participate in shaping the profession's future and understand the principles and obligations associated with being a member of a profession.

*The Lancet 2000; 356: 156-159.*

## Medicine Under Threat: Professionalism and Professional Identity

William M. Sullivan

The professions have never been more important to the well-being of society. Professional knowledge and expertise are at the core of contemporary society. How such professional expertise is developed, how it is deployed, by whom it is deployed and for what ends are among the most pressing issues facing all modern nations. At the same time, many of the most distinctive features of the professions, especially their privileges of self-regulation and self-policing, are being curtailed. This is true even in countries such as Britain, the United States and Canada, where professions have historically been most autonomous and enjoyed the greatest social prestige.

To date, the efforts by professional groups to respond to these threats seem to reveal the weakness of appealing to expertise alone as the basis for professional control of medical services. Expertise does not provide much leverage for asserting traditional professional privileges in the face of calls for greater efficiency and cost reduction, let alone public demands for more personalized attention and care in dealing with complex technologies and more daunting social problems. What is missing from these ways of responding to contemporary challenges is precisely the moral core of professionalism: the contract between professional and society in which physician and patient are bound together within a larger "body politic."

*Canadian Medical Association Journal 2000; 162: 673-677.*

# Role Modeling in Physicians' Professional Formation: Reconsidering an Essential but Untapped Educational Strategy

Nuala P. Kenny, O.C., M.D.; Karen V. Mann, Ph.D.;  
Heather MacLeod, M.A.

Forming technically proficient, professional, and humanistic physicians for the 21st century is no easy task. Mountains of biomedical knowledge must be acquired, diagnostic competence achieved, effective communication skills developed, and a solid and applicable understanding of the practice and role of physicians in society today must be reached. The central experience for learners in this complex and challenging terrain is the "modeling of" and "learning how to be" a caregiver and health professional.

Role modeling remains one crucial area where standards are elusive and where repeated negative learning experiences may adversely impact the development of professionalism in medical students and residents. The literature is mainly descriptive,

defining the attributes of good role models from both learners and practitioners' perspectives. Because physicians are not "playing a role" as an actor might, but "embodying" different types of roles, the cognitive and behavioral processes associated with successfully internalizing roles (e.g., the good doctor/medical educator) are important.

In this article, the authors identify foundational questions regarding role models and professional character formation; describe major social and historical reasons for inattention to character formation in new physicians; draw insights about this important area from ethics and education theory (philosophical inquiry, apprenticeship, situated learning, observational learning, reflective practice); and suggest the practical consequences of this work for faculty recruitment, affirmation, and development.

*Academic Medicine* 2003; 78: 1203-1210.