Enhanced Recovery After Surgery: Role of Anesthesiologist

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Conflict Of Interests
Research Grants and/or Honoraria
• Baxter Pharmaceuticals
• Mallinckrodt Pharmaceuticals
• Pacira Pharmaceuticals

Changes in Healthcare Delivery
• Emphasis on cost containment
• Emphasis on evidence-based practice
  - Need to know what works and at what costs
• Rising patient expectations
  - Importance of patient satisfaction

Procedure Specific Best Practices Enhance Recovery After Surgery
• Decrease the incidence and severity of perioperative complications
• Shorten hospital length of stay
• Reduce postop readmission rates
• Allow early return to daily living
• Reduce healthcare costs without compromising patient care

Perioperative Management

Preoperative Considerations
Preoperative Optimization Improves Perioperative Outcome

• Suboptimal preoperative care (i.e., inadequate patient evaluation or incorrect preoperative management) is a major contributing factor to perioperative morbidity/mortality

Preanesthesia Assessment

• Preoperative screening and optimization of comorbidities
• Assessment of chronic medication use
  - β-blockade, ACE inhibitors, anti-platelet drugs, anti-coagulants, anti-diabetic drugs, statins
• Education and psychological preparation of the patient (and their caregivers)
  - Reduces anxiety and fear
  - Improves overall patient satisfaction

Preoperative Risk Reduction Through “Pre-habilitation”

• Preoperative training: muscle strengthening
  - Reduces frailty and disability
• Preoperative cardiovascular conditioning
  - Snowden CP, Minto G: Br J Anaesth 2015; 114: 186-9
• Avoidance of preoperative dehydration
  - Encourage water intake throughout the fasting period
• Nutritional support to boost periop immune function and accelerate convalescence
  - Preoperative carbohydrate loading
  - Gillis C, Carli F: Anesthesiology 2015; 123: 1455-72
• Preoperative psychological preparation
  - Avoid anxiety and fear

European Society of Anesthesiologists Recommendations

It is safe for patients (including diabetics) to drink carbohydrate-rich drinks up to 2 h before elective surgery

Patients with obesity, gastrointestinal reflux, and diabetes can safely follow all of the above guidelines

Preoperative Carbohydrate Load: Well-Controlled Diabetics Vs. Healthy

Preoperative Testing

• Routine screening tests are of no clinical benefit
  - Preop period is not for screening asymptomatic disease
• Unnecessary tests may cause anxiety, increase delays and cancellations, cause potential harm stemming from false-negative or false-positive results, and increase costs
• Tests guided by patient’s, clinical status, comorbidity (cardiovascular, pulmonary, and renal) and invasiveness of surgical procedure

ASA Practice Advisory: Anesthesiology 2002; 96: 485-96
Avoid Benzodiazepine Premedication

- Avoid routine preop sedative-hypnotics even in patients with significant anxiety
  - Increases cognitive dysfunction
  - Increases pharyngeal/laryngeal dysfunction - micro aspiration
- No evidence that pre-induction midazolam reduces awareness
  - Anesthesiology 2006; 104: 847

Problems that plagues the practice of anesthesia is that the residual effects of hypnotic-sedative/opioids/muscle relaxants influence long-term outcomes

Residual Effects of Sedative-hypnotics/Opioids/NMBs

- Delays emergence from anesthesia
- Increases OT stay, PACU stay, ICU admission
- Compromises airway patency
- Increases pharyngeal dysfunction, aspiration
- Decreases ventilatory response to hypoxia and hypercarbia
- Increases hemodynamic instability
- Increases cognitive dysfunction
Balanced General Anesthesia

Unconsciousness/Lack of Recall (MAC/EEG-based Monitoring)

Hemodynamic Stability (BP/HR)

Muscle Relaxation (Peripheral Nerve Stimulator)

Desflurane Versus Sevoflurane

- Meta-analysis of RCTs (n=29) comparing extubation times with des and sevo
- Anesthesia information management system data (n=32,792 cases) used model the time from end of surgery to extubation
- Des reduced average extubation time and variability of extubation time by 20%-25%


Desflurane

- MAC
- Low MAC

Sevoflurane

- MAC
- Low MAC

Nitrous Oxide

- Increase PONV
- Expand closed spaces (bowel)
- Influence surgical conditions
- Cardiovascular, pulmonary, thrombotic morbidity

Avoid Deep Anesthesia
Inhaled Anesthetic Concentrations For Prevention of Recall

- Doses of inhaled required to prevent awareness (recall) are smaller (0.45 MAC) than those required for unconsciousness
- 0.6 to 0.8 MAC of inhaled anesthetics with or without N₂O, respectively

Dwyer et al: Anesthesiology 1992; 77: 888-96

Neuromuscular Blockade

- Residual paralysis in postop period is frequent and difficult to recognize clinically
- Even minimal paralysis (TOF < 0.9) increases postoperative complications and ICU admission
- Avoid /minimize muscle relaxants, if possible
- Reverse blockade unless there is unequivocal evidence of adequate function
- Neostigmine dose based on the degree of blockade at the time of reversal


Neuromuscular Monitoring Site and Residual Paralysis

Thilen SR et al: Anesthesiology 2012; 117:934-6

High Dose Neostigmine and PACU Stay and Hospital LOS

**Neostigmine Dose:**

TOF Response at Ulnar Nerve

<table>
<thead>
<tr>
<th>TOF Response</th>
<th>Fade</th>
<th>Dose (µg/kg)</th>
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<tbody>
<tr>
<td>4</td>
<td>-</td>
<td>20-30</td>
</tr>
<tr>
<td>3</td>
<td>++</td>
<td>40</td>
</tr>
<tr>
<td>2</td>
<td>+++</td>
<td>50</td>
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<tr>
<td>1</td>
<td>++++</td>
<td>60</td>
</tr>
<tr>
<td>None</td>
<td>-</td>
<td>Wait</td>
</tr>
</tbody>
</table>

Modified from Bevan et al: Anesthesiology 1992; 77: 785-805
Reverse unless there is unequivocal evidence of adequate function

**Opioids Reduce Propofol Requirements**

- Opioids reduce propofol dose synergistically (approx 40-80%)
- Ceiling effect


**Opioid Reduces MAC**

- Moderate opioid doses reduce MAC synergistically (up to 75%)
- MAC reduction is not complete
- Ceiling effect

McEwan AI et al: Anesthesiology 1993; 78:864-9

**“Front Loading” Opioids During Induction of Anesthesia**

- Increases post-induction hypotension
- Increases potential for acute tolerance


**Differential Opioid Tolerance and Opioid-induced Hyperalgesia**

A Clinical Reality

Christina J. Højholt, M.D., Marc E. Duloue, M.D., Ph.D.

Anesthesiology 2016; 124: Epub
Opioid Dosing at Induction: Patient Controlled Analgesia Concept

Fentanyl/sufentanil dosing based IV-PCA concept

Front loading of opioids for achieving longer duration of action is NOT acceptable.

Consider other causes of hemodynamic changes

Do not attempt to normalize or achieve “tight” control of hemodynamic variables (HR/BP)

Intraoperative Long-acting Opioids: For Postoperative Analgesia

- Longer-acting opioid
  ~20 min prior to expected time to extubation
  - Morphine (0.1-0.15 mg/kg)
  - Hydromorphone (10-20 mcg/kg)


Procedure Specific Multimodal Pain Management

Multimodal Analgesic Techniques (www.postoppain.org)

- Regional analgesic techniques
  - Wound infiltration
  - Peripheral nerve blocks
- NSAIDs/COX-2 inhibitors
- Acetaminophen
- Adjutants
  - Dexamethasone
  - Ketamine
- Opioids (as rescue)

PONV Prophylaxis
**Multimodal Prevention To Facilitate Implementation Of PONV Policies**

### Risk-Adapted PONV-Prevention Algorithm

- **Low risk patients**: No prevention ("wait and see")
- **Medium risk patients**: Drug A + Drug B in TAV
- **High risk patients**: Drug A + Drug B + TAV or a combination decision further interventions

<table>
<thead>
<tr>
<th>Prevention for prevention</th>
<th>Drug A</th>
<th>Drug B</th>
<th>Drug C</th>
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<tr>
<td>Low risk patients</td>
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</tr>
<tr>
<td>Medium risk patients</td>
<td>Drug A</td>
<td>Drug B</td>
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</tbody>
</table>

**PONV-Prevention Algorithm in All Patients**

- Estimated risk for PONV for patients, as determined by a risk score

**Impact of Risk Assessments on Prophylactic Antiemetic**

- "Implementation of PONV prophylaxis based on prediction models did not reduce the incidence of PONV despite increased antiemetic prescription in high-risk population."


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**Optimal Multimodal Antiemetic Therapy**

- **Intraoperative**
  - Dexamethasone 4-8 mg
  - Ondansetron 4 mg (end of surgery)
  - High risk population (add)
  - Droperidol 0.625-1.25 mg (intraop)
  - Transderm scopolamine (preop)
  - TIVA
- **Postoperatively**
  - Promethazine (Phenergan) 6.25 mg
  - Dimenhydrinate 1 mg/kg
  - Do not repeat ondansetron, use another 5HT, antagonist

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**Mechanical Ventilation**

- Optimal lung protective ventilatory strategy
  - Low TV (6-8 ml/kg, IBW)
  - PEEP (5-10 cm H2O)
  - Initial respiratory rate 8/min
  - Maintain ETCO2 ~ 40 mm Hg
- Mild hypercapnia (PaCO2 = 50 mmHg) improves tissue O2

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**Intraoperative Ventilation: Avoid Hyperventilation**

- Increase CO, vasodilatation, O2 off-loading from right shift of oxyhgb dissociation curve
- Improves tissue oxygenation
- Hager et al: Anesth Analg 2006; 103: 677-81
- Fleischmann et al: Anesthesiology 2006; 104: 944-9
- Protective effect against organ injury

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**Intraoperative Ventilation: Allow Mild Hypercapnia**

**Hypercapnia Reduces Systemic Inflammation and Improves Respiratory Function**

- Patients randomized to PaCO₂ 35 to 45 mmHg or 60 to 70 mmHg with CO₂ inhalation
- Patients with hypercapnia had improved respiratory function and reduced lung and systemic inflammation
- No severe adverse events related to hypercapnia


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**Fluid Management**

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**Perioperative Fluid Therapy**

- Patients commonly receive large amounts of fluids
- Excessive fluids increase morbidity and mortality
- Eliminate algorithm use (i.e., preloading and replacement of “third space”)
- Avoid fluid administration based upon static indicators (HR, MAP, CVP), use dynamic indicators
- Role of CO monitors in ERAS remain questionable
- Need to follow postop, avoid weight gain > 1kg

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**Postoperative Considerations**

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**Emergence Considerations**

- Primary aim should be to washout inhaled anesthetic, not build-up CO₂
- Pressure support ventilation to maintain FRC
- Nasal ventilation, superior to oral ventilation
  - Liang Y et al Anesthesiology 2008; 108: 998
- Semi-upright (30-40°) position

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**Postoperative Care: Fast Track Rehabilitation**

- Avoid tubes, catheters, drains, restrictions
- Early mobilization and physical therapy
- Optimize pain relief
- Respiratory therapy
  - Extended lung expansion exercises
  - Early use of CPAP, non-invasive ventilation, early tracheal extubation
- Improve sleep
- Early oral feeding
- Early detection of complications
Summary

• ERAS clinical pathways improve periop outcome and enhances recovery
• Involves the entire periop period (pre-, intra-, and post)
• Anesthesiologists should take leadership in development and implementation of clinical pathways
• Improve communication and teamwork amongst caregivers
• Data-driven analytical process of continuous improvement

Thank You. Questions?

Insanity is doing the same things the same way and expecting different results.

Albert Einstein