Coping with Drug Shortages in OMS Practices

Drug Shortages: a public health disaster

When vital drugs run out, patients pay the price

Drug Shortages Distress Hospitals

Shortage Of Nearly 60 “Medically Necessary” Drugs, Federal Health Officials Explain

Los Angeles Times

FDA Dragged Into Execution-Drug Controversy
Business and Market Factors

- Lack of transparency or communication about actual or possible product shortages
- Lack of business incentives to enter a specific product market
- Unpredictable changes in product demand
- Reallocation of production lines
- Consolidation of companies

Raw Materials and Manufacturing Factors

- 80% of raw materials used come from outside the United States
- Disruption to acquisition can be due:
  - Political instability/Government interference
  - Natural disasters
  - Contamination during production, storage or transport
- Problematic if single source Active product ingredients (API) or raw materials multiple manufacturers affected
Distribution Factors

- Inventory practices by healthcare facilities and supply chain entities
- Little or no inventory cushion to address short-term shortages or excess inventory due to distribution systems
- Variability in inventory procurement capabilities between small and large healthcare facilities
- Grey market

Regulatory and Legislative Factors

- Limited FDA resources for timely inspection of manufacturing sites and review of NDA/ANDA
- Lack of FDA authority to:
  - Require notification from manufacturers of anticipated market withdrawal
  - Enforce notification requirements for medically necessary products
Annual New Drug Shortages
January 2001 to December 2010 31, 2010

Tripled since 2006

73 58 74 70 129 149 166 211

University of Utah Drug Information Service

Figure 1. Proportion of drug shortages according to route of administration from 2005 to 2010. The relative proportion of intravenous medication shortages has increased in recent years.


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Reasons for Sterile Injectable Shortages

![Chart showing percentages of injectables shortages]

*Courtesy of Center for Drug Evaluation and Research (Feb 2011)*

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Anesthetic drug shortages

Table 1. Anesthetic Drug Shortages Affecting Anesthesia Practice in 2007

<table>
<thead>
<tr>
<th>Drug Name</th>
<th>Drug Shortage (Incidence)</th>
<th>Most Common Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ketamine</td>
<td>2%</td>
<td>Medication shortage</td>
</tr>
<tr>
<td>Fentanyl</td>
<td>3%</td>
<td>Medication shortage</td>
</tr>
<tr>
<td>Propofol</td>
<td>4%</td>
<td>Medication shortage</td>
</tr>
<tr>
<td>Remifentanil</td>
<td>10%</td>
<td>Medication shortage</td>
</tr>
<tr>
<td>Midazolam</td>
<td>11%</td>
<td>Medication shortage</td>
</tr>
<tr>
<td>Succinylcholine</td>
<td>21%</td>
<td>Medication shortage</td>
</tr>
<tr>
<td>Vecuronium</td>
<td>54%</td>
<td>Medication shortage</td>
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*Table 1: Anesthetic Drug Shortages Affecting Anesthesia Practice in 2007*
The impact

- Cost
- Safety
- Forced changes in routine

Recommendations for the OMFS office: Substitute drug regimens
What's new?

- Midazolam
- Propofol
- Fospropofol
- Romazicon
- Ketamine
- Remifentanil
- Etomidate
- Dexmedetomidine
- IV acetaminophen
- Infusion pump
- LMA
- Capnography
- Blue tooth stethoscope
- BIS monitoring
- Video laryngoscope

balance

analgesia
immobilization
amnesia
hypnosis
Balanced anesthesia

- A single drug cannot achieve all desired effects
- Polypharmacy
  - What effect do we want to achieve with each drug?
  - When do we want to achieve that effect?
  - How long do we want that effect to last?

Infusion versus bolus?
Which agent(s)?
Should agents be combined in one syringe?
What about newer agents?
Incremental Bolus Versus a Continuous Infusion of Propofol for Deep Sedation / General Anesthesia During Dentoalveolar Surgery

Bennett, Shafer, Efaw, Goupil
J Oral Maxillofac Surg
56:1049-1053, 1998

Bolus versus infusion

- Pharmacokinetics
Bolus versus infusion

- Minimize fluctuations in drug serum concentration
- Smoother intra-operative course
- Enhanced cardiovascular stability
- Enhanced respiratory stability
- Less patient movement
- More rapid recovery
- Utilize less drug

Propofol

**Therapeutic applications**

- Sedation / hypnosis
- Anxiolysis
- Amnesia
- Antiemetic
- Analgesia

**Dosing**

- Onset: 1 minute
- Duration: 5 – 10 minutes
- Maintenance
  - GA: 100 – 140 
    \( \mu \text{g/kg/min} \)
  - MAC: 25 - 100 
    \( \mu \text{g/kg/min} \)
Comparison of Methohexital and Propofol Use in Ambulatory Procedures in Oral and Maxillofacial Surgery

Lee J, Gonzalez M, Chuang S, Perrott D
J Oral Maxillofac Surg

Benzodiazepines

- Anxiolysis
- Amnesia
- Sedation
- Hypnosis

- Midazolam
  - Onset: 3 – 8 m
  - Duration: 20 – 35 m
Propofol and Fentanyl Compared With Midazolam and Fentanyl During Third Molar Surgery

Panworth L, Frost D, Zuniga J, Bennett T

Propofol instead of midazolam

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<thead>
<tr>
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Clinical use of Opioids

**Advantages**
- Analgesia
- Reduce sympathetic tone
- Smoothens anesthetic
- Potentiates other anesthetic agents

**Disadvantages**
- Respiratory depression
- Trunchal rigidity
- Prolonged emergence
- Dysphoria
- Bradycardia
- Hypotension
- Nausea & vomiting
- Urinary retention

Opioid analgesics

- Fentanyl
- Alfentanil
- Sufentanil
- Remifentanil
- Meperidine
- Hydromorphone
- Nalbuphine
- Morphine
Meperidine

- Onset: 2-4 minutes
- Duration: 30 – 45 minutes
- Active metabolite: normeperidine
- Usual dose: 25 – 50 mg
- Equivalency
  - Fentanyl 50 mcg : meperidine 50 mg
  - Issues
    - Histamine release
    - Synthetic – resembles atropine
    - Interaction with MAO inhibitors

Fentanyl

- Potency
  - 50 - 100 x's more potent than morphine
- Low dose (1 - 2 μg/kg): analgesia
- Speed of onset: 3.5 – 6 minutes
- Duration: 20 – 30 minutes
- Recurrent respiratory depression
  - Biphasic respiratory depressions
    - Associated with 2º peaks in plasma concentration
    - Sequestration into gastric fluid with later release
    - Redistribution from lungs to blood

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Hydromorphone

- Dosing: 0.5 – 2 mg
- Onset: 5 – 15 minutes
- Duration: 2 – 4 hours
- Equivalency
  - Fentanyl 50 mcg : hydromorphone 0.7 mg
- Onset
  - Fentanyl 5 – 6 m: hydromorphine 5 – 10 m
- Duration
  - Fentanyl 60 m: Hydromorphone 2 -4 h

Ketamine

- Dissociative anesthesia
- Noncompetitive antagonist at NMDA receptor
- Analgesia
- Intact reflexes
- Maintenance FRC
- Bronchodilation
- Sympathomimetic effects
- "chemical straight jacket"

- Onset
  - 60 – 90 s
- Duration
  - 15 – 20 m
Ketamine instead of an opioid

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<tr>
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<th>Opioid</th>
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<td>• Analgesia without respiratory depression</td>
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Ketamine instead of an opioid

• Dosing
  • 0.25 mg/kg to 0.5 mg/kg
### Propofol & ketamine used together

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Is there an advantage to combining two drugs in the same syringe?
Ketamine: incorporated into the anesthetic

- Up-front as a premedicant
  - 0.25 mg/kg to 0.5 mg/kg
- Infusion (admixture of ketamine & propofol)
  - 1:10 mixture (1 mg ketamine: 10 mg propofol)
    - 20 mL of Propofol 10mg/10 mL
    - 0.2 mL of Ketamine 100 mg/mL
  - 1:5 mixture (2 mg ketamine: 10 mg propofol)
    - 20 mL of Propofol 10 mg/mL
    - 0.4 mL of Ketamine 100 mg/mL
- Both

Propofol – ketamine infusion

- 1:10 mixture (1 mg ketamine: 10 mg propofol)
- Midazolam: 1 – 2 mg
- Initial bolus: 500 mcg/kg
- Infusion: 100 mcg/kg/min
- Incremental bolus
  - Propofol/ketamine mixture 0.25 – 0.5 mg/kg
- For a 70 kg adult (45 m)
- Induction
  - Propofol = 35 mg
  - Ketamine = 3.5 mg
- Infusion
  - Propofol 7 mg/min
  - Ketamine 0.7 mg/min
- Total dose
  - Propofol = 350 mg
  - Ketamine = 35 mg
Remifentanil

- μ-opioid receptor agonist
- Completely metabolized by non-specific esterases
- No disease identified that can cause reduced breakdown of remifentanil

Context-sensitive half-time

- The time required for the central compartment drug concentration at the end of infusion to decrease by 50%
- Rapid and uniform clearance
- Predictable onset & offset of effect
- Terminal half life of 10 to 20 minutes
- Context sensitive half time is 3 to 4 minutes

**Remifentanil**
- Peak CNS effect: 1.5 m
- $\alpha$ half life 1-6 m
- $\beta$ half life 3 - 10 m
- 2 x's more potent
- Apnea
- Chest wall rigidity
- Bradycardia
- $4.50 \$/ case

**Fentanyl**
- Peak CNS effect: 5 m
- $\alpha$ half life 13 m
- $\beta$ half life 300 m
- $0.25 \$/ case
Should remifentanil be the opioid of choice?

Remifentanil dosing

- GA dose: 0.1 – 1 mcg/kg/min
- Sedation dose: 0.04 – 0.1 mcg/kg/min

  • Many patients are hypopneic or apneic at 0.1 mcg/kg/min
Propofol / remifentanil mixtures

- 5 mcg/mL remifentanil in 10 mg/mL propofol (100 mcg remifentanil in 20 mL propofol)
  - Add 2.5 mL of NS to 1 mg of remifentanil
  - 0.25 mL will contain 100 mcg remifentanil
  - Add 100 mcg remifentanil to 20 mL of propofol
- 2.5 mcg/mL remifentanil in 10 mg/mL propofol (50 mcg remifentanil in 20 mL propofol)

Propofol / remifentanil mixture
(5 mcg/mL remifentanil in 10 mg/mL propofol) for DS or GA

- Midazolam: 1 – 2 mg
- 500 mcg/kg bolus of mixture
- Propofol / remifentanil Infusion
  - 75 – 100 mcg/kg/min for DS
  - 100 – 140 mcg/kg/min for non-intubated GA
- Propofol (plain) bolus: 0.25 to 0.5 mg/kg
Propofol / remifentanil mixture (5 mcg/mL remifentanil in 10 mg/mL propofol) for DS or GA

- Midazolam: 1 – 2 mg
- 500 mcg/kg bolus of mixture
- Propofol / remifentanil infusion
  - 75 – 100 mcg/kg/min for DS
  - 100 – 140 mcg/kg/min for non-intubated GA
- Propofol (plain) bolus: 0.25 to 0.5 mg/kg
  - For a 70 kg adult (45 m)
  - Induction
    - Propofol = 35 mg
    - Remifentanil = 17.5 mcg
  - Total dose
    - Propofol = 275 mg
    - Remifentanil = 120 mcg
      - 0.035 mcg/kg/min
      - 2.5 mcg/min

Propofol / remifentanil mixture (5 mcg/mL remifentanil in 10 mg/mL propofol) for DS or GA

- Midazolam: 1 – 2 mg
- 500 mcg/kg bolus of mixture
- Propofol / remifentanil infusion
  - 75 – 100 mcg/kg/min for DS
  - 100 – 140 mcg/kg/min for non-intubated GA
- Propofol (plain) bolus: 0.25 to 0.5 mg/kg
  - For a 70 kg adult (45 m)
  - Induction
    - Propofol = 35 mg
    - Remifentanil = 17.5 mcg
  - Total dose
    - Propofol = 475 mg
    - Remifentanil = 237 mcg
      - 0.07 mcg/kg/min
      - 5 mcg/min

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Propofol / remifentanil mixture 
(2.5 mcg/mL remifentanil in 10 mg/mL propofol) for DS or GA

- Midazolam: 1 – 2 mg
- 750 mcg/kg initial bolus of mixture
- Propofol / remifentanil infusion
  - 50 - 75 mcg/kg/min
- Propofol / remifentanil intermittent bolus
- Remifentanil bolus
- Ketamine bolus

Propofol / remifentanil mixture 
(2.5 mcg/mL remifentanil in 10 mg/mL propofol) for DS or GA

- For a 70 kg adult (45 m)
- Induction
  - Propofol = 50 mg
  - Remifentanil = 10 mcg
- Total dose
  - Propofol = 290 mg
  - Remifentanil = 70 mcg
    - 0.017 mcg/kg/min
    - 1.25 mcg/min

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Impeccable monitoring

- WATCH ventilations
- Bradycardia

Potential problems

- Location of remifentanil drug infusion into running iv line
- Watch flow of the intravenous line

- Pump malfunction: risk of continuous infusion at a rate greater than expected

- Drug mixing errors
Which of our patients has OSA?

- Sleep disordered breathing in 20% of general population and 22% of the surgical population
  - 7% have moderate-severe OSA
  - Bariatric population literature ~ >70% have OSA

- Millions are undiagnosed
  - 60-90% of these are obese (BMI>30kg/m²)
  - 10-20% are NOT OBES

Anesthetic agents

- Reduce the muscle tone of pharyngeal dilators that acts to maintain pharyngeal patency
- Opioids reduce phasic activity of pharyngeal muscles which dilate pharyngeal airway (neg pressure reflex)
- OSA blunts response to hypoxia and hypercarbia
- Chemo-responsiveness of ventilatory drive is blunted
Propofol / remifentanil mixture for moderate sedation

- 5 mcg/mL remifentanil in 10 mg/mL propofol
- Infusion: 25 – 50 mcg/kg/min

- Elderly
- Obese
- OSA

“Analgesia based sedation”

- Rapid onset
- Can provide intense levels of analgesia of short duration
- No residual opioid effect - reduced ventilatory depression
- ?More rapid recovery?
Remifentanil in clinical practice

- Midazolam = 2 mg
- Start remifentanil dose: 0.07 mcg/kg/min
- Titrate in increments of 0.0125 mcg/kg/min
- Allow 5 minutes between dose adjustments
- Adapt remifentanil & hypnotic dosage to individual patient’s need
- Rapid offset of action will result in no analgesia effect in 5 to 10 minutes after d/c infusion

Remifentanil: An alternative to propofol

- Remifentanil + midazolam instead of propofol, midazolam and fentanyl
- Remifentanil provided
  - Trend towards less pain during regional block
  - Decreased episodes of discomfort (p<0.05)
  - Better hemodynamic stability
  - Faster recovery
  - Increased nausea & vomiting

Desmonds, et al. (1996)
Dexmedetomidine

- Imidazole compound
- Most selective central α-2 adrenoceptor agonist
  - α2:α1 adrenoreceptor ratio – 1600:1
  - 8 times higher affinity than clonidine
- Dose dependent sedation, analgesia, sympatholysis & anxiolysis
  - Without relevant respiratory depression

Sedative response

- Similar to natural sleep
- Clinically effective sedation, yet are still easily arousable
Pharmacokinetics

- α half-life: 6 minutes
- Elimination half-life: 2 hours

Clinical applications of dexmedetomidine

- Procedural sedation
  - Replacement for benzodiazepine
  - Replacement for opioid
- Awake intubation
- OSA patients and avoidance of opioids
Recovery from dexmedetomidine

- Prolonged recovery
- Hemodynamic parameters
  - Tendency toward lower blood pressure and heart rate

What else is in shortage?

- Glycopyrrolate
- Neostigmine
- Dexamethasone
- Marcaine Injection
- IV Fluid bags – NS, LR
- Clindamycin Injection
- Ondasetron
- Rabies vaccine

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Beyond the Horizon - New and Helpful Drugs

Division of Oral and Maxillofacial Surgery
Deepak Krishnan DDS
Why Change?
All those things that have changed in the last 15 years

- Monitoring
  - Capnography
  - Bluetooth Steth
  - EHR integration
- AED in the office
- LMA
- iPad setting control for hand-pieces
- Infusion pumps
- Motion sensing infusion pumps
All those things that have changed...

Medications

- Propofol
- Midazolam
- Romazicon
- Remifentanil
- Ketamine
- IV Acetaminophen
Drug Shortages: a public health disaster

Drug Shortages Distress Hospitals

Shortage Of Nearly 60 “Medically Necessary” Drugs, Federal Health Officials Explain

FDA Dragged Into Execution-Drug Controversy

Los Angeles Times

Drug shortages cause hospitals to use older types of medicines

February 21, 2011 | By Bruce Japsen
The Ideal Anesthetic

- Emphasis on outpatient anesthetic
- An increasingly older population with a greater number of significant co-morbidities
- Efforts to constrain costs have increased the demand for intravenous agents that can be more easily (and safely) administered by non-specialists and without the expensive equipment required for inhaled agents
- Agents that provide anesthesia and/or sedation in a rapidly titratable manner (i.e., rapid onset of action and recovery)
- Minimal side effects
- A high therapeutic index and be easy to formulate in an aqueous solution
- Currently, there is no clinically available hypnotic agent that possesses all of these properties
The Ideal Sedative

• Hypnotic drug
  – a rapidly titratable intravenous agent
  – a high therapeutic index
  – minimal side effects
• Current efforts
  – modifying the structures of existing drugs
  – improve their pharmaco-dynamic and pharmaco-kinetic properties
  – rapid screening of large libraries of molecules for activity in structural or phenotypic assays that approximate anesthetic and target receptor interactions
  – identifying completely novel classes of drugs.
  – a resurgence of interest - new demands on our clinical practice
Why do we need a new sedatives?

- Propofol and Midazolam

- Midazolam - highly water soluble, pharmacologically reversible

- Onset of action is relatively slow and recovery may be prolonged – active metabolite

- Causes respiratory depression
Why do we need a new sedatives?

- Propofol – limitations
- Pain on injection
- Propofol infusion syndrome - metabolic acidosis (especially in pediatrics)
- ASA guidelines - practitioners with insufficient airway skills are discouraged from using Propofol
- Target-controlled infusion (TCI) devices are currently unavailable for Propofol in USA
- Hypotension, respiratory depression
- poorly water soluble
- emulsion that supports bacterial growth
Remimazolam

- (CNS 7056)
- Midazolam analogue
- Midazolam + Remifentanil
- Rapidly metabolized ultra-short acting Benzo
- Potent sedative, minimal recovery time
Remimazolam

- Acts on GABA receptor, specifically GABA-alpha
- Dose independent hydrolysis – no accumulation
- Organ independent elimination - safety

- Other drugs acting on GABA receptors –
  - Propofol (GABA-beta)
  - Etomidate (GABA-alpha)
  - Thiopentone
Remimazolam

• Single dose for premedication
• Bolus followed by supplemental doses for procedural sedation.
• Intravenous anesthetic along with an opioid (as part of total intravenous anesthesia)
• Intensive care unit (ICU) sedation
Remimazolam

- Pre-medications – quick onset = shorter wait time – 1-3 mins = same as Midazolam
- Infusion in procedural sedation – GI procedures – shorter recovery, quick turn over times
- TIVA – replaces Propofol, reversible agent
- ICU - short-acting agent, metabolism independent of liver or kidney
Phase II Clinical Trials
Dexmedetomidine

- Precedex
- Does not cause respiratory depression
- alpha$_2$ agonist
- Not GABA-mimetic like benzos or Propofol
Precedex

Indications

• Sedation of initially intubated and mechanically ventilated patients during treatment in an intensive care setting

• Sedation of non-intubated patients prior to and/or during surgical and other procedures

• no absolute contraindications
Precedex

• Dosing in IV infusion
• Infusion at 1 µg/kg loading dose, administered over 10 minutes, maintenance infusion of 0.2–1.0 µg/kg/hour
• Adjunct opioids, local
• a reversal agent, Atipamazole (trade name Antisedan) – not indicated in humans
• Cost effective?
Dexmedetomidine Sedation for Awake Fiberoptic Intubation of Patients With Difficult Airways Due To Severe Odontogenic Cervicofacial Infections

Barry C. Boyd, DMD, MD, Steven J. Sutter, DDS
Published Online: March 10, 2011
Etomidate

- sedative hypnotic
- provides superior hemodynamic stability
- Safe in critically ill and trauma patients
- Adreno-cortical suppression
- PONV
Tweaked Etomidate

• MOC- Etomidate – Methoxycarbonyl
• Carboetomidate
• Methoxycarbonyl carboetomidate

• 'Soft' pharmacology (rapid ester hydrolysis)
  – Rapid onset, rapid offset
Ketafol
## Propofol & ketamine used together

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IS THERE AN ADVANTAGE TO COMBINING TWO DRUGS IN THE SAME SYRINGE?
Ketamine: incorporated into the anesthetic

• Up-front as a pre-medicant
  – 0.25 mg/kg to 0.5 mg/kg
• Infusion (admixture of Ketamine & Propofol)
  – 1:10 mixture (1 mg Ketamine: 10 mg propofol)
    • 20 mL of Propofol 10mg/10 mL
    • 0.2 mL of Ketamine 100 mg/mL
  – 1: 5 mixture (2 mg Ketamine: 10 mg Propofol)
    • 20 mL of Propofol 10 mg/mL
    • 0.4 mL of Ketamine 100 mg/mL
• Both
Propofol – Ketamine Infusion

- 1:10 mixture (1 mg Ketamine: 10 mg Propofol)
- Midazolam: 1 – 2 mg
- Initial bolus: 500 mcg/kg
- Infusion: 100 mcg/kg/min
- Incremental bolus
  - Propofol/Ketamine mixture 0.25 – 0.5 mg/kg

- For a 70 kg adult (45 m)
- Induction
  - Propofol ≈ 35 mg
  - Ketamine ≈ 3.5 mg
- Infusion
  - Propofol 7 mg/min
  - Ketamine 0.7 mg/min
- Total dose
  - Propofol ≈ 350 mg
  - Ketamine ≈ 35 mg
Through maintenance of hemodynamic stability and faster recovery time, the admixture of 10:1 propofol-ketamine ratio provided the greatest benefit for continuous intravenous general anesthesia in adults undergoing dento-alveolar surgery in an outpatient clinic setting.
JM-1232 (-) (MR04A3)

- a non-benzodiazepine sedative-hypnotic
- Goal - increase sedative potency, therapeutic index, and water solubility
- binds to the same site on the GABA\textsubscript{A} receptor as classic benzodiazepines – hence reversible with Flumazenil
- safety margin that is greater than Propofol, Midazolam, thiopental, and Etomidate
The SEDASYS® System is indicated for the intravenous administration of 1% (10 mg/mL) propofol injectable emulsion for the initiation and maintenance of minimal-to-moderate sedation, as defined by the American Society of Anesthesiologists (ASA) Continuum of Depth of Sedation, in ASA physical status I and II patients ≥ 18 years old undergoing colonoscopy and esophagogastroduodenoscopy (EGD) procedures.
Suggamedex

• Reversal agent for neuromuscular blocker
  – Rocuronium, Vecuronium, Pancuronium
Suggamedex

- Sugammadex has a lipophilic core
- Rocuronium molecule bound within the core is rendered unavailable to bind to the acetylcholine receptor at the neuro-muscular junction
Replacing Succinylcholine?

Rocuronium and sugammadex: An alternative to succinylcholine for electro convulsive therapy in patients with suspected neuroleptic malignant syndrome

Karthik G. Ramamoorthy, H. Downey, and P. Hawthorne

Author information. Copyright and License information.


[Rocuronium and sugammadex in emergency medicine: requirements of a muscle relaxant for rapid sequence induction].

[Article in German]
Luxen J¹, Trentsch H, Urban B.
Post-operative Analgesics

• IV Acetaminophen – Ofirmev®
• injection is indicated for the management of mild to moderate pain, management of moderate to severe pain with adjunctive opioid analgesics, and reduction of fever.
IV Acetaminophen

Mean pain intensity scores

- IV acetaminophen 1 g given 30 min prior to induction (n=28)
- IV acetaminophen 1 g prior to skin closure (n=27)
- Placebo (n=27)

*P<0.05
Intraoperative IV Acetaminophen Does Not Improve Pain Outcome in Ambulatory Surgery

A single-center Australian trial compared three regimens:

- Pre- and postoperative placebo (n=50)
- Intra-operative IV and postoperative oral acetaminophen (n=49)
- Pre- and postoperative oral acetaminophen (n=48)

Cost
  - 2 PO Tylenol tabs $0.50
  - 1 IV Tylenol $15

Purpose

Acetaminophen (Tylenol) is a drug that is used commonly for relief of mild to moderate pain. It is found in many pain medicines that people take after having surgery. Narcotics are other drugs also used for pain (examples of narcotics are morphine and related pain medications). Medical science knows for a fact that acetaminophen works well when taken with narcotics for moderate to severe pain. Recently, acetaminophen has become available in an intravenous (IV) form called Ofirmev®. The IV form means that acetaminophen can be given into a vein. The benefits of getting medicine from an IV include:
Exparel®

Non-opioid post-op analgesic

Bupivacaine liposome injectable suspension

- FDA approved for bunionectomy and hemorrhoidectomy
- 72 hrs of pain relief
- Reduces intake of post-op narcotic analgesics
Anti-emetics

• Aloxi® - Palonosetron
• 5 HT3 antagonist used in the prevention and treatment of delayed nausea and vomiting
• IV dose is better than PO
• prevention of postoperative nausea and vomiting (PONV) for up to 24 hours following surgery
• $50 / dose to patient
Slide 1

Adapting....

Slide 2

Objectives for the day

- Practicing until perfect – incorporating simulation in your team
- Coping with drug shortages in your daily practice
- What’s on the horizon – new drugs and technology in ambulatory anesthesia you could use
- Changing demographics of patients and staff and your practice

Slide 3

Practicing until Perfect
Practicing for the unexpected in your practice
Rare events seek us out, whether we seek them out or not.
Rare events, in aggregate occur frequently.

Total In-Office Death/Brain Damage Cases Reported to OMSNIC 2000 - 2012 103
Slide 7

Incidence of In-Office Anesthesia Death & Brain Damage Cases

| 103 cases | = 1 |
| 36,272,094 procedures | 352,156 |

Slide 8

Frequency of Office Anesthetic Deaths 2000-2012

• 1 in every 528 OMS will experience an office anesthetic death per year
• In a 30 year practice life 1 in 18 OMS will experience an office anesthetic death

Slide 9

Adverse Events in Outpatient Setting

• Pediatric Sedation Research Consortium1 – collection of data from 26 institutions, 30,037 sedation/anesthesia encounters July 2004 – November 2005

Slide 10

- Intolerance of the uncertainty
- Management of anxiety and pain
- Options for anesthesia - from local to general
- Safety
- Training in techniques, understanding of pharmacology, management of potential complications
- High stakes, high risk

Slide 11

- Intolerance of the uncertainty
- Management of anxiety and pain
- Options for anesthesia - from local to general
- Safety
- Training in techniques, understanding of pharmacology, management of potential complications
- High stakes, high risk

Slide 12

Current Paradigm

- Residency training
- Progressive exposure to anesthesia in the relevant setting
- A familiar drug cocktail, set of skills, crash cart, vague recollection of ACLS
- OAE every five years by a peer
- Anesthesia CE credits

- Is that enough?
AAOMS SIM-Man Course

At the AAOMS meeting
Teams of OMS/staff
Clinical scenarios played out on SimMan
Some public shaming
Some scary moments
Generally popular
? Teach anything

What were we hoping to teach/learn?

The concept of simulation
Introduction of technology of SimMan
Recognition of one’s preparedness to tackle common emergencies
Skills?
Encourage routine emergency drills in offices
A positive experience

Intent of OAE

Since 1975
Each practicing AAOMS member maintained a properly equipped office and was prepared to use accepted techniques for managing emergencies and complications of anesthesia in the treatment of the OMS patient in the office or outpatient setting
OAE manual is being revised for the next edition
Slide 16

Is that enough?

• Is it?
• ACLS retention with hi-fi Sim = 120 days
• Daily practice of routine technique
• Competent – mastery of a set of skills, knowledge
• Proficient – a measure of performance – a snapshot of success

Slide 17

• Safety
• State Certification requirements
• Malpractice costs
• Advanced safer sedation and monitoring techniques
• Training

Slide 18

Vigilance at every step

• Appropriate patient selection
• Appropriate preparedness
Slide 19

Vigilance at every step

Pre-Procedural Vigilance
• A documented pre-sedation medical evaluation, including a focused airway exam
• An appropriate interval of fasting before sedation
• No sedative or anxiolytic medications without supervision from skilled medical personnel (i.e., not at home or by a technician)
• Sedative and anxiolytic medications should only be administered by, or in the presence of individuals skilled in airway management and cardiopulmonary resuscitation

Slide 20

Vigilance at every step

Procedural Vigilance
• Age- and size-appropriate equipment and appropriate medications
• Continuous and appropriate monitoring
• Designated anesthesia personnel to monitor the patient’s cardiorespiratory status during and after the procedure

Slide 21

Vigilance at every step

Post-Procedural Vigilance
• Specific discharge criteria
• Children/young adults sedated using medication with a long half-life (e.g., chloral hydrate, pentobarbital and chlorpromazine) may require extended observation.
• Don’t hurry the D/C
• 2 responsible escorts
Slide 22

Vascular Access

• IV
• IO availability and training to use
• Safety Net

Slide 23

• Top 5 reasons never to sedate in your practice
  1. ___
  2. ___
  3. ___
  4. ___
  5. ___

Slide 24

Medical Management is Risk Management

• Basic understanding of medical issues
• Understanding of risks associated with medical problems
• Risk stratification
• Keeping current is important...new
• Diagnosis/management
• Treatment strategies
• Pharmacology
Medical Assessment & Management

1. Pre-surgical workup
2. Cardiac
3. Pulmonary
4. GI
5. Renal
6. Endocrine/Obesity
7. Hematologic

---

Pre-surgical Workup

- Screening questionnaire
- OMSNIC
- Medication list
  - Often yields as much/more info than the questionnaire
  - Printed/written or from pt’s pharmacy
- Targeted questions based on above

---

A 64 year old type II diabetic managed with oral Metformin and a recent Hgb A1c of 5.5 and predictable mild exertional angina presents for closed reduction of a condylar neck fracture. What is his ASA classification?

A. II E
B. III
C. IV E
D. V
Slide 28

ASA Preoperative Health Status Comments, Examples

ASA PS 1
Normal healthy patient
No organic, physiologic, or psychiatric disturbance; excludes the very young and very old; healthy with good exercise tolerance

ASA PS 2
Patients with mild systemic disease
No functional limitations; has a well-controlled disease of one body system; controlled hypertension or diabetes without systemic effects, cigarette smoking without chronic obstructive pulmonary disease (COPD); mild obesity, pregnancy

ASA PS 3
Patients with severe systemic disease
Some functional limitation; has a controlled disease of more than one body system or one major system; no immediate danger of death; controlled congestive heart failure (CHF), stable angina, old heart attack, poorly controlled hypertension, morbid obesity, chronic renal failure; bronchospastic disease with intermittent symptoms

ASA PS 4
Patients with severe systemic disease that is a constant threat to life
Has at least one severe disease that is poorly controlled or at end stage; possible risk of death; unstable angina, symptomatic COPD, symptomatic CHF, hepatorenal failure

ASA PS 5
Moribund patients who are not expected to survive without the operation
Not expected to survive > 24 hours without surgery; imminent risk of death; multiorgan failure, sepsis syndrome with hemodynamic instability, hypothermia, poorly controlled coagulopathy

ASA PS 6
A declared brain-dead patient whose organs are being removed for donor purposes


Slide 29

ASA Classification System

- Overlap of categories
- Vague
- Medico-legally necessary for risk stratification prior to surgery/anesthesia
- Other more complex systems exist
  - Adult Co-morbidity Evaluation index (ACE)
  - APACHE II (Acute Physiology/Chronic Health Evaluation)
  - ASA
  - European systems
- No demonstrated superiority re: pre-op prediction of anesthetic morbidity/mortality


Slide 30

Presurgical/Anesthesia Tests


- Content of the pre-anesthetic evaluation includes,
  - (1) readily accessible medical records,
  - (2) patient interview,
  - (3) a directed pre-anesthesia examination,
  - (4) preoperative tests when indicated, and
  - (5) other consultations when appropriate.
- At a minimum, a directed pre-anesthetic physical examination should include an assessment of the airway, lungs, and heart.
- Routine preoperative tests NOT INDICATED unless medical or physical exam necessary
- SELECTION and TIMING of specific tests cannot be supported in the current literature
Slide 31

Which test is appropriate for an otherwise healthy 19 yo sexually active female on oral birth control medication prior to surgery?

a. Serum beta-HCG
b. CBC
c. Urine beta-HCG
d. None

?  

Slide 32

Pre-surgical/Anesthesia Tests

CMS guidelines:

• H&P < 30 days before an operation for an outpatient procedure
• Pre-anesthesia evaluation by an anesthesia provider within 48 hours before surgery
• Components of exam/testing left up to surgeon/anesthesiologist

ASA Guidelines 2012


• Minimum pre-op exam consists of exam of airway, CV, pulmonary
• High “severity of disease” or high “invasiveness of surgery” should take recent review and exam done 48 hrs before day of surgery
• Low/mid invasiveness with low disease severity can have exam on day of surgery
Pre-surgical/Anesthesia Tests

SO WHAT ARE WE LEFT WITH?
• Guidelines are often institutional
• “Common sense” guidelines
• Cost factors
  • Hospital
  • Insurance
  • Patient

Which test is appropriate for an otherwise healthy 19 y-o sexually active female on oral birth control medication prior to surgery?

a. Serum beta-HCG
b. CBC
c. Urine beta-HCG
d. None

So, what pre-op tests to order?

• Based on risk factors
• ASA classification
• History of smoking
• History of hypertension
• Family history of diabetes
• Surgical classification

**Surgical Risk Classification System**

*Fattahi et al*

- **Category 1**
  - Minimal risk to patients independent of anesthesia
  - Minimally invasive procedures with little or no blood loss. Often done in an office setting.

- **Category 2**
  - Minimal to moderately invasive procedure. Blood loss less than 500 mL. Mild risk to patients independent of anesthesia.

- **Category 3**
  - Moderately to significantly invasive procedure. Blood loss potential 500–1500 mL. Moderate risk to patients independent of anesthesia.

- **Category 4**
  - Highly invasive procedure. Blood loss greater than 1500 mL. Major risk to patients independent of anesthesia.

---

**“Routine” Pre-surgical Tests**

*Fattahi et al*

- **ASA I**
  - Category 1 surgery
  - Male: No tests required
  - Female (childbearing age): Consider beta-HCG

- **Category 2 surgery**
  - Hemogram or CBC, chemistry
  - Male > 40–50 years: Add ECG
  - All > 60 years: Add ECG and CXR

- **ASA II or greater**
  - Labs as indicated by medical history and/or physical examination

---

---
Laboratory Testing

- Unnecessary use of tests increases costs, may not benefit
- "Abnormal" = generally > 2 standard deviations from median value

ASA > II Lab Indications From Physical Exam Or Medical Hx

| CBC | | Chem 7 (BNP) |
|-----|----------------|
| Recent infection | | Malnutrition/dehydration |
| Immunosuppression/treatment | | Steroids |
| Steroid use | | Diuretics |
| HS of significant recent blood loss, anticipated high surgical blood loss, anemia | | Digital |
| S/p splenectomy or hematologic abnormality | | Renal failure |
| DM | | DM |

Common Individual Lab Indications

- Serum glucose: DM, steroids, pancreatic/adrénal/pituitary problems
- PT/PTT/dilution studies: Known/suspected coagulopathy, renal failure, hepatic dysfunction, DM, alcohols, anticoagulants
- LFTs: Hepatic or pancreatic disease, DM, alcohol
### Slide 43

**Common individual lab indications**

- UA: Dysuria/suspicion of RF or UTI
- CXR: CV disease, pulmonary disease, URI, TOB abuse, severe obesity
- ECG: Age, HTN, dyslipidemia, significant obesity

### Slide 44

**U of NE Med Center**

**“Hybrid” Pre-anesth Testing Guidelines**

- 14 questions RN phone call screening tool
- Need for testing and necessity of separate pre-anesth. clinical evaluation based on this tool
- Pre-anesth. testing based on co-morbidities, NOT age based
- Can be adapted for office surgery


### Slide 45

<table>
<thead>
<tr>
<th>Symptom</th>
<th>...</th>
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<tbody>
<tr>
<td>Anemia</td>
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<tr>
<td>Bleeding history</td>
<td>X</td>
</tr>
<tr>
<td>CV disease</td>
<td>X</td>
</tr>
<tr>
<td>Cerebrovascular</td>
<td>X</td>
</tr>
<tr>
<td>DM</td>
<td>X</td>
</tr>
<tr>
<td>Diuretics</td>
<td>X</td>
</tr>
<tr>
<td>Liver disease</td>
<td>X</td>
</tr>
<tr>
<td>PVD</td>
<td>X</td>
</tr>
<tr>
<td>COPD</td>
<td>X</td>
</tr>
<tr>
<td>Renal disease</td>
<td>X</td>
</tr>
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<td>Rheumatoid Arthritis</td>
<td>X</td>
</tr>
<tr>
<td>Slab apnea</td>
<td>X</td>
</tr>
<tr>
<td>UTI</td>
<td>X</td>
</tr>
<tr>
<td>SLE</td>
<td>X</td>
</tr>
<tr>
<td>Thyroid disease</td>
<td>X</td>
</tr>
<tr>
<td>TPN fed</td>
<td>X</td>
</tr>
</tbody>
</table>
How Safe Is Anesthesia Provided By OMSs?


- No complications
- Local anesthesia – 99.6%
- Conscious sedation – 99.1%
- Deep sedation / GA – 98.5%

Parameters of Care & AAOMS Office anesthesia manual
- Ventilatory monitoring should include auscultation
  - Stethoscope – 41.5%
  - Capnography – 48%
  - IV access
  - Angiocatheter – 49.8%
How Safe Is Anesthesia Provided By OMSSs?
- OMSNIC
- 2000 to 2013
- 39,392,008 office based anesthetics
- 113 cases resulted in death or brain injury
- 1 per 348,602 cases
- 1 per every 6.4 weeks

Normal Accidents: Living With High-risk Technologies
- Accidents are normal and should be expected

Goal: safe care
### Airway Assessment

**Can you intubate the patient?**

**Can you ventilate the patient?**

- Mallampatti – Samsoon
- Thyromental distance
- Macroglossia
- Retrognathia
- Tonsillar hypertrophy
- Inter-incisal distance
- Length of upper incisors
- Short neck
- Neck hyperextension
- Neck circumference
- Position of larynx
- Prior tracheostomy
- Infection / mass
- Obesity

---

### Slide 52

<table>
<thead>
<tr>
<th>Mallampatti – Samsoon</th>
<th>Thyromental distance</th>
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<tbody>
<tr>
<td>Macroglossia</td>
<td>Retrognathia</td>
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<tr>
<td>Tonsillar hypertrophy</td>
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</tr>
<tr>
<td>Obesity</td>
<td></td>
</tr>
</tbody>
</table>

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### Slide 53

Airway Assessment

Class I  Class II  Class III  Class IV

---

### Slide 54

Airway Assessment

2 Rotational:

- Midline
- Slight deviation

---

Airway Assessment

3 Rotation:

- High rotation
- Low rotation

---

Airway Assessment

4 Rotation:

- Full rotation
- No rotation

---
Change in Emphasis

• Old: "If you can't INTUBATE it…don't sedate it"
• New: "If you can't VENTILATE it…don't sedate it"
• Difficult to intubate does NOT necessarily mean difficult to ventilate
• Most studies do not investigate "difficult to ventilate"

Can You Ventilate The Patient?
• Facial hair
• BMI > 26 kg/m²
• Edentulous
• Age > 55 years
• H/o snoring
• Skeletal abnormalities
• Poor Atlanto-occipital extension
• Lingual tonsil hypertrophy
• Facial burns
• Heavy jaw muscles
• Macroglossia
• H/o OSA

The Pediatric Respiratory System

Not just a small adult….
Airway

- Proportionally larger head and tongue
- Narrow nasal passages
- Anterior and more cephalad larynx (C4 versus C6 in adults)
- Long epiglottis
- Short neck
- Short trachea, narrow cricoid, funnel shaped

D G Krishnan ODSA Nov 2016
Geriatric Airway Changes

- Decreased pharyngeal muscular support
- Opening and/or maintaining the airway
- Cervical arthritis limits neck extension
- Increased risk for aspiration
- Decreased upper esophageal sphincter tone
- Increased gastric emptying time
- Diminished protective laryngeal reflexes
- Decreased number and activity of respiratory cilia
Pharyngeal Muscular Dilators

- Tensor palatini – soft palate - nasopharynx
- Genioglossus – tongue – oropharynx
- Hyoid muscles – epiglottis – laryngopharynx
- Geriatric dilator muscle tonus decreases, with obstruction tendency

Geriatric Pulmonary Morbidity

- Ventilatory patterns
- Irregular / apneic spells
- Anesthesia
- Decreased resting PaO2
- Decreased ventilatory responses to hypoxia & hypercarbia
- Increased incidence of desaturation and apnea

Obesity (more on this later)

- Body mass index (BMI) weight (kg) / Height² (meters)
- Adult weight classification:
  - Underweight: <18.5
  - Normal: 18.5 to 24.9
  - Overweight: 25 to 29.9
  - Obese: 30 to 39.9
  - Extremely obese: > 40
- Obesity
  - 20% > IBW
- Morbid obesity
  - > 2 x's IBW
STOP-BANG Score

1. Snoring: Do you snore loudly (louder than talking or loud enough to be heard through closed doors)?
   - Yes
   - No

2. Tired: Do you often feel tired, fatigued, or sleepy during daytime?
   - Yes
   - No

3. Observed: Has anyone observed you stop breathing during your sleep?
   - Yes
   - No

4. Blood Pressure: Do you have or are you being treated for high blood pressure?
   - Yes
   - No

5. BMI: BMI more than 35 kg/m2?
   - Yes
   - No

6. Age: Age over 50 years old?
   - Yes
   - No

7. Neck circumference: Neck circumference greater than 40 cm (16 in)?
   - Yes
   - No

8. Gender: Gender male?
   - Yes
   - No

High risk of OSA: answering yes to three or more items
Low risk of OSA: answering yes to less than three items

Sensitivity
- Mild – 83.6%
- Moderate – 92.9%
- Severe – 100%

Negative predictive value – 90%

Respiratory Anatomy - Changes In Obesity

- Altered airway anatomy
- Decrease in cervical & mandibular range of motion
- Decrease in thyromental distance
- Less favorable Mallampati classification
- Airway more likely to collapse during anesthesia
- Lateral pharyngeal fat

Controversial if obesity is associated with increased difficulty in intubation
Slide 70

**O₂ sat Vs. Time to Apnea Variability**

- Decreased capacity for oxygen loading
- **FRC**
- Increased oxygen consumption

Slide 71

**Anatomic Alterations in Upper Airway**

- Down syndrome
- Rheumatoid arthritis
- Diabetes
- Ankylosing spondylitis
- Spinal cord injuries

Slide 72

**Down syndrome**

- Atlanto-axial instability
- Macroglossia
Slide 73
Diabetic Patient: Cheiro-arthropathy

Prayer sign

Slide 74
Acromegaly

• Excess growth hormone produced from pituitary
• Features: big tongue, full lips, big mandible, prominent frontal sinuses
• Overgrowth of soft tissues of pharynx, larynx
• Obstructive sleep apnea
• Recurrent laryngeal nerve paralysis
• Limited range of TMJ movement

Slide 75
Rheumatoid Arthritis

• Reduced mandibular motion (esp. juvenile)
• Micrognathia
• Limited neck motion
• Flex the lower cervical vertebrae
• Extend the atlanto-occipital joint (sniffing position)
• Atlanto-axial subluxation & separation of the atlanto-odontoid articulation
• Cricoarytenoid arthritis
Slide 76

Disease Processes that alter Upper Airway Management

- Muscular dystrophy
- Malignant hyperthermia
- Spinal cord injuries
- Myasthenia gravis
- Burn patient

Slide 77

Monitoring

- Definition: continuous observation of data to evaluate physiologic function
- Rationale: to permit prompt recognition of a deviation from normal, so corrective therapy can be implemented before morbidity ensues

Slide 78

Monitoring
Slide 79

What monitors do you use?  
What monitors should be used?  
• Respiratory  
  • Pulse oximetry  
  • Ventilation  
  • Observation of chest rise  
  • Pre-tracheal stethoscope  
  • Capnography  
• Cardiac  
  • Blood pressure  
  • ECG  
• Depth of sedation  
  • Anesthetic monitor

Slide 80

Role of Respiratory Monitoring  
• Maintenance of arterial oxygenation  
• Arterial cannulation  
• Transcutaneous oxygen  
• Maintenance of oxyhemoglobin saturation  
• Adequacy of ventilation

Slide 81

Pulse Oximetry  
• Spectrophotometric analysis  
  • Red @ 660 nm  
  • Infrared @ 940 nm
Pulse Oximetry

- Continuous account of peripheral arterial oxy-hemoglobin saturation
- "Rapidly" recognizes changes
- Finger probe is peripherally located & has a delayed response
- Does not directly measure PaO2
- Failure to detect hypoventilation in patients receiving supplemental oxygen

Limitations of Pulse Oximetry?

- With supplemental O2 administration
- Provides no indication of ventilation!

Limitations of Pulse Oximetry

- Carboxyhemoglobin
- SaO2 unreliably high
- Methemoglobinemia
- SaO2 ~ 85%
- Fingernail polish:
  - Green, blue, black can cause false reduction in SaO2 by 3%, 5% and 6%
- Cold extremities
- Anemia
  - SaO2 accurate to hemoglobin of 3 gm/dL
- Hyperventilation
  - SaO2 accurate to BP of 30 mm Hg
Slide 85

Where does the Probe function best?

- Strong signal
- Fingers
- Toes
- Less time delay
- More central location
- Ear

Slide 86

Should O₂ be Administered?

- Supplemental oxygenation
- De-nitrogenation in airway
- Functional residual capacity
- De-nitrogenation in reserve (ERV)

Slide 87

"During moderate or deep sedation, the adequacy of ventilation shall be evaluated by continual observation of qualitative clinical signs and monitoring for the presence of exhaled carbon dioxide unless precluded or invalidated by the nature of the patient, procedure or equipment."

American Society of Anesthesiologists (ASA) Basic Anesthetic Monitoring Standards, Section 3.2.4.
What is the difference between capnometry & capnography?

- Capnometry
  - Numerical measurement
  - Level of CO₂

- Capnography
  - Graphic display of expired CO₂ versus time

---

- Intubated patient
  - Confirms tracheal intubation
  - Detects disconnect
  - Appropriateness of minute ventilation
  - Numerical expired CO₂ concentration

---

- Non-intubated patient
  - Measures PETCO₂ (maybe)
  - Graphic display of exhaled CO₂ pattern
Slide 91

**Evaluation of ETCO**

- Ventilation
- Cardiac output
- Metabolic activity
- Predict outcome of resuscitation (< 10, poor outcome)
- Correlation with $P_{aCO_2}$

Slide 92

**Capnographic Waveform**

Slide 93

**What may cause a decrease in ETCO2?**

- Partial airway obstruction
- Hyperventilation
- Increasing dead space
- Airway leaks
- Dislodgement of ETT
- Low cardiac output
- Pulmonary embolism
Slide 94

No ETCO

DGK5

Slide 95

What may cause an \( \uparrow \) in ETCO\(_2? \)

- Hypoventilation
- Partial airway obstruction
- Increasing body temperature
- Increased metabolic activity

DGK7

Slide 96

EtCO\(_2\) in Obstructions

- Phase II: reflects emptying of bronchopulmonary tree
Slide 97

**Summary of EtCO₂**

![Graph showing respiratory changes](image)

Slide 98

**Capnography - Is it practical?**

- What is its benefits?
- Can it predict changes that would be detected by pulse oximetry prior to these changes occurring?
- How can it be used?
- Is it effective, despite an open mouth and potential oral exhalation?
- Cost? (of safety)

Slide 99

**Cormack-Lehane Laryngoscopy Grades**

![Images of laryngoscopy grades](image)
Airway Setup

- Airway setup in each operatory
- Drugs
- Airway adjuncts
- Oxygen
- Suction
**Slide 103**

**Crash Cart**
- Central area
- Oxygen tank
- Regulator
- BVM
- Airway adjuncts
- Laryngoscope
- Batteries
- Stylettes
- LMA/iGel
- Suction

**Slide 104**

**Airway Bougies / Exchange Catheters**
- Grades III & IV views
- Technique
- Blind or under-visualization
- "Feel" bougie rubbing tracheal rings
- Pass endotracheal tube over bougie
- Cook airway exchange catheters

**Slide 105**

**Can You Perform A Cricothyrotomy?**
**Slide 106**

Naso-pharyngeal Airway

- Up the nose with a rubber hose

---

**Slide 107**

Oro-pharyngeal Airway

- Measure airway from commissure of the lip to the ear lobe
- Open mouth with cross finger technique
- Pull tongue forward & insert device

---

**Slide 108**

- Optimize visualization
- Minimize the angle between:
  - Oral axis
  - Pharyngeal axis
  - Laryngeal axis
**Slide 109**

- Miller Blade
- Small mandibular space
- Anterior larynx
- Long floppy epiglottis

**Slide 110**

- Macintosh Blade
- Little upper airway room
- Small narrow mouth
- Narrow palate
- Small oropharynx
- Less traumatic to teeth
- Curved blade does not touch epiglottis
- Pharyngeal surface of epiglottis innervated by glossopharyngeal nerve
- Laryngeal surface of epiglottis innervated by superior laryngeal nerve
- Stimulation of superior laryngeal nerve
- Laryngospasm & bronchospasm

**Slide 111**

- A Different View
**Slide 112**

**Nasal Intubation**

- Awake: Prepare nostril (decongest/dilators)
- Anesthetize airway
- Spray / rinse oral pharynx
- Trans-tracheal block
- Glossopharyngeal nerve block
- Recurrent laryngeal nerve block
- Small endotracheal tube
- Lubricated
- Presoaked in warm water
- Orient tube such that tip is against septum and bevel faces turbinate
- RAE (fixed flexion length per diameter) vs. "regular" ET

---

**Slide 113**

**A Difficult or Failed Intubation**

- Tooth damage
- Soft tissue trauma
- Crico-arytenoid joint subluxation
- Assoc. with: chronic renal insufficiency, Crohn's dx, acromegaly
- S/S: voice changes, sore throat, pain on swallowing, stridor, shortness of breath
- Early (better) vs. late intervention

---

**Slide 114**

**Attempted Intubation – Action & Reactions**

- Autonomic responses
  - Tachycardia
  - Hypertension
  - Dysrhythmias
  - Bronchospasm
  - Hypotension & bradycardia
- Laryngospasm &/or bronchospasm
- In-holding of arytenoids
- Coughing & bucking
- Vomiting, regurgitation, aspiration
Supraglottic Airway Devices

- Minimally invasive device
- Inflatable mask fitted with a tube
- Occupies the hypo-pharyngeal space
- Forms a seal above the glottis
- Go to rescue airway

LMA Types

LMA Unique
LMA Fastrach
Slide 118

LMA Types

- LMA ProSeal
- LMA Supreme

Slide 119

LMA Types

- LMA C-trach
- LMA Flexible

Slide 120

Laryngeal Mask Airway

- Muscle relaxation is unnecessary
- Laryngoscopy is circumvented
- Hemodynamic changes are minimized during insertion
### Slide 121

**LMA Contraindications**

- Non-fasted patient
- Morbidly obese
- High inspiratory pressures (>20 – 25 cm H2O)
- Hiatal hernia
- GERD

---

### Slide 122

**LMA Complications**

- Coughing
- Laryngospasm
- Labored breathing
- Complete airway obstruction
- Sore throat
- Dysarthria
- Hypoglossal nerve paralysis
- Inability to protect against pulmonary aspiration

---

### Slide 123

**iGel**

- Anatomic gel seal. No inflation
- Integral bite block
- Gastric suction possible
- Ease of insertion
- Less laryngeal trauma
- Max airway pressures equivocal
- Superior ventilation
- Simple insertion avoidable
Slide 124

Supraglottic Airway Devices
- LMA/iGel
- King airway
- Combitube

Slide 125

Supraglottic Airway Devices
- Cobra perilaryngeal airway
- Cuffed oropharyngeal airway

Slide 126

Video Laryngoscopy
- glidescope
- king
- McGrath
- Vivid trac
Slide 127

Comparsion of Direct Laryoscopy and Video Laryoscopy in Intubating a Mannequin Should Video Laryoscopy Be Available to Manage Airway Emergencies in the Oral and Maxillofacial Surgery Office?

Slide 128

The unanticipated adverse event

Slide 129

4 P’s of Ambulatory Anesthesia

• Preparation Prevents Poor Performance
• Airway Techniques/Tools
• Emergency Drugs
• Cool!
Slide 130

- Rare events seek us out, whether we seek them out or not
- Rare events, in aggregate occur frequently

Slide 131

Goals of Sedation

- Allay fear and anxiety
- Obtain cooperation
- Achieve immobilization to the degree needed for the procedure
- Induce amnesia
- Reduce discomfort and pain
- Keep patient safe

Slide 132

(balance)
Ideal Anesthetic

- Onset
- Offset
- Sedation
- Analgesia
- Amnesia
- Immobility
- Nausea / vomiting
- Lack of respiratory depression
- Cardiovascular stability

Impeccable Monitoring

Preparation and set up
Checklists

• Successful quality improvement initiatives utilize cognitive aids such as checklists and have been shown to optimize pediatric patient experience and anesthesia outcomes and reduce perioperative complications.

Curr Opin Anaesthesiol. 2014 Apr 8

Monitoring Requirements

• Current guidelines
  - Positive pressure oxygen delivery system
  - 650 L 'E' cylinder
  - 90% O2 at 10L/Min for at least 60 mins
  - Functional Suction apparatus
  - Adult and Pediatric masks, nasal cannulae, BP cuffs, pulse oximetry, capnography, heart and resp rate monitors
  - Pre-cordial stethoscope
  - Emergency Kit, defibrillator

AAOMS ParCare 2012/7

• Time-oriented anesthesia record
• Documentation of
  - anesthetic agents, including dosages, routes of administration, and times of administration
  - continuous monitoring including heart rate, blood pressure, ventilation, SpO2, arterial oxygen saturation, ETCO2 and temperature (when indicated) on at least a 5-minute interval
  - Continuous electrocardiograph (ECG) monitoring
**Personnel Requirement**

- At least two personnel
- BLS/PALS/ACLS
- Three individuals Level 3 and above
- Recovery room

**Emergency Drugs**

**Emergency Meds**

- Calculate doses along with sedation meds
- Pre-draw IM doses for procedure
- Have IV meds in room
- Atropine
- Succinylcholine
Why Do Anesthetics Fail?

- Agitation vs. Apnea
- Movement / combative ness
- Inability to maintain an airway
- Uncontrolled sympathetic response
- Kung Fu fighters!
- Poor planning

The Anxious Surgical Patient

- 75% of all surgical patients
- More difficult induction
- More difficult maintenance
- Increased autonomic tone

Anxious Patients

- 3 times more likely to miss appointments
- Require more chair time
- Enduring memories of an unpleasant experience
Slide 145

Benefits of Reduced Anxiety

• Increased cooperation
• Easier induction and maintenance
• Attenuated autonomic response
• More rapid recovery/discharge

Slide 146

Range of Anxiety

- Mild: Unpleasant Experience
- Moderate: Delay in obtaining care
  Expresses concerns
- Severe: Avoidance of care
  Sleep disturbances
  Syncope
  Hyperventilation

Slide 147

How are you going to sedate this patient?

• "Conscious sedation"
• General anesthesia
Sedative Techniques

• Goals
  • Reducing anxiety
  • Establishing cooperation
  • Ensuring comfort
  • Establishing amnesia and analgesia
  • Ensuring hemodynamic stability

Sedative Techniques

• Considerations
  • Age of patient
  • Level of anxiety and ability to cooperate
  • Medical history
  • Prior experience
  • Duration and intensity of procedure
  • Equipment, facility, personnel, training

The Continuum of sedation
Airway Challenges

- Ability to mask ventilate
- BMI > 26
- History of snoring
- Obese
- Facial hair
- Ability to intubate
- Mallampatti score
- Thyromental distance
- MO
- ROM of neck
- Distortion of airway
- Obese patients?

Plan for failure

- Airway assessment pre-op and understand ability of patient to tolerate apnea – correct patient selection (review of medical history and physical exam!)
- Identify cricothyroid membrane pre-op
- Anticipate that if you cannot perform BVM have supra-glottic airway ready (correct size)
- If need to intubate, consider a laryngoscope you are comfortable using

Unable to ventilate/intubate

- Stop procedure, pack off wound
- Open airway, confirm sniffing position, grab tongue and pull forward
- BVM with or without nasal or oral airways
- Second generation supraglottic airway
- Call 911?
- Intubate patient (no more than 3 attempts!)
- Cricothyroidotomy (or TTJV)
Slide 154

SO MUCH WORK TO DO

SO LITTLE TIME

Slide 155

Unable to call 911?

Slide 156

Fan of tiny offices?
Slide 160

Why Simulate?

Slide 161

Why Simulation?

- Simulation centers in academic medical centers
- Practice makes perfect
- Validated model for modern training
- Work hour restrictions
- Train the uncommon
Slide 163

Not a Stranger to Simulation

Slide 164

- Plating workshops
- Suturing pigs’ feet
- Arch bar workshops
- Mock board exams

Slide 165

Incorporation in OMS curriculum

- Novice dental/medical student to responsible surgical intern
- Graduated training in more complex procedures
- Practice prior to procedure
- Preparation for certification examination
- Certification in ACLS, ATLS
- Re-certification for credentialing
- Virtual surgical planning
- Low risk, high stakes!
Incorporation in OMS curriculum

Techniques and infra-structure
- Patient Actors
- Simulation Suite
- Physical equipment
- SimMan/TraumaMan
- Cadaver and animal labs
- Haptic Simulation
- Virtual Reality

Stage 1 – conversion of the Novice
- Sterile technique, proper scrubbing for operation
- Basic flap design
- Basic life support
- Suture skills
- Emergency drills
- Patient interview
- Breaking bad news

3rd Intern Boot Camp – UC, UK, OSU, CWRU, UoL, IU
Slide 172
Sterile operating theatre and prep area

Slide 173
Stage 2 - simulated surgical procedures
- Cadaver and animal labs
- High-fidelity simulators
- Haptic simulation environment
- Virtual reality

Slide 174
TMJ arthroscopy
Slide 175

Developing a curriculum

Objectives – TMJ scope

• Identifies landmarks and palpate glenoid fossa on either side of patient
• Introduces scope and confirms position in superior joint space
• Insufflates joint
• Introduces portal or outflow
• Able to perform arthrocentesis
• Navigates joint
• Identifies structures
• Advanced arthroscopic maneuvers

Slide 176

Validating Simulation Training

• Validate a new assessment tool used to measure the proficiency of a subject in TMJ arthroscopy in an objective manner
• Efficiency Endpoint: an assessment tool will correlate TMJ skill level with a numeric result
• Subjects will include Oral and Maxillofacial Surgery (OMS) residents, faculty, and community based private practitioners
• Subjects will perform a TMJ arthroscopy on a fresh cadaver head
• Procedures will be video recorded from both an external and arthroscopic view
• Procedures will be reviewed by an expert evaluator blinded to the identity and experience level of each subject
• Numeric scores will be compared to experience level of each subject

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Slide 181

Trachs, Crics and chest tubes

Slide 182

SimMAIn and Anesthesia

Slide 183

AAOMS Sim in Anesthesia Project

- Partnering with MUSC
- Development of a Comprehensive Simulation-based Sedation and Crisis Management Course
- Since 2014 – 3 phases:
  1. Residency program simulation learning system
  2. Regional CME simulation learning system based on outcomes of phase 1
  3. Certification program for office-based practices based on outcomes and validation research of phases 1 and 2
AAOMS Sim in Anesthesia Project
3 modules
• Basic Emergency Airway Management (BEAM) for Oral and Maxillofacial Surgeons
• Office-based Crisis Management for Oral and Maxillofacial Surgeons
• Office-based Sedation (minimal through deep levels) for Oral and Maxillofacial Surgeons

Pilot Programs
1. Pilot 1 - 8/29/15 at Medical University of SC
2. Pilot 2 - 10/17/15 at the University of Cincinnati
3. Pilot 3 - 11/21/15 at the University of Pittsburgh
4. Pilot 4 - 8/6/16 at the University of Minnesota
**Roles and Training**

1. **One (1) Facilitator**
   - a one-hour phone conference pre-training
   - a two-hour web conference review of the programmed scenarios
   - six (6) hour face-to-face training reviewing how to run the simulation workshop component of the course

2. **Eight (8) OMS residents**
   - complete a self-paced pre-course curriculum that provided information on the content
   - self-paced module and quiz on interpreting the sedation monitor
   - online instruction on how to run mastery-based cooperative learning scenarios
   - during the simulation workshop component of the course, the residents received approximately five (5) minutes of cooperative learning review prior to operating scenarios

3. **Simulation support staff**
   - simulation support staff handled all manikin and course-specific set up

---

**BEAM Simulation Scenario set**

1. **Normal BMV**: mastery based practice with test, single practice
2. **Difficult BMV**: mastery based practice with test, single practice
3. **Two person BMV demo**: mastery based practice with test, single practice
4. **Assisted BMV demo**: mastery based practice, test
5. **LMA insertion**: mastery based practice, test, single practice
6. **Airtraq (disposable, one time use video-laryngoscope)**: mastery based practice, test
7. **Adult Laryngospasm (Heel-stroke manikin)**: with the following drills:
   1. Partial Laryngospasm
   2. Complete laryngospasm with CPAP
   3. Complete laryngospasm with IV Sux
   4. Complete laryngospasm with IM Sux
8. **Pediatric Laryngospasm**
Slide 196

**Time to Achieve Goals**

![Graph showing time to achieve goals]

Slide 197

- Ability to measure pre-practice and post-practice mastery of skills training:
  - Each skill set
  - Each group
  - Each individual
- Practice until perfect – especially new skills – LMA, Airtraq
- Work as a team

Slide 198

**Summary from BEAM Pilots**

1. Standardized, mastery-based approach simulation scenario methodology leads to consistent documentation of 100% achievement of educational goals and skills regardless of the training site
2. Lower operating costs (1 Facilitator: 1 Simulation Specialist: 4 simulators: 8 trainees vs. traditional 1 Facilitator: 1 Simulation Specialist: 1 simulator: 2 trainees)
3. Quality assurance and performance metrics course data is unique. Data emerging from these pilots is so robust it can be used to support a clear, defensible data-driven case for “value” versus costs and promising for improved patient safety impact
4. Participants and facilitators provided positive feedback
Moving Forward

• On track to start piloting modules 2, 3
• Roll out module 1 to state societies
• Eventually replace OAE with hands-on mastery based approach to simulation to all members
• Powerful, meaningful data
• Practice until perfect
• Patient safety – low risk practice for high stake scenarios

Practice Makes Perfect
Slide 202

- Practicing managing the unexpected in OMS
- Nerve repair model

Slide 203

Haptic Simulators

- A physics-based head and neck simulator to enhance training of oral & maxillofacial, plastic, trauma, ENT, and other trainees and surgical educators
- Haptic feedback, virtual environment

Slide 204

Specific Aims

1. Simulate accurate heterogeneous tissue of the facial region
2. Demonstrate the feasibility of an accurate, interactive, physics-based simulation of microsurgical repair
3. Develop a practical curricular structure for use in conjunction with the OMS to illustrate how an approach similar to what has been done by the ACS/APDS can work
Phase I

Aim 1.
- Simulate heterogeneous tissue of the facial region
  - 1.1. Use the existing tool chain to model facial structure detail in a small region with details of the surrounding anatomy
  - 1.2. Adapt the physics computational approach to handle the heterogeneous multi-structure mechanical behavior needs of the anatomy including nerves, and vasculature.
Phase I

• Aim 2. Demonstrate the feasibility of an appropriate, interactive, physics-based simulation of microsurgical repair
  • 2.1. Implement standalone nerve model embedded in a homogeneous background tissue
  • 2.2. Place sutures around the circumference of the epineurium

Phase II major aims:

• (1) Define an overall curriculum and tools to create it so that the simulator will ultimately fulfill its long-term commercial incarnation
• (2) Build off of the technical foundation of Phase I and use the models from Aim 1 to create the microsurgical skills training simulator prototype that provides the IAN repair approximation scenario
• (3) Evaluate and refine the prototype, carry out an initial assessment study to discern how well the simulator fulfills its mission to teach the perception of the surgical scenario, discern the actions to be taken, perform the physical skills that are the culmination of the decision to act.
It’s a whole new world
Adapting to changing demographics in your practice

• Next Gen Surgeons
• Weirdo Millennial staff
• Are you creating a prescription drug abuser?
Objectives

- Generational differences
- Cultural differences
- Identifying some red flags

Materialistic
- Narcissistic
- Ambitious
- Entitled
- Lazy
- Arrogant

Connect?
Slide 7

Multigenerational Workforce

Slide 8

Millennials in Workforce

2014 - 34%
2020 - 46%

Source: Lynch, 2008

Slide 9

<table>
<thead>
<tr>
<th>Generation</th>
<th>Born</th>
<th>Age(s)</th>
<th>% of total workforce</th>
<th>% of total workforce using computer</th>
</tr>
</thead>
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<tr>
<td>Millennials</td>
<td>1981-1999</td>
<td>30</td>
<td>35</td>
<td></td>
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<td>1965-1980</td>
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<td>Younger Boomers</td>
<td>1953-1964</td>
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<td></td>
</tr>
<tr>
<td>GI Generation</td>
<td>1890-1909</td>
<td>6</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

*Source: PwC/USA Today Work and Life Project, April 26-May 19, 2010.
**Survey of 2,004 workers in 2010.
• Millennials are
  • continuous learners
  • team players
  • collaborators
  • diverse
  • optimistic
  • achievement-oriented
  • socially conscious
  • highly educated

Challenges
• Communication styles differ

Blink...
Slide 13

Quick Short Story Telling

---

Slide 14

Millennial Surgical Resident

- Immersed in tech
- Work-life balance
- Multi-taskers
- Absence of hierarchy
- Need constant feedback

---

Slide 15

Engaging the Millennial

Some day when you grow up to become a Millennial, you'll be lazy, entitled, and good with the internets.
Slide 16

Interactive Tech + Feedback

Slide 17

Social Media!

Slide 18

A Snapshot on Social Media Usage

US Friends
- Spends less time online
- Selective friendship
- Self disclosure
- Opinions based on facts, often searches before posting
- Privacy super-important

Indian Friends
- Spends more time online
- Many (many) friends
- Self Enhancement/status update
- More inclined to discuss/opinionate than search
- Privacy is not a concern
Slide 19

Slide 20

• Post-Millennials – Gen Z
• The Class of 2025 – Smart Kids Who Might Not Be "Buying It"?

Slide 21

The Heroin Epidemic
• Prescription Drug Abuse and a New Patient
Epidemiology of the menace
Opioid Use Disorder
Signs of abuse and addiction
Health Consequences in OUD
Anesthetic and Surgical Plan
The pain contract
Personalizing Post-operative Analgesia
The Menace

In the United States, 5.1 million people (1.9 percent of persons age 12 or older) were estimated in 2015 to have used heroin at some point in their lives.

329,000 (0.1 percent) reported use in the last month.

Heroin-related overdose deaths with nearly 13,000 reported in 2015.

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The Menace

*CDC*
Slide 28

Heroin Addiction and Overdose Deaths are Climbing

Slide 29

- Heroin overdoses skyrocketing by 670% between 2004 and 2010 in the emergency departments of Cincinnati and Hamilton County hospitals
- Deaths from heroin jumping from 5 in 2010 in Campbell County, Kentucky, to 14 in just the first six months of this year

*Fox News Cincinnati

Slide 30

What is Heroin?

- an opioid drug made from morphine, diacetylmorphine
- a natural substance taken from the seed pod of the Asian opium poppy plant
- a white or brown powder, or a black sticky substance known as black tar heroin
- Other common names - Junk, Dragon, Dope, Mr. Brownstone, Snow, Bricks, Snorts, Mexican Brown, Heroin, 'H'

*Fox News Cincinnati
Slide 31

Heroin

- People inject, snort, or smoke heroin.
- Some people mix heroin with crack cocaine, called a speedball.
- Intranasal use – “snorting” or “sniffing”
- Intravenous use – “shooting up” or “mainlining”
- Subcutaneous use – “skin-popping”
- Intramuscular use – “muscling”
Slide 34

**Getting Hooked**

- While prescription opioid misuse is a risk factor for starting heroin use, only a small fraction of people who misuse pain relievers switch to heroin.
- According to a national survey, less than 4 percent of people who had misused prescription pain medicines started using heroin within 5 years.*
- This suggests that prescription opioid misuse is just one factor leading to heroin use.

*Prescription Opioids and Heroin Research Report 2017

Slide 35

**How it works**

- Like all opioids, heroin binds to receptors that are part of the endogenous opioid systems.
- Heroin is more lipid soluble than other opioids, allowing it to rapidly cross the blood-brain barrier (within 15 to 20 seconds) and to reach high brain levels.
- Heroin has a half-life of 30 minutes but a duration of action of four to five hours due to active metabolites, including morphine.
- Heroin is metabolized to 6-monoacetylmorphine (6-MAM), a metabolite specific to heroin, detectable on urine testing.

Slide 36

**Buying Heroin**

- The heroin price per gram depends upon its purity and the availability of the drug in the area at that given time.
- The average cost of a single dose (0.1 g) of heroin purchased on the street has been reported as approximately $15–$20 in Ohio.
- Someone with a “hard-core” heroin habit may pay $150–$200 per day in order to support their habit.
- Can be bought online, can be cheaper than local.
Variable Responses

- Builds tolerance with use
- Genetic polymorphisms and drug interactions — Between 1 and 7 percent of Caucasians of European descent have a genetic defect placing them at risk of respiratory depression from small doses of codeine*
- This group has multiple functional alleles for cytochrome-P450 enzyme CYP2D6, making them “ultra-rapid metabolizers” of codeine into morphine
- Their increased metabolism can result in potentially lethal morphine levels

OUD
Opioid Use Disorder – clinical manifestations

• Most patients with a mild disorder/abuse may maintain jobs and relationships
• Subtle signs during interview
• Detailed interviewing can often reveal problems related to drug use
• Typically have impaired social functioning - can vary widely in association with the severity and duration of the disorder

Acutely intoxicated patient
• Slurred speech
• appear sedated (“nodding”)
• pinpoint pupils (miosis)
• fresh injection sites especially on non-dominant side

The duration of acute intoxication will depend upon the half-life of the drug taken + patient’s tolerance to opioid
OUD
Opioid Use Disorder – clinical manifestations

Patients with a severe disorder
• may present impoverished and engaged in illegal behavior (e.g., shoplifting, burglary, prostitution) to obtain money with which to purchase heroin or other opioids
• Use of heroin (or other illicit opioids) can become the organizing feature in the lives of some patients, and their day is centered on either obtaining money to purchase the drug or using the drug
• Other aspects of life, such as work and relationships, may be sacrificed for their drug use

OUD
Opioid Use Disorder – clinical manifestations

• Patients who have developed tolerance to opioids may show no acute effects after use of the drug at a dose typical for that patient

Health Consequences
• cellulitis, localized abscess at the injection site, endocarditis, osteomyelitis
• shared needles or syringes = increased risk of infection with a bloodborne pathogens - HIV, hepatitis B, and hepatitis C
• increased risk for systemic bacterial infections - pneumonia and tuberculosis
• hepatitis C virus (HCV) infection may also occur in those who abuse heroin but do not inject it - sharing of straws for intranasal insufflation
Health Consequences

• Opioid-induced bowel syndrome — Opioid agonists affect gastrointestinal motility with effects that usually manifest as constipation, but can result in bloating, early satiety, and pain.
• Patients occasionally develop ileus or a syndrome characterized by a relatively high level of abdominal pain.
• When pain is significant, the term “narcotic bowel syndrome” has sometimes been applied.

Health Consequences

• Opioid-induced hyperalgesia — Chronic use of opioid agonists may result in hyperalgesia, characterized by an increased sensitivity to pain.
• The pain can be severe, chronic or recurring, and significantly reduced following medically supervised withdrawal from the opioids.
• Not all patients treated with chronic opioids develop opioid induced hyperalgesia.

Health Consequences

• Accidents — People who use heroin have higher rates of motor vehicle collisions than the general population.
• Opioid addiction is associated with increased mortality compared with the general population, higher rates of overdose and trauma.
• Patients maintained on methadone or buprenorphine do not have significant deficits in tasks related to driving performance when not using illicit drugs.
Health Consequences

- Signs of withdrawal
  - muscle and bone pain
  - sleep problems
  - diarrhea and vomiting
  - cold flashes with goose bumps ("cold turkey")
  - uncontrollable leg movements ("kicking the habit")
  - severe heroin cravings
  - decision-making, behavior control, and responses to stressful situations

Being Prudent

- Be aware
- Subtle signs
  - Patients
  - New employees in the office
  - Co-workers – OMS, Anesthesiologists
  - Family and friends

Anesthetic and Surgical planning in OUD
Slide 52

**Dr., there is a heroin user in your office today...**

- All patients have OUD
  - unless proven otherwise
  - Heroin is an equal opportunity employer!
- Known abuser
- Potential abuser
- Potential enabler
- Recovering addict

Slide 53

**Peri-operative challenges**

- Exaggerated organic and psychological comorbidity
- Higher analgesic requirement
- Craving
- Hyperalgesia
- Tolerance
- IV access challenges

Slide 54

**Perioperative challenges**

- Which substance are they abusing?
- CNS depressors –
  - Heroin, alcohol, sedatives, hypnotics
- CNS Stimulants –
  - Cocaine, amphetamines, designer drugs
- Other psychotropic –
  - Cannabis, hallucinogens, inhalants
Combinations of some or all of the above?
Slide 55

**Perioperative challenges**

- Don’t attempt therapy for addiction!
- Accept characteristics of chronic disease

- Stress
  - Protective
  - (generous)

- Analgesia
  - Effective
  - (sufficient)

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Slide 56

**Unknown OUD patient**

- Heroin users frequently abuse other drugs
- Sympathetic activation
  - Tachycardia
  - Vasoconstriction
  - Unpredictable BP effects
  - Arrhythmias
  - MI
- Endocarditis and valvular damage

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Slide 57

**Unknown OUD patient**

- Autonomic changes
  - Increased parasympathetic, decreased sympathetic activity
  - Cardiac arrhythmias
  - Overdose = non-cardiogenic pulmonary edema
Slide 58

A Known Addict

- IV challenges!
- Usually false or poor historians
- Consent and escort challenges
- Nutritional and volume depletion – hyperproteinemia and hypovolemia
- Universal precautions of HIV, hepatitis
- Opioid based or non-opioid based anesthesia

Slide 59

A Tooth Extraction Under IVS in a Known Heroin Addict

- 35 yr old sous chef, self-confessed Heroin addict, non-restorable # 13, 14
- Last use?
- Other drugs with Heroin?
- Benzos, alcohol, cocaine?
- Previous surgeries and anesthesia recall?
- IVS in office or hospital?

Slide 60

Likely outcome

- Smoked weed this AM
- Used Heroin over the weekend
- IV is in
- Benzo dosing?
- Opioid vs non-opioid anesthesia?
- Propofol pump
- Good local
- Wide open fluids
- Anticipate light anesthesia, hypotension, ectopy…
Slide 61

Patients on De-addiction Therapy

- Identify the de-addiction therapy modality
- Make contact with primary manager
- Consider pain contract
- Consider non-opioid anesthesia and analgesia
- Multimodal analgesia – Ketamine, IV Tylenol, long acting LA, gabapentanoids
- Don’t prescribe narcotics for post-op; let the pain doc do it!

Slide 62

Management of OUD

- Opioid Addiction Therapy
  - Opioid replacement/substitution therapy
    - Methadone or Buprenorphine
    - Reduces symptoms of drug withdrawal
    - 40-65% remain completely abstinent from opiates
    - Most-effective way of reducing illegal opiate use, drug-related crime
    - Improper diluents and non-sterile injectors

Slide 63

Management of OUD

- Opioid Addiction Therapy
  - Methadone
  - Methadone maintenance treatment (MMT)
  - Relieves narcotic craving and blocks the euphoric effects of opiates
  - For “those who feel unable to go the whole way and get clean”
  - Methadone reduction program
Management of OUD

- Opioid Addiction Therapy
  - Buprenorphine
    - Mu-opioid receptor agonist and a K-opioid receptor antagonist
    - Sublingual
    - Suboxone = Buprenorphine: Naloxone in 4:1 ratio
  - The sedating/narcotic effect of buprenorphine is increased by other sedating drugs such as benzodiazepines, sedative antihistamines, alcohol, and antipsychotics. In addition, opioids and especially benzodiazepines increase the risk for potentially lethal respiratory depression.

Management of OUD

- Opioid Addiction Therapy
  - Naltrexone
    - Revia, Vivitrol
    - Blocks effects of opioids
    - More frequently used to treat alcoholism
    - Sensitizes the opioid receptors – not good for long-term management

Personalizing post-operative Analgesia

Genetic profiling is the future
Real Challenge in Post-op Pain Management

• Legislation Vs.
• Patient's expectations Vs.
• Abuse potential Vs.
• Selling drugs on street Vs.
• Doing your bit to add to the nation-wide epidemic!
• Maybe, one size doesn't fit all!

Relatively few studies examining the role of genetic factors in the rate of postoperative complications and pain control.

In the US, opioid medications are the standard for control of post-operative pain.

Patients show a wide ranging variability and often significant side effects and in response to narcotic analgesics.
Several single nucleotide polymorphisms (SNPs) identified involved in the pain pathway with response variability to both postsurgical pain as well as analgesics.

CYP2D6 is the enzyme largely responsible for metabolism of the Hydrocodone into its active metabolite - Hydromorphone.
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Opioids and CYP2D6

Oral opioids affected by CYP2D6:
Codeine >> Tramadol > Hydrocodone >> Oxycodone

Oral opioids NOT affected by CYP2D6:
Morphine, Hydromorphone, Tapentadol

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Codeine Metabolism
0% of analgesia (Pro-drug)
100% of analgesia

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The gene encoding CYP2D6 demonstrates significant polymorphism but can be phenotypically divided into 4 groups:

- Poor metabolizers (PM): minimal enzymatic activity
- Intermediate metabolizers (IM): partial enzyme activity
- Extensive metabolizers (EM): normal enzyme function
- Ultra metabolizers (UM): increased enzymatic function
CYP2D6 & Codeine Metabolism

PM = Poor Metabolizer (~15%); UM = Ultra Rapid Metabolizer (~2%)
IM = Intermediate Metabolizer (~50%) & EM = Extensive Metabolizer (~30%)
IND = Indeterminate (2%, duplicated allele & number of copies unknown)

Empowered Clinician

• Ability to personalize post-operative analgesia
• Minimize side effects
• Minimize bias about patient's prescription habits
• Evidence based prescription pattern
Slide 79

• Can we create a clinical tool to personalize post-operative pain management based on our understanding of our patient’s genetics?

• Can technology be partnered in this pursuit?

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Clinical Study

• To obtain data on the predictive value of a patients’ CYP2D6 phenotype
  – on their response to Hydrocodone/Oxycodone as a post-operative analgesic
  – following third molar surgery
  – specific emphasis on pain control and adverse effects

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Study Design

Include -
- Greater than 17 years of age
- ASA physical status 1 and 2, scheduled for third molar extraction with minimum 1 full bony impaction

Exclude —
- Pre-operative pain requiring analgesics within 48 hours (e.g. chronic pericoronitis, radiographic evidence of infection, etc.)
- Currently taking tricyclic, selective serotonin reuptake inhibitor (SSRI), serotonin-norepinephrine reuptake inhibitor (SNRI) class of medications within the last month
- With a known allergy to hydrocodone
- With a psychological/psychiatric condition for which patient currently takes medication (including, but not limited to, ADD, ADHD, depression, OCD, ODD, PTSD, Schizophrenia, Tourette’s Syndrome, etc.)
Slide 82

Blood was drawn at the time of IV catheter placement prior to surgery and was submitted for limited genetic sequencing to analyze CYP2D6 genotype.

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**Standardization**

A standardized anesthetic technique including Midazolam, Fentanyl, Ketamine, and Propofol to achieve deep sedation or general anesthesia plus lidocaine and bupivacaine for local anesthesia.

Surgical procedures completed by attending oral and maxillofacial surgeons or senior OMS residents.

Slide 84

**Measuring Outcomes**

In the recovery area and at home:

- **Sedation level** - Modified Ramsay Sedation Scale
- **Therapeutic effects** - numerical rating scale (1-10) to quantify the patient's pain level prior to and following the administration of the anesthetic.
- **Frequency and change of analgesic medication** - along with pre and post administration pain scores were recorded for post-op days 1-3.
- **Adverse effects** - associated with opioid use including nausea, vomiting, quantity and duration of sleep, and decreased arousability were also recorded.
Following completion of genetic analysis, the cohort was divided into CYP2D6 phenotype: poor, intermediate, extensive and ultra-rapid metabolizers.

These genotype-predicted phenotypes were consistent with previous reports (Prows et al) with only a small portion of the total cohort classified as intermediate or ultra-rapid metabolizers.
Significant differences were found between total narcotic requirement in the EM and PM groups with PM requiring higher doses throughout the postoperative period.

**Slide 89**

**Total Narcotic Reqmt**

![Graph](chart)

**Adverse Drug Reactions**

- 21 patients (52%) reporting at least one ADR.
- 11 of 26 (43%) individuals within the EM group reported at least one ADR.
- 8 of 6 (75%) in the PM experienced adverse reactions with the most common being drowsiness.
- Pain drop 60 minutes following administration of narcotic was noted to be higher in the EM group as compared to the PM group.
**Slide 91**

<table>
<thead>
<tr>
<th>Population</th>
<th>UM Genotypes/Phenotypes (↑ Activity)</th>
<th>Prevalence % (UM/Total n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>African/Ethiopian</td>
<td>UM (active duplicate genes)</td>
<td>29% (35/122)</td>
</tr>
<tr>
<td>African American</td>
<td>UM (three active duplicate genes)</td>
<td>3.4% (3/87)</td>
</tr>
<tr>
<td>Asian</td>
<td>UM (active duplicate genes)</td>
<td>1.2% (5/400)</td>
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<tr>
<td>Caucasian</td>
<td>UM (three active duplicate genes)</td>
<td>3.6% (33/919)</td>
</tr>
<tr>
<td>Greek</td>
<td>CYP2D6*2xN/UM</td>
<td>6.0% (17/283)</td>
</tr>
<tr>
<td>Hungarian</td>
<td>UM (active duplicate genes)</td>
<td>1.9%</td>
</tr>
<tr>
<td>Northern European</td>
<td>UM (active duplicate genes)</td>
<td>1% - 2%</td>
</tr>
</tbody>
</table>

http://www.fda.gov/Drugs/DrugSafety/ucm313631.htm

**Slide 92**

**What did we learn?**

The great variability in CYP2D6 phenotype may play a role in the effectiveness of Hydrocodone in controlling postoperative pain (as well as adverse drug reactions).

CYP2D6 phenotype is an **effective predictor** not only of a patient’s ability to control postoperative pain with Hydrocodone but also of their **risk of experiencing adverse drug reactions**.

Clinical application of these results if validated could lead to a preoperative genetic screening tool which could allow the clinician to **personally personalize the analgesic regimen** to maximize clinical effectiveness for the patient and minimize adverse drug reactions.

**Slide 93**

Results of the study demonstrate trends which correspond closely to the predicted outcomes in terms of pain drop and total drug requirement.

Statistical significance of the results is limited by the small sample size of this pilot study and a study with increased cohort size is ongoing.
### Slide 94

**Current Status**

<table>
<thead>
<tr>
<th>Study Arm</th>
<th>Post-op Opioid</th>
<th># of enrolled patients</th>
<th># of completed patients</th>
</tr>
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<tbody>
<tr>
<td>Pilot 1 Hydrocodone</td>
<td>40</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Oxycodone Only Arm</td>
<td>141</td>
<td>47</td>
<td></td>
</tr>
<tr>
<td>Hydrocodone Only arm</td>
<td>132</td>
<td>47</td>
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<tr>
<td>Randomized</td>
<td>Oxycodone or Hydrocodone</td>
<td>37</td>
<td>11</td>
</tr>
<tr>
<td>Total</td>
<td>350</td>
<td>195</td>
<td></td>
</tr>
</tbody>
</table>

### Slide 95

**Conclusions**

- Eventual goal - use genetic variability to identify patients at risk for adverse events during and after surgery
- Post-op pain relief is only one of the variables being studied

### Slide 96

**Conclusions**

- Heroin epidemic is real
- "Opidemic" related to Rx drugs from our offices is real
- Patient’s pain is real!
Conclusions

- Make a real effort to minimize and personalize post-operative narcotic prescriptions
- Use multimodal therapy for post-operative pain control
- Don’t contribute to the Epidemic
- Save your patients and family from addiction

Thank you

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