Pharmacology of Airway Management

John Shields DNP, CRNA, APN
Objectives

• Describe airway assessment techniques and equipment preparation
• Identify factors predisposing a patient to difficult airway management
• Discuss induction and sedation drugs used during airway management
• List adjunct medications used in airway management
• Describe complications associated with advanced airway management
Introduction

- Airway management is associated with a high complication rate
- Airway pharmacology is a critical component of good outcomes
- Well-defined clinical practice guidelines are limited
Airway Management Considerations

• Multiple indications for a secure airway
• Airway assessment and equipment preparation is essential
• Verification of medications and availability
• Technical proficiency with mask ventilation and laryngoscopy is essential
Indications for Secure Airway

- Respiratory arrest
- Failure or contraindication to NPPV
- Hemodynamic instability
- Decreased LOC
- Pain management
- Severe dyspnea with use of accessory muscles
- RR > 35 bpm
- Severe hypoxemia/hypercapnia
- Severe acidosis
- Inability to protect the airway
## Airway Assessment

<table>
<thead>
<tr>
<th>Criteria</th>
<th>How to Perform</th>
<th>Concerning Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thyromental distance</td>
<td>Distance between the mandible and the thyroid cartilage with extension</td>
<td>&lt; 6 cm or approximately 3 fingerbreadths</td>
</tr>
<tr>
<td>Mouth opening</td>
<td>Open mouth as far as possible and measure distance between the upper and lower incisors (gum line if edentulous)</td>
<td>&lt; 4 cm or 2-3 fingerbreadths</td>
</tr>
<tr>
<td>Cervical spine mobility</td>
<td>Extend his or her head backward to discomfort</td>
<td>Limited/painful extension within the reference ROM</td>
</tr>
<tr>
<td>Mallampati Classification</td>
<td>Extend tongue as far as possible without saying “ahh”</td>
<td>Inability to visualize the entire uvula or soft palate (MP&gt;2)</td>
</tr>
<tr>
<td>Dentition</td>
<td>Loose, missing or damaged teeth</td>
<td>Loose teeth or structure that may be aspirated or limit DL</td>
</tr>
<tr>
<td>Jaw mobility</td>
<td>Ask patient to prognath</td>
<td>Inability to bring lower in front of upper</td>
</tr>
<tr>
<td>Neck circumference</td>
<td>Measure neck at level of cricothyroid cartilage</td>
<td>40 cm-5%; 60 cm-35% difficulty level</td>
</tr>
<tr>
<td>Upper airway obstruction</td>
<td>General appearance, work of breathing, voice quality</td>
<td>Stridor, drooling, edema, facial trauma or burns</td>
</tr>
</tbody>
</table>
LEMON Airway Assessment

L- Look externally
  • Facial trauma
  • Large incisors
  • Beard
  • Large tongue

E- Evaluate (3-3-2 Rule)
  • 3- Interincisor gap
  • 3- Hyomental distance
  • 2- Thyromental distance

M- Mallampati score

O- Obstruction

N- Neck mobility
Class I
Full visibility of tonsils, uvula, and soft palate

Class II
Visibility of hard and soft palate, upper portion of tonsils and uvula

Class III
Soft and hard palate, and base of the uvula are visible

Class IV
Only hard palate visible
Airway Assessment

Class I

Class II

Class III

Class IV

Grade I

Grade II

Grade III

Grade IV
Which patient would be the most difficult intubation based on thyromental distance?

- Patient A
- Patient B
- Patient C
- Patient D
Risk Factors for Aspiration

• Short fasting times
• Pregnancy
• Increased abdominal pressure
• GI disease
• GERD
• Bowel obstruction
• Neuromuscular disease and/or nervous system dysfunction
Equipment Preparation

1. Cardiac/ECG/BP monitor
2. IV access
3. Induction and ACLS drugs
4. Bag-valve-mask connected to Oxygen delivery system
5. Nasal cannula/NRB/FM/LMA
6. Pulse oximetry, CO₂ detector
7. Laryngoscope/Intubation kit
8. Suction with Yankauer tip
9. ETT, stylette, 10cc Syringe
10. Cricothyrotomy tray available
11. Emergency airway bag with bougie
12. Scalpel available with 6.0 ETT
Alternative Airway Devices

- Gum elastic bougie
- Video laryngoscope
  - McGrath
  - Glidescope
  - Bullard
- Intubating laryngeal mask airway
- Flexible fiber-optic bronchoscopy
- Lighted stylet
- Retrograde intubation
Pharmacologic Management

• Direct laryngoscopy is unpleasant, painful and elicits the stress response
• Achieving reasonable intubating conditions with responsive, awake patient is difficult
• Careful analysis of risk-benefit ratio is essential
• Patient comorbidities and current status rule the day
Pharmacologic Requirements

- Induction agents
  - Propofol
  - Etomidate
- Neuromuscular blocking agents
  - Succinylcholine
  - Rocuronium
- Adjuncts
  - Lidocaine
  - Fentanyl
  - Midazolam
- Emergency medications
  - Atropine
  - Ephedrine
  - Phenylephrine
  - Epinephrine
Induction Drugs and GABA Receptors

• Primary targets are either NMDA (excitatory) or GABA (inhibitory) neurotransmitters

• Typical induction drugs target subunits of GABA receptors
  o Propofol
  o Etomidate
  o Pentothal
  o Brevital
  o Midazolam
Induction Drugs and NMDA Receptors

• Dissociative induction drugs target NMDA receptors

• Neuronal membrane is depolarized
  o Memory
  o Neurocognitive dysfunction

• NMDA-type drugs affect cognitive dysfunction
  o Ketamine
  o PCP
  o Alcohol
  o N₂O
  o Dextromethorphan
<table>
<thead>
<tr>
<th>Drug and Dose</th>
<th>Indications</th>
<th>Avoid/Use Caution</th>
<th>Adverse Effects/Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ketamine 1-2 mg/kg</td>
<td>Asthma; SNS stimulation desirable; analgesia</td>
<td>Increased ICP, IOP, CAD, HTN</td>
<td>Salivation, delirium, myoclonus</td>
</tr>
<tr>
<td>Etomidate 0.2-0.3 mg/kg</td>
<td>Poor cardiac function, hypotension, hypovolemic</td>
<td>Seizure disorder, multiple doses</td>
<td>Painful injection, adrenal suppression, short E1/2t</td>
</tr>
<tr>
<td>Propofol 1-2.5 mg/kg</td>
<td>CAD with normal cardiac function, increased ICP</td>
<td>Egg allergy, poor cardiac function, hypotension, hypovolemia</td>
<td>Antiemetic properties, painful injection, short E1/2t</td>
</tr>
<tr>
<td>Thiopental 1-6 mg/kg</td>
<td>Increased ICP or IOP</td>
<td>Porphyria, hypotension, hypovolemia</td>
<td>E1/2t 8-11 hours, allergic reaction vs. histamine release</td>
</tr>
</tbody>
</table>
## Induction Agents

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose (mg/kg)</th>
<th>Onset (seconds)</th>
<th>Duration (minutes)</th>
<th>Pain with Injection</th>
<th>Heart Rate</th>
<th>Blood Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Propofol</td>
<td>1-2.5</td>
<td>15-45</td>
<td>5-10</td>
<td>++</td>
<td>0/-</td>
<td><img src="down_arrows.png" alt="down arrows" /></td>
</tr>
<tr>
<td>Etomidate</td>
<td>0.2-0.3</td>
<td>15-45</td>
<td>3-12</td>
<td>+++</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Methohexital</td>
<td>1-3</td>
<td>&lt;30</td>
<td>5-10</td>
<td>+</td>
<td><img src="up_arrows.png" alt="up arrows" /></td>
<td><img src="down_arrow.png" alt="down arrow" /></td>
</tr>
<tr>
<td>Thiopental</td>
<td>1-6</td>
<td>&lt;30</td>
<td>5-10*</td>
<td>0/+</td>
<td><img src="up_arrow.png" alt="up arrow" /></td>
<td><img src="down_arrow.png" alt="down arrow" /></td>
</tr>
<tr>
<td>Midazolam</td>
<td>0.05-0.4</td>
<td>30-90</td>
<td>10-30</td>
<td>0</td>
<td>0</td>
<td>0/↓</td>
</tr>
<tr>
<td>Diazepam</td>
<td>0.2-0.6</td>
<td>45-90</td>
<td>15-60*</td>
<td>+/+++</td>
<td>0</td>
<td>0/↓</td>
</tr>
<tr>
<td>Lorazepam</td>
<td>0.03-0.06</td>
<td>60-120</td>
<td>60-120*</td>
<td>++</td>
<td>0</td>
<td>0/↓</td>
</tr>
<tr>
<td>Ketamine</td>
<td>1-2</td>
<td>45-60</td>
<td>10-20</td>
<td>0</td>
<td><img src="up_arrows.png" alt="up arrows" /></td>
<td><img src="up_arrows.png" alt="up arrows" /></td>
</tr>
</tbody>
</table>

*Context-sensitive half-life (variable)
Physiology of Neuromuscular Transmission

- Impulse from brain to nerve terminal
- Ach released from vesicles
- Ach crosses synaptic cleft and occupies receptor
- Muscle is activated
- Ach is broken down by Achase
Depolarizing Drugs (Succinylcholine)

- Enters the channel and causes depolarization
- Unlike acetylcholine (Ach), succinylcholine is not metabolized as rapidly and depolarization persists
- Membrane remains unresponsive to impulses
Non-Depolarizing Drugs (Rocuronium)

- Enters the channel and antagonizes Ach by competitive antagonism
- Lower concentrations are overcome by “reversal”
  - Increased Ach by anticholinesterase
  - No true “reversal”
- Higher concentrations not reversed and dependent on metabolism
  - Unable to achieve high enough concentration of Ach
  - Clinically weak
<table>
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<tr>
<th>Drug and Dose</th>
<th>Indications</th>
<th>Avoid/Use Caution</th>
<th>Adverse Effects/ Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Succinylcholine</td>
<td>Difficult intubation, morbid obesity, rapid onset (0.5 minutes) and offset (4-6 minutes)</td>
<td>Increased ICP, IOP, hyperkalemia, MH history, burns, neuromuscular disease, spinal cord injury, pediatrics</td>
<td>Hyperkalemia, asystole, bradycardia, myalgia, nausea, vomiting, avoid using more than one dose,</td>
</tr>
<tr>
<td>1-1.5 mg/kg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rocuronium 0.6-1.2</td>
<td>More rapid onset (1-2 minutes) than other nondepolarizing drugs, longer E1/2t (30”-120”)</td>
<td>Neuromuscular, renal and hepatic disease increased sensitivity, burn patient resistant</td>
<td>E1/2t variable (30-90”, anticipated difficult airway need to verify mask ventilation</td>
</tr>
<tr>
<td>mg/kg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Atracurium 0.3-0.5</td>
<td>Slower onset (3-5 minutes), less dependent on renal and hepatic function</td>
<td>Asthmatics (use cisatracurium 0.2 mg/kg), resistant in burn patients, hypotension, hypovolemia</td>
<td>Potential for anaphylaxis, hypotension with higher doses, anticipated difficult airway need to verify mask ventilation</td>
</tr>
<tr>
<td>mg/kg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vecuronium 0.1 mg/kg</td>
<td>Slower onset (3-5 minutes), stable CV</td>
<td>Neuromuscular, renal and hepatic disease increased sensitivity, burn patient resistant</td>
<td>E1/2t predictable (30”-45”, anticipated difficult airway need to verify mask ventilation</td>
</tr>
</tbody>
</table>
## Neuromuscular Blocking Agents

<table>
<thead>
<tr>
<th>Drug</th>
<th>ED$_{95}$ (mg/kg)</th>
<th>Dose (mg/kg)</th>
<th>Onset (m)</th>
<th>Duration (m)*</th>
<th>Heart Rate/Rhythm</th>
<th>Blood Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Succinylcholine</td>
<td>0.3 mg/kg</td>
<td>1-1.5 mg/kg</td>
<td>0.5-1</td>
<td>6-8</td>
<td>0/ Asystole/VT PVC’s/Nodal</td>
<td>0/↑</td>
</tr>
<tr>
<td>Rocuronium</td>
<td>0.3 mg/kg</td>
<td>0.6-1.2 mg/kg</td>
<td>1-2</td>
<td>30-40</td>
<td>0/ ↑</td>
<td>0</td>
</tr>
<tr>
<td>Atracurium</td>
<td>0.25 mg/kg</td>
<td>0.3-0.5 mg/kg</td>
<td>3-4</td>
<td>30-40</td>
<td>0</td>
<td>0/↓</td>
</tr>
<tr>
<td>Cisatracurium</td>
<td>0.05 mg/kg</td>
<td>0.1-0.3 mg/kg</td>
<td>5-7</td>
<td>30-40</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Vecuronium</td>
<td>0.05 mg/kg</td>
<td>0.05-1 mg/kg</td>
<td>3-4</td>
<td>35-45</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

*Time to 75% recovery
Hypotensive patient in ER for intubation, mallampati 4, BMI 46, O2 sat 90%. Best induction drug combination?

A. Propofol 2 mg/kg, Rocuronium 0.3 mg/kg

B. Etomidate 0.3 mg/kg, vecuronium 0.05 mg/kg

C. Ketamine 1 mg/kg, Rocuronium 0.4 mg/kg

D. Propofol 1 mg/kg, succinylcholine 1 mg/kg

E. Etomidate 0.3 mg/kg, succinylcholine 1 mg/kg
Oxyhemoglobin Dissociation Curve

A - Sat 90%
B - Sat 98%
Are Muscle Relaxants Necessary?
## Adjunct Anesthetic Agents

<table>
<thead>
<tr>
<th>Drug and Dose</th>
<th>Indications</th>
<th>Avoid/Use Caution</th>
<th>Adverse Effects/Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midazolam 0.02-0.07 mg/kg</td>
<td>Mild sedation or induction, amnestic</td>
<td>Respiratory depression, concomitant drugs</td>
<td>Slow onset (3-5”), E1/2t 2.2 hours in healthy subjects</td>
</tr>
<tr>
<td>Fentanyl 2-6 mcg/kg</td>
<td>Suppression of SNS, analgesic for DL</td>
<td>Respiratory depression, concomitant drugs</td>
<td>Slow onset (3-5”), E1/2t 30-180” in healthy subjects</td>
</tr>
<tr>
<td>Lidocaine 1-2 mg/kg</td>
<td>Suppression of SNS, analgesic for DL, antidysrhythmic</td>
<td>Agonal rhythm, allergies</td>
<td>Asystole in agonal rhythm, ringing in ears, seizures</td>
</tr>
<tr>
<td>Esmolol 0.1-0.5 mg/kg</td>
<td>Suppression of SNS for DL</td>
<td>Bradycardia, heart block, hypotension</td>
<td>E1/2t 9”, tachycardia is better than no cardia</td>
</tr>
</tbody>
</table>
## Ancillary Drugs

<table>
<thead>
<tr>
<th>Drug and Dose</th>
<th>Indications</th>
<th>Avoid/Use Caution</th>
<th>Adverse Effects/Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Glycopyrollate</strong></td>
<td>0.2-0.4 mg&lt;br&gt;Antisialagogue, bradycardia</td>
<td>Tachycardia, CAD</td>
<td>Tachycardia, myocardial ischemia, nodal rhythm</td>
</tr>
<tr>
<td><strong>Phenylephrine</strong></td>
<td>100-200 mcg&lt;br&gt;Hypotension</td>
<td>Bradycardia, HTN</td>
<td>Reflex bradycardia, ineffective in shock, E1/2t 3-5”</td>
</tr>
<tr>
<td><strong>Epinephrine</strong></td>
<td>10-100 mcg&lt;br&gt;Bradycardia, hypotension, shock, anaphylaxis, bronchospasm etc.</td>
<td>Tachycardia, dysrhythmias, hyperglycemia, CAD</td>
<td>Nasty tachycardia, dysrhythmias, monitor glucose, E1/2t 3-5”</td>
</tr>
<tr>
<td><strong>Ephedrine</strong></td>
<td>5-25 mg&lt;br&gt;Hypotension, shock, refractory hypotension, bradycardia, CHF</td>
<td>HTN, CAD (?), tachycardia</td>
<td>E1/2t 3-5”, mild HR increase, tachyphylaxis with repeated doses</td>
</tr>
<tr>
<td><strong>Vasopressin</strong></td>
<td>0.4-2 mcg&lt;br&gt;Hypotension, shock, refractory hypotension, acidosis (pH &lt; 7.2)</td>
<td>HTN, CAD (?)</td>
<td>Excellent with acidosis, ace inhibitors refractory to conventional vasopressors</td>
</tr>
</tbody>
</table>
Induction Sequence

• Assess preoxygenation (time, minute ventilation, saturation)
• Cricoid if aspiration risk or available for difficult airway
• Sedative hypnotic and verify ability to provide positive pressure ventilation
• Individualize dose and for circulation time
• Oral airway is not a sign of weakness
• Muscle relaxant of choice
• Ventilate, tape eyes, consider sedation
Complications of Airway Management

- Failed intubation
- Can’t Ventilate - Can’t Intubate
- Airway trauma
- Aspiration
- Mainstem intubation
- Bronchospasm

Diagram: Inflammation leads to hyperresponsiveness, which results in obstruction, causing clinical symptoms.
PLAN A - INITIAL INTUBATION STRATEGY

- Elective Intubation: max 4 attempts
- Rapid Sequence Intubation: max 3 attempts
- Optimize position
- Use bougie or stylet
- Alternative blade / scope
- Alternative operator
- Bougie
- Alternate blade
- Airtraq
- Video laryngoscope

PLAN B - SECONDARY INTUBATION STRATEGY

- No RSI
- PLAN B not appropriate in elective RSI
- Classic LMA (cLMA) + Intubating LMA (ILMA) eg: Fast Trach or AirQ
- cLMA
- ILMA
- Fibreoptic Stylet or Flexible Fibreoptic Scope
- Fibreoptic intubation through ILMA
- Malleable Fibreoptic Stylet (eg: Levitan)
- Fibreoptic Scope (eg: Ambu Ascope 2)

PLAN C - MAINTAIN OXYGENATION & VENTILATION

- Attempt to wake patient up
- Consider sugammadex if available
- Mask, NPO, Guedel
- Face mask
- Nasopharyngeal airway
- Guedel airway
- Classic LMA (cLMA)
- Intubating LMA (ILMA) eg: Fast Trach or AirQ
- cLMA
- ILMA

PLAN D - RESCUE TECHNIQUES FOR ‘CAN’T INTUBATE, CAN’T VENTILATE’

- Bag 1, a, b, c: Paediatric or Easy Anatomy
- Needle cricothyroidotomy
- Scalpel-bougie-ETT (greater success in NAP4)
- Bag 2, Adult or Easy Anatomy:
- Scalpel-bougie-needle
- Scalpel-finger-needle
- Bag 3, Impossible Anatomy:
- Meker kit
- Quick trach
- Oxygation device
- Scalpel-bougie-ETT

Refer to CICV FLOWCHART and NURSING PROMPT CARDS overleaf.
Difficult Mask Ventilation Strategies

- Head tilt, jaw lift, mouth open
- Oral/nasal airway
- Two-man ventilation
- Continue bagging unless unable to ventilate with two people, oral/nasal airway
- LMA
- Magill forceps for foreign body
- If unable to ventilate do not burn bridges with muscle relaxant if oxygen saturation reasonable
Reasons for Airway Complications and Management Failures

• Inaccurate or incomplete airway assessment
• Incorrect prediction of
  o Easy mask airway
  o Routine direct laryngoscopy (DL) intubation
  o Uncomplicated extubation
• Unwillingness to abandon failed airway management plan
• Failure to call for help early when difficult airway is recognized
• Incomplete preparation of backup plan
• Deterioration of performance under stress
• Failure in judgment
Response to Unanticipated Difficult Airway

- Ventilate by mask (first response) while preparing for second attempt
- **Call for help** if only provider
- Maximize neck flexion, head extension
- **BURP** maneuver
  - Backwards Upwards Rightwards Pressure on cricoid cartilage
- Reorient to landmarks and adjust DL vs. **use different blade**
- Consider other airway alternatives
  - Videolaryngoscope
  - Fiberoptic intubation
  - Wake patient and do awake FOB
Patient Factors Associated with Difficult Facemask Ventilation

- **Facial hair**
  - Early use of oral, nasal or LMA

- **Edentulous**
  - Leave dentures in
  - Early use of oral, nasal or LMA

- **BMI > 26**
  - Preoxygenate
  - Positioning (reverse trendelenberg, ramp etc.)

- **Snoring and Obstructive Sleep Apnea**
  - Preoxygenate
  - Early use of oral, nasal or LMA

- **Glottic pathology or stridor**
  - Avoid preinduction sedation
  - Consider awake intubation

- **Bronchospasm risk**
  - Nebulize with bronchodilator
Videolaryngoscopy (VL)

- Tracheal intubation under direct laryngoscopy has limitations
- Video-laryngoscopes improve visualization of the glottis
- Improved glottic view does not mean easier intubation
  - Boogie
  - Stylet
- DL may be more useful in the presence of blood and copious secretions
During intubation of ER patient with BMI 46, sat 90%, you have a grade 4 view. What next?

A. Ask for a VL and ventilate by mask until it arrives  • A
B. Change providers and have someone else give it a try  • B
C. Maximize neck flexion, head extension  • C
D. Try the BURP maneuver or a different blade  • D
Environmental factors

Dendritic cell

Th2/Th1 cytokines (e.g., IL-13, TNF-α)

Environmental factors and inflammatory products

Airway Effects
- Bronchospasm
- Acute inflammation
- Persistent inflammation
- Remodeling

Airway microenvironment

Initiation
Amplification
Propagation

(myo) fibroblasts

Smooth muscle
Blood vessels

Mucus

Inflammation

B lymphocyte
T lymphocyte
IgE
IL-3, IL-4, IL-13, IL-9, GM-CSF
IL-3, IL-5
TNF-α
Neutrophil
Eosinophil
Mast cell

Acute inflammation

Pro-inflammatory mediators

Persistent inflammation and development of remodeling
## Bronchospasm Drugs

<table>
<thead>
<tr>
<th>Drug and Dose</th>
<th>MOA</th>
<th>Adverse Effects/ Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albuterol</td>
<td>Selective beta$_2$ agonist</td>
<td>E1/2t &lt; 4 hours; tachycardia; nervousness; other beta$_2$ agents last longer but longer onset</td>
</tr>
<tr>
<td>Epinephrine</td>
<td>Nonselective beta agonist</td>
<td>E1/2t several minutes, may be administered IV/SQ</td>
</tr>
<tr>
<td>Beclomethasone</td>
<td>Antiinflammatory</td>
<td>Long term or chronic use, not a rescue drug (hours or days for effect)</td>
</tr>
<tr>
<td>Ipratropium</td>
<td>Anticholinergic, affects parasympathetic airway innervation</td>
<td>Tachycardia, dry mouth, slow onset (up to 90”)</td>
</tr>
<tr>
<td>Leukotriene modifiers</td>
<td>Inhibition of arachidonic acid metabolites (leukotrienes)</td>
<td>PO drug, useful as adjunct but not in acute crisis</td>
</tr>
<tr>
<td>Cromolyn</td>
<td>Inhibit release of inflammatory mediators</td>
<td>Preventive only</td>
</tr>
</tbody>
</table>
# Post-Intubation Infusion Therapy

<table>
<thead>
<tr>
<th>Drug</th>
<th>Infusion Rate</th>
<th>Adverse Effects/ Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Propofol</td>
<td>5-80 mcg/kg/min</td>
<td>Increments of 10 mcg/kg/min; no preservatives; hypotension</td>
</tr>
<tr>
<td>Dexmedetomidine</td>
<td>0.2-0.7 mcg/kg/hr (up to 1.5 mcg/kg/hr)</td>
<td>Alpha_2 receptor agonist, variable hypotension and sedation, analgesic properties</td>
</tr>
<tr>
<td>Ketamine</td>
<td>2-8 mg/hr, up to 25 mg/hr</td>
<td>Anesthetic agent (sedative) with profound analgesic properties; delirium, tachycardia; minimal respiratory depression; bronchodilation(?)</td>
</tr>
<tr>
<td>Midazolam</td>
<td>Load 2-5 mg; infusion 2-10 mg/hr</td>
<td>Respiratory depression, anxiolysis, amnestic</td>
</tr>
<tr>
<td>Fentanyl</td>
<td>25-200 mcg/hr</td>
<td>Respiratory depression, minimal cardiac depression</td>
</tr>
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Guidelines for Rapid Sequence Intubation (RSI)

I. Definition

Rapid sequence intubation is indicated when concern for aspiration exists. In the post-surgical patient this is often the case. To complete an RSI, the patient should not be ventilated until the ETT is in place. In the event of a desaturation (<80%) or a failed intubation attempt, mask ventilation with an oral airway should ensue.

II. Equipment that must be present

1. Cardiac monitor
2. Blood Pressure cuff or arterial line
3. Pulse oximetry (on opposite side of BP cuff or forehead)
4. IV access (on opposite side of BP cuff or central access)
5. Non-rebreather mask with oxygen source connected
6. High-flow nasal cannula with oxygen source connected
7. Bag-valve mask with oxygen connected (used after intubation)
8. ACLS drugs
9. End-tidal CO2 detector
10. Laryngoscope/Intubation kit
11. Suction with yankauer tip
12. 10 mL syringe
13. ETT with stylet (8.0 preferred, 7.0 as backup)
14. Airway adjuncts (i.e. oral airway, LMA, etc.)
15. Emergency airway bag with bougie
16. Percutaneous Tracheostomy kit, trach tray, and #8 Shiley trach available at bedside (#8 XLT or #9 if BMI>35 or with severe edema)
17. 11 blade scalpel available at bedside with 6.0 ETT

III. Induction drugs and paralytics to facilitate airway visualization

1. Hypnotic/sedatives:
   a. Midazolam (Versed): 0.01-0.03mg/kg or 1-3mg. Usually has minimal hemodynamic effects. Excellent for preventing recall.
   c. Propofol (Diprivan): 0.5-2mcg/kg or 50-200mcg. Will cause hypotension especially in elderly, hypovolemic, and septic patients. Should be treated with pressor either before or after administration.
   d. Etomidate (Amidate): 0.1-0.2mg/kg or 10-20mcg. Usually causes minimal hemodynamic changes immediately but does cause adrenal suppression. Should be used with caution in sepsis, hypovolemia, or patients expected to require pressor support. Consider decreased dose for those patients.
2. Paralytics:
   a. Rocuronium (Zemuron): RSI dose 1mg/kg. No hemodynamic
      changes or significant contraindications. Induction dose onset ~45-60
      sec. **Post-intubation sedation (fentanyl and/or propofol drip) is
      critical due to prolonged neuromuscular blockade.**
   b. Succinylcholine (Quelicin): RSI dose 1.5-2mg/kg. Succinylcholine
      contraindicated with prolonged bedrest, hyperkalemia, myopathy,
      burns, spinal cord injury, pseudocholinesterase deficiency, open
      globe, renal failure, and malignant hyperthermia. Can also cause
      significant bradycardia, especially with repeated doses.

3. Pressors:
   a. Phenylephrine (Neoephedrine): Given in 100mcg doses (1mL). Will
      cause reflex bradycardia and should be avoided if HR is <60.
   b. Ephedrine: Given in 5-10mg doses (1-2mL). Has both beta and
      alpha properties and will increase both BP and HR. Ideal for
      hypotension with bradycardia or low normal HR.

IV. Preparation for Procedure

1. Review medical chart for previous airway management note or Anesthesia
   OR record
2. Consent for procedure if not emergent
3. Critical Care attending or Anesthesia airway team notified and present
4. If airway exam is concerning for high-risk airway (i.e. beard, thick neck, short
   thyromental distance, small mouth opening, prominent incisors, facial trauma
   or recent head neck surgery, documented difficult airway by Anesthesia OR
   record, halo or cervical traction) then Anesthesia airway team should be
   present
5. Identify medication nurse
6. Identify individual performing the intubation and back-up personnel
7. Verify a functioning IV (verified by physician and medication nurse)
8. Verify a functioning oxygen saturation probe with back up probe available
9. Blood pressure cuff should be set to record every 1 minute and **not on same
   side as saturation probe or IV**
10. Verify medication doses and sequence to be given with 3-4 10mL flush
    syringes available (Consider contraindications for particular meds or dosage
    adjustments indicated)
11. Additional doses of drugs available as well as post-intubation sedation
12. Perform a “timeout” once everyone that is to be involved with the procedure is
    at the bedside

V. Procedure

1. Wash hands and don personal protective equipment
2. Lay sterile towel or bedside table at the head of bed to place equipment
3. Non-rebreather mask and high-flow nasal cannula on patient with oxygen
   connected and flowing and HOB as high as possible for preoxygenation
SICU Standard Operating Procedure: Guidelines for Intubation

I. Definition

Intubation is required for SICU patients who cannot maintain a patent airway, who are hemodynamically unstable, who have decreased LOC (GCS ≤ 8, non-purposeful), PaO2/FiO2 ratio ≤ 250, or a respiratory rate < 10 or > 30. Rapid sequence intubation (RSI) is necessitated in patients with increased aspiration risk (e.g., bowel obstruction, recent oral intake, GERD).

II. Equipment that must be present.

1. Cardiac monitor.
2. IV access.
3. ACLS drugs (obtain from Pharmacy).
4. Bag-valve-mask connected to Oxygen delivery system
5. Nasal cannula
6. Pulse oximetry.
7. CO2 detector.
8. Laryngoscope/Intubation kit
9. Suction with Yankauer tip.
10. 10cc Syringe
11. ETT with stylette
12. Cricothyrotomy tray available (kept in Trach box)
13. Emergency Airway bag with bougie
14. Airway adjuncts (LMA, oral airway, etc.)
15. 11 blade scalpel available with 6.0 ETT

III. Drugs used during intubation. These may vary depending on the fellow or attending performing the procedure.

1. Sedative:
   - Etomidate 0.2mg/kg; usually 20mg IVP (less if hypovolemic). Onset 60 sec, Duration 3-5 min.
   - Propofol 2 mg/kg (less if hypovolemic). Onset 9-51 seconds (average 30 secs), Duration 3-10 mins.
   - Ketamine 2 mg/kg; usually 100mg IVP. Onset 30 secs, Duration 5-10 mins.
   - Midazolam: 0.01-0.03mg/kg or 1-3mg. Usually has minimal hemodynamic effects. Excellent for preventing recall.

2/24/2009
Revised 06/05/2015
Fentanyl 1-2 mcg/kg or 50-200 mcg. May cause hypotension and bradycardia.

2. Paralytic:
   - Succinylcholine 1.5 mg/kg IVP (usually 100 mg)—unless contraindicated:
     Onset 20-50 sec, Duration 4-6 min. Succinylcholine contraindicated with prolonged bedrest, hyperkalemia, myopathy, burns, spinal cord injury, pseudocholinesterase deficiency, open globe, renal failure, and malignant hyperthermia. Can also cause significant bradycardia, especially with repeated doses.
   - Rocuronium 1 mg/kg. Onset 1-2 mins. Duration 30 mins. No hemodynamic changes or significant contraindications.
   - Vecuronium .1 mg/kg. Onset 2.5-3 mins. Duration 25-40 mins.
   - Cisatracurium 0.2 mg/kg. Onset 2-3 minutes. Duration 25-35 minutes.

3. Pressors:
   - Phenylephrine given in 100 mcg doses (1 ml). May cause reflex bradycardia and should be avoided in patients with HR < 60 bpm.
   - Ephedrine given in 5-10 mg doses. Has both beta and alpha properties and will cause increase in both HR and BP. Ideal for hypotension with bradycardia or low normal HR.

   Note: Sedative should always be given before paralytic

   Reduce dose of induction agents in hemodynamically unstable patients and have vasopressors available for IV push or infusion.

   Have 2x's the dose of meds needed at the bedside

IV. Preparation for Procedure

1. Insure proper consent is obtained by the physician when possible, unless emergent.
2. Critical Care attending must be notified and present
   a. If Critical Care attending is not available the anesthesia airway phone (cell: 615-887-7369, pager: 615-835-1509) should be called to have anesthesia attending and/or anesthesia team supervise as needed.
   b. Critical Care attending may elect to have anesthesia present for high risk airways
   c. For emergent airways, move forward to secure the airway with oropharyngeal airway and bag/mask ventilation if possible while

2/24/2009
Revised 06/05/2015
Checklist for Intubation “Time Out”

- Verify Consent, Code Status (DNI), Urgent vs Emergent
- Indication for endotracheal intubation (AMS, hypoventilation, hypoxia, etc)
- Preoxygenate with a self-inflating bag valve mask attached to 100% oxygen, 100% NRB, BIPAP or high flow nasal cannula
- Examine airway for
  a) predictors of difficult intubation
  b) dentures
  c) loose dentition
- Oral airway present and appropriately sized
- Identify medication nurse
- Identify the individual performing the intubation and back-up personnel
- RT at bedside
- Verify IV (By medication nurse)
  a) Functioning properly
  b) Not below BP Cuff
- Oxygen saturation probe functioning (not below BP cuff and back-up probe available)
- Induction drugs:
  a) drawn up
  b) sequence verified.
  c) Verify an extra dose of all medications are in the room and post intubation sedation is available
- Vasopressors available at bedside
- Cardiac monitoring in place
- Bag-valve-mask connected to Oxygen delivery system
- All necessary equipment available:
  a) CO2 detector
  b) Stethoscope
  c) Laryngoscope present X2 and verified
  d) Suction with Yankauer tip
  e) 10cc Syringe
  f) ETT with stylette
  g) Emergency Airway bag including bougie
  h) Percutaneous tracheostomy kit, trach instruments, and #8 Shiley trach available (#8 XLT or #9 if BMI>35 or with severe edema)
- Attending (Critical Care or Anesthesia if CC unavailable) (In emergent setting, notify while intubation process moves forward)

****ANESTHESIA AIRWAY****
Cell 615.887.7369
*******TRAUMA ATTENDING******
Cell 615.480.1149

2/24/2009
Revised 06/05/2015
Pgr 615.835.1509
References

