Goals of sedation:

1. Patient safety
2. Patient comfort

Conscious Sedation

- Minimal Sedation (anxiolysis)
- Moderate Sedation
- Deep Sedation
- Anesthesia

**Minimal Sedation (Anxiolysis)**

- Patients respond normally to commands
- Cognitive function and coordination may be impaired
- Ventilatory and cardiovascular functions are unaffected

**Moderate Sedation**

- Depressed consciousness
- Patients respond purposefully to verbal commands
- No interventions are required to maintain airway
- Spontaneous ventilation is adequate
- Cardiovascular function is usually maintained
### Deep Sedation
- Depressed consciousness
- Patients cannot be easily aroused but will respond after repeated or painful stimuli
- Ventilatory function may be impaired
- May require airway assistance
- Spontaneous ventilation may be inadequate
- Cardiovascular function is usually maintained

### General anesthesia
- Patients are not arousable even with painful stimuli
- Ventilatory function is often impaired
- Often require airway assistance
- May require mechanical ventilation
- Cardiovascular function may be impaired

---

The sedation plan must be clearly articulated among all members of the procedure team.
## Pre-sedation history

- Cardiac conditions
- Pulmonary conditions
- Renal disease
- Hepatic disease
- Endocrine disorders
- Head trauma
- Prior surgical or airway issues
- Prior intubation
- Stridor
- Snoring
- Sleep apnea
- Previous reactions to sedative medications

## STOP-BANG

<table>
<thead>
<tr>
<th>S</th>
<th>Snore: have you been told you snore</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>Tired: are you tired during the day</td>
</tr>
<tr>
<td>O</td>
<td>Obstruction: do you stop breathing at night</td>
</tr>
<tr>
<td>P</td>
<td>Pressure: do you have high blood pressure</td>
</tr>
<tr>
<td>B</td>
<td>BMI: is your BMI greater than 28</td>
</tr>
<tr>
<td>A</td>
<td>Age: 50 or over</td>
</tr>
<tr>
<td>N</td>
<td>Neck: circumference greater than 17 inches</td>
</tr>
<tr>
<td>G</td>
<td>Gender: male</td>
</tr>
</tbody>
</table>

Yes to 3 or more = increased risk for sleep apnea

## Other key elements of the history:

- Current medications
- Allergies
- Pregnancy status
- Last oral intake
- Need for isolation for infections
- Alcohol, tobacco, and drug use

## Physical examination

- Cardiac exam
- Pulmonary exam
- Ability to lay in the proper procedure position
- Airway assessment
ASA Physical Status

<table>
<thead>
<tr>
<th>Status</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>Normal healthy patient</td>
</tr>
<tr>
<td>P2</td>
<td>Mild systemic disease</td>
</tr>
<tr>
<td>P3</td>
<td>Severe systemic disease</td>
</tr>
<tr>
<td>P4</td>
<td>Severe systemic disease that is a constant threat to life</td>
</tr>
<tr>
<td>P5</td>
<td>Moribund and likely to die</td>
</tr>
<tr>
<td>P6</td>
<td>Brain dead organ donor</td>
</tr>
</tbody>
</table>

When to consider anesthesia consult?

- Significant co-morbid disease
- Significant sleep apnea
- History of airway problems during sedation
- History of adverse reaction to sedation
- High risk airway
- Chronic opioid or sedative use

Airway Assessment

John S. Rogoski, DO
Assistant Professor
Clinical Anesthesiology
The Ohio State University Wexner Medical Center

Four Types of Difficulty

- Difficult to bag/mask ventilate/oxygenate
- Difficult laryngoscopy
- Difficult intubation
- Difficult to perform cricothyroidotomy
How Does the ASA Define the Difficult Airway?

• Difficult mask ventilation
  - Impossible for an unassisted anesthesiologist to prevent or reverse signs of inadequate ventilation during positive pressure mask ventilation

• Difficult rigid laryngoscopy
  - It is not possible to visualize any portion of the vocal cords with conventional laryngoscopy

• Difficult intubation
  - Proper insertion of an endotracheal tube requires more than 3 attempts or greater than 10 minutes

Causes of Difficulty

• Anatomical
  – Obesity
  – Short neck
  – Protruding teeth, long high arched palate
  – Receding mandible
  – Decreased distance between occiput and spinous process
  – Increased alveolar-mental distance

• Acquired
  – Acute neck swelling: trauma, infection, post-operative bleeding
  – Restricted jaw opening: Trismus, fibrosis, rheumatoid arthritis, mandibular fracture
  – Restricted neck movement: osteoarthritis, scarring, C-spine tumor, ankylosing spondylitis
Predicting Difficult Bag & Mask Ventilation

- B - bearded
- O - obese /obstetric
- N - no teeth
- E - elderly
- S - snores/sleep apnea

Predicting Difficult Intubation

Mallampati Classification

- Class 1: view of the entire posterior oropharynx to the bases of the tonsillar pillars
- Class 4: no view of the posterior oropharynx or uvula

3-3-2 Rule

- 3 finger mouth opening
- 3 fingers mentum to hyoid distance
- 2 fingers hyoid to thyroid
Predicting Difficult Intubation

- Review medical record, history
- Assess
  - teeth especially protruding incisors
  - patent nares
  - open mouth & extend tongue (mallampati)
  - protrude mandible
  - thyromental distance, submental space
  - neck - short, thick ?, overall mobility & sniffing position
  - body habitus

Video of Airway Examination

Airway Management

Supplemental Oxygen

- Nasal cannula
- Simple mask
- Non-rebreather mask
Airway Support

- Jaw thrust
- Nasal airways
- Oral airways

Bag / Mask Ventilation

- Technique dependent
- Mask seal essential
- 2 are better than 1
- Incorporate jaw thrust
- Nasal / Oral airways
- Assist spontaneous ventilation

Video of Airway Maneuvers

Before the procedure

- There must be signed written consent for:
  - The procedure
  - The sedation
- If 2 procedures are planned, get consent for both before giving sedation
- A “time-out” must be performed
### Q 5 minutes during the procedure:

- Level of consciousness
- Blood pressure
- Oxygen saturation
- Respiratory rate
- Cardiac rhythm (only required in patients with known heart disease)

### Monitoring every 15 minutes until:

- Patient is awake, alert, and oriented
- Recovered protective reflexes
- Vital signs returned to normal
- Oxygen saturation > 95% or at baseline

### Post-procedure transport:

- Accompanying personnel trained in sedation monitoring
- Pulse oximeter
- Supplemental oxygen
- Ventilation equipment
- Nasal and/or oral airways
- Emergency drug supplies
- Cardiac monitor (in patients with heart disease)

### Post-procedure discharge:

- Instruction sheet
- No driving
- No alcohol or sedatives
- No operating machinery
- Phone number for questions
- A responsible adult to accompany (taxis do not count!)
Pharmacology of Sedatives and Reversal Agents

Mary Beth Shirk, PharmD, RPh
Clinical Associate Professor
The Ohio State University College of Pharmacy
Specialty Practice Pharmacist, Emergency Medicine
The Ohio State University Wexner Medical Center

Agents for Procedural Sedation

- Opioids
- Benzodiazepines
- Etomidate
- Ketamine
- Methohexital
- Propofol
- Dexmedetomidine

Opioids

- Class II Controlled Substances
- Mu receptor agonists
  - Fentanyl
  - Hydromorphone
  - Morphine
  - Meperidine
- Hepatic metabolism with varying t½

Opioids Adverse Effects

- Respiratory depression
- Hypotension
- Miosis
- Decreased GI motility
- Urinary retention
### Opioids

**Estimated Potency**

- Fentanyl 75 - 100 *micrograms*
- Hydromorphone 1.5 mg
- Meperidine 75 mg
- Morphine 10 mg

### Fentanyl

- Phenylpiperidine opioid agonist
- Preferred opioid for procedural sedation
- Precautions
  - Skeletal muscle and chest wall rigidity
  - Dose and administration rate related
  - Reversible with naloxone
  - Bradycardia
- Black box warning with CYP3A4 inhibitors

### Benzodiazepines

**Adverse Effects**

- Respiratory depression
- Hypotension
- Paradoxical reactions
- Nausea/vomiting
- Hiccoughs

**Class IV Controlled Substances**

- GABA and Benzodiazepine agonists
  - Midazolam
  - Lorazepam
  - Diazepam
- Hepatic metabolism with varying t ½
<table>
<thead>
<tr>
<th>Benzodiazepines</th>
<th>Midazolam</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Estimated Potency</strong></td>
<td><strong>Preferred BZD for procedural sedation</strong></td>
</tr>
<tr>
<td>• Diazepam 5 mg</td>
<td>• CYP3A4 substrate</td>
</tr>
<tr>
<td>• Lorazepam 1 mg</td>
<td>• Elimination t ½ prolonged</td>
</tr>
<tr>
<td>• Midazolam 2 mg</td>
<td>✓ CHF</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Etomidate</th>
<th>Etomidate</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Not currently controlled substance</td>
<td>• Inhibits 11-β hydroxylase</td>
</tr>
<tr>
<td>• Nonbarbiturate benzylimidazole hypnotic</td>
<td>• Blocks cortisol production</td>
</tr>
<tr>
<td>• 0.1 – 0.3 mg / kg IVP over 30-60 seconds</td>
<td>• Myoclonus (up to 33%)</td>
</tr>
<tr>
<td></td>
<td>• Injection site pain (30-80%)</td>
</tr>
<tr>
<td></td>
<td>✓ Propylene glycol</td>
</tr>
<tr>
<td></td>
<td>• Minimal effect on hemodynamics</td>
</tr>
<tr>
<td></td>
<td>• Decreases ICP and seizure threshold</td>
</tr>
</tbody>
</table>

- Renal function impairment
- Hepatic function impairment
- Obesity
- Elderly

- Injection site pain (30-80%)
- Myoclonus (up to 33%)
- Minimal effect on hemodynamics
- Decreases ICP and seizure threshold

- CHF
- Renal function impairment
- Hepatic function impairment
- Obesity
- Elderly
Ketamine

- Class III Controlled Substance
- NMDA receptor antagonist and PCP derivative
- Analgesic properties appealing
- IM or IV administration
- 0.5 – 2 mg/kg IVP over at least 60 seconds

Ketamine

- Respiratory drive maintained
- Three concentrations available
  - 10 mg/mL
  - 50 mg/mL
  - 100 mg/mL (dilute if administered IV)

Emergence reaction (12 - 50%)
- Severity varies
- Less common in < 15 yrs and > 65 yrs
- Less frequent with IM administration
- Minimize verbal, tactile, visual stimulation during recover
- Pretreat with BZD or butyrophenone

Ketamine

- Emergence reaction (12- 50%)
- Hypersalivation ? pretreat?
- Nystagmus
- Increases ICP/IOP
- Minimal affect on BP/HR or increase
- Increased skeletal muscle tone
<table>
<thead>
<tr>
<th>Methohexital</th>
<th>Propofol</th>
</tr>
</thead>
</table>
| • Class IV controlled substance  
• Ultrashort acting IV barbiturate anesthetic  
• pH of 1% solution is 10-11  
• Contraindicated in porphyria  
• Hypotension  
• Respiratory depression  
• Dose 0.25 – 1 mg/kg at <10mg/5 seconds  
• 500 mg vials! | • Currently not controlled substance  
• Patient can transition in unpredictable fashion to deeper level of sedation  
• At OSUMC physician must be credentialed for deep sedation  
• Cardiovascular depressant – hypotension! |

<table>
<thead>
<tr>
<th>Propofol</th>
<th>Dexmedetomidine</th>
</tr>
</thead>
</table>
| • Contraindicated if  
✓ egg allergy  
✓ soy intolerance  
✓ peanut allergy (Fresenius brand)  
• 0.5 - 1 mg/kg IV over 2-3 min once then  
  0.5 mg/kg every 3-5 min if needed | • “relatively selective” alpha₂ adrenergic agonist  
• FDA approval in 2008  
✓ Sedation of nonintubated patients prior to and/or during surgical and other procedures  
• Limited published experience for procedural sedation (ablation, hysteroscopy, etc) |
**Dexmedetomidine**

- Hypotension 54% vs 30% (Placebo)
  - SBP <80 or DBP <50 or ↓ >30% from baseline
  - 72% in ≥ 65yo patients (n=131)
- Bradycardia/sinus arrest 14% vs 4% (Placebo)
  - <40BPM or ↓ >30% from baseline

**Approaches Being Explored**

- Alternative routes of administration
  - Intrasal
  - Nebulized
- Alternative combinations of medications
  - Ketamine + Propofol
  - Ketamine + Dexmedetomidine

<table>
<thead>
<tr>
<th></th>
<th>Onset (Min)</th>
<th>Peak (Min)</th>
<th>Duration (Min)</th>
<th>Elimination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fentanyl</td>
<td>Immed</td>
<td>Immed</td>
<td>30-60</td>
<td>Hepatic</td>
</tr>
<tr>
<td>Midazolam</td>
<td>1-2</td>
<td>2-2.5</td>
<td>30</td>
<td>Hepatic</td>
</tr>
<tr>
<td>Etomidate</td>
<td>&lt;1</td>
<td>1</td>
<td>3-5</td>
<td>Hepatic</td>
</tr>
<tr>
<td>Ketamine</td>
<td>1</td>
<td>1</td>
<td>15-20</td>
<td>Hepatic</td>
</tr>
<tr>
<td>Methohexital</td>
<td>Immed</td>
<td>Immed</td>
<td>10-20</td>
<td>Hepatic</td>
</tr>
<tr>
<td>Propofol</td>
<td>½</td>
<td>1</td>
<td>3-10</td>
<td>Hepatic</td>
</tr>
<tr>
<td>Dexmedetomidine</td>
<td></td>
<td></td>
<td>4 hours</td>
<td>Hepatic</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Amnestic</th>
<th>Analgesic</th>
<th>Anxiolytic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzodiazepines</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Opioids</td>
<td>-</td>
<td>+</td>
<td>-/+</td>
</tr>
<tr>
<td>Etomidate</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Ketamine</td>
<td>+</td>
<td>+</td>
<td>Dissociative properties</td>
</tr>
<tr>
<td>Methohexital</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Propofol</td>
<td>+/-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Dexmedetomidine</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>
**Recommended Agents at OSUMC**

- Midazolam ± fentanyl agents of choice
- Propofol limited to physicians credentialed in deep sedation
- Meperidine not for routine use
- Alternative agents used by physician experienced in their use

**Dose**

- No universally safe & effective dose
- Variable dose requirements
  - Age (especially >65 yrs)
  - Weight
  - Medical condition
  - Medication history
  - Previous requirements during procedures
  - Goal depth of sedation

**Dose**

- Combination agents have added risks/benefits
- TITRATE
  - Small incremental doses
  - **Sufficient time must elapse** between doses to evaluate effect of previous dose
  - Time between doses longer for nonintravenous routes

**Fentanyl: Typical Initial Regimen**

- 25-100 micrograms SLOW IVP
- IVP over at 1 - 2 minutes
- Dilute to permit slower administration
- **Additional doses in 2 minutes if needed**
- Administer prior to midazolam if using combination regimen

*Dosages are highly variable*
<table>
<thead>
<tr>
<th><strong>Midazolam: Typical Initial Regimen</strong>*</th>
<th><strong>JCAHO &amp; Medication Administration During Procedures</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• 0.2 – 2.5 mg IVP</td>
<td>• Sterile technique!</td>
</tr>
<tr>
<td>• IVP over <em>at least 2 minutes</em></td>
<td>• Proper product labeling</td>
</tr>
<tr>
<td>• Dilute to permit slower administration</td>
<td>✓ Label: drug name, strength, and amount</td>
</tr>
<tr>
<td>• Additional dose(s) in 3 minutes if needed</td>
<td>✓ Single individual process and immediate administration = no label</td>
</tr>
<tr>
<td>• Administer after opioid if using combination regimen</td>
<td>✓ Two individual process = product verification with vial and label</td>
</tr>
</tbody>
</table>

*Dose is highly variable

<table>
<thead>
<tr>
<th><strong>JCAHO &amp; Medication Administration During Procedures</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Document waste of Controlled Substances</td>
</tr>
<tr>
<td>• Complete charting</td>
</tr>
<tr>
<td>✓ Medication</td>
</tr>
<tr>
<td>✓ Dose</td>
</tr>
<tr>
<td>✓ Route</td>
</tr>
<tr>
<td>✓ Time of administration</td>
</tr>
<tr>
<td>✓ Who administers</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Reversal Agents</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Used to reverse sedatives or treat overdose</td>
</tr>
<tr>
<td>• Half lives can be shorter than sedative</td>
</tr>
<tr>
<td>• Can precipitate withdrawal symptoms</td>
</tr>
<tr>
<td>• May not completely reverse all complications of sedatives</td>
</tr>
<tr>
<td><strong>Flumazenil</strong></td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>• Onset of action 1-2 minutes</td>
</tr>
<tr>
<td>• Half life 41-79 minutes</td>
</tr>
<tr>
<td>• Flumazenil use requires 90 min monitored recovery time</td>
</tr>
<tr>
<td>• Hepatic clearance</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Naloxone</strong></th>
<th><strong>Naloxone</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Opiate receptor antagonist</td>
<td>• Dosing</td>
</tr>
<tr>
<td>• Onset of action 2-3 minutes</td>
<td>✓ 0.1 – 0.2 mg IVP every 1-2 minutes</td>
</tr>
<tr>
<td>• Half life 30-81 minutes</td>
<td>✓ Doses up to 2 mg may be required</td>
</tr>
<tr>
<td>• Naloxone use requires 90 min monitored recovery time</td>
<td>✓ May need to redose if naloxone wears off before opiate</td>
</tr>
<tr>
<td>• Duration of effect varies (45min – 4 hrs)</td>
<td>• Adverse Effects</td>
</tr>
<tr>
<td>• Hepatic clearance</td>
<td>✓ Opiate withdrawal</td>
</tr>
<tr>
<td></td>
<td>✓ Pulmonary edema</td>
</tr>
<tr>
<td></td>
<td>✓ Acute hypertension and dysrhythmias</td>
</tr>
<tr>
<td></td>
<td>✓ Seizures</td>
</tr>
<tr>
<td>Moderate and Deep Sedation</td>
<td>Deep sedation</td>
</tr>
<tr>
<td>---------------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>• Emergency medicine</td>
<td>• Oral maxillary facial surgery</td>
</tr>
<tr>
<td>• Pulmonary medicine</td>
<td>• Or demonstrated advanced airway expertise and intubation skill</td>
</tr>
<tr>
<td>• Critical care</td>
<td></td>
</tr>
<tr>
<td>• Critical care</td>
<td></td>
</tr>
<tr>
<td>• Oral maxillary facial surgery</td>
<td></td>
</tr>
<tr>
<td>• Or demonstrated advanced airway expertise and intubation skill</td>
<td></td>
</tr>
</tbody>
</table>

Case #1: 52 year-old man with a lung mass and cough referred for bronchoscopy

Case #2: 60 year-old woman with COPD exacerbation and respiratory failure requiring intubation
<table>
<thead>
<tr>
<th>Case #3: 50 year-old man with HIV on anti-retroviral medications needs a colonoscopy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case #4: 23 year-old undergoing dental procedure requires oxygen then develops bradycardia</td>
</tr>
<tr>
<td>Case #5: 21 year-old man with pneumothorax needs a chest tube</td>
</tr>
<tr>
<td>Case #6: patient with atrial fibrillation needs external cardioversion</td>
</tr>
</tbody>
</table>
Case #7: after TEE, patient develops cyanosis, headache, and SaO2 = 85%. Blood looks brown