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 required 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

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

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

P1 - normal healthy patient
P2 – mild systemic disease
P3 – severe systemic disease
P4 – severe systemic disease that is a constant threat to life
P5 – moribund and likely to die
P6 – brain dead organ donor

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

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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
Predicting Difficult Intubation 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
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

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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

- Class IV Controlled Substances
- GABA and Benzodiazepine agonists
  - Midazolam
  - Lorazepam
  - Diazepam
- Hepatic metabolism with varying t½

### Benzodiazepines

**Adverse Effects**

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

**Estimated Potency**

- Diazepam 5 mg
- Lorazepam 1 mg
- Midazolam 2 mg

## Midazolam

- Preferred BZD for procedural sedation
- CYP3A4 substrate
- Elimination t½ prolonged
  - ✓ CHF
  - ✓ Renal function impairment
  - ✓ Hepatic function impairment
  - ✓ Obesity
  - ✓ Elderly
**Etomidate**

- Not currently controlled substance
- Nonbarbiturate benzylimidazole hypnotic
- 0.1 – 0.3 mg / kg IVP *over 30-60 seconds*

---

**Etomidate**

- Inhibits 11-β hydroxylase
- Blocks cortisol production
- Myoclonus (up to 33%)
- Injection site pain (30-80%)
  ✓ Propylene glycol
- Minimal effect on hemodynamics
- Decreases ICP and seizure threshold
## 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)
# Ketamine

## 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
# Methohexital

- 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!

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# Propofol

- 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!
**Propofol**

- 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

**Dexmedetomidine**

- “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
  - Intransal
  - 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>
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<tbody>
<tr>
<td>Fentanyl</td>
<td>Immed</td>
<td>Immed</td>
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<tr>
<td>Midazolam</td>
<td>1-2</td>
<td>2-2.5</td>
<td>30</td>
<td>Hepatic + (Renal)</td>
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<tr>
<td>Etomidate</td>
<td>&lt;1</td>
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<td>3-5</td>
<td>Hepatic</td>
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<tr>
<td>Ketamine</td>
<td>1</td>
<td>1</td>
<td>15-20</td>
<td>Hepatic Active Metabolite</td>
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<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>
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<table>
<thead>
<tr>
<th></th>
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<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>
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<td>-</td>
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<tr>
<td>Ketamine</td>
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<td>+</td>
<td>Dissociative properties</td>
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<td>Methohexital</td>
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</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

*Dose is highly variable*
Midazolam:
Typical Initial Regimen*

- 0.2 – 2.5 mg IVP
- IVP over at least 2 minutes
- Dilute to permit slower administration
- Additional dose(s) in 3 minutes if needed
- Administer after opioid if using combination regimen

*Dose is highly variable

JCAHO & Medication Administration During Procedures

- Sterile technique!
- Proper product labeling
  ✓ Label: drug name, strength, and amount
  ✓ Single individual process and immediate administration = no label
  ✓ Two individual process = product verification with vial and label
JCAHO & Medication Administration During Procedures

- Document waste of Controlled Substances
- Complete charting
  - Medication
  - Dose
  - Route
  - Time of administration
  - Who administers

Reversal Agents

- Used to reverse sedatives or treat overdose
- Half lives can be shorter than sedative
- Can precipitate withdrawal symptoms
- May not completely reverse all complications of sedatives
<table>
<thead>
<tr>
<th>Flumazenil</th>
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<tbody>
<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>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Flumazenil</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Adverse Effects</td>
</tr>
<tr>
<td>✓ Seizures</td>
</tr>
<tr>
<td>✓ Panic attacks and emotional lability</td>
</tr>
<tr>
<td>✓ Withdrawal symptoms</td>
</tr>
<tr>
<td>✓ Dizziness</td>
</tr>
<tr>
<td>• Reversal of Procedural Sedation</td>
</tr>
<tr>
<td>✓ 0.2mg IVP q 1 min prn to MAX of 1mg</td>
</tr>
<tr>
<td>✓ Repeat every 20 min as needed</td>
</tr>
</tbody>
</table>
Naloxone

- Opiate receptor antagonist
- Onset of action 2-3 minutes
- Half life 30-81 minutes
- Naloxone use requires 90 min monitored recovery time
- Duration of effect varies (45min – 4 hrs)
- Hepatic clearance

Naloxone

- Dosing
  - 0.1 – 0.2 mg IVP every 1-2 minutes
  - Doses up to 2 mg may be required
  - May need to redose if naloxone wears off before opiate
- Adverse Effects
  - Opiate withdrawal
  - Pulmonary edema
  - Acute hypertension and dysrhythmias
  - Seizures
## Moderate and Deep Sedation

## Deep sedation

- Emergency medicine
- Pulmonary medicine
- Critical care
- Oral maxillary facial surgery
- Or demonstrated advanced airway expertise and intubation skill
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
Case #3: 50 year-old man with HIV on anti-retroviral medications needs a colonoscopy

Case #4: 23 year-old undergoing dental procedure requires oxygen then develops bradycardia
Case #5: 21 year-old man with pneumothorax needs a chest tube

Case #6: patient with atrial fibrillation needs external cardioversion
Case #7: after TEE, patient develops cyanosis, headache, and SaO2 = 85%. Blood looks brown