

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

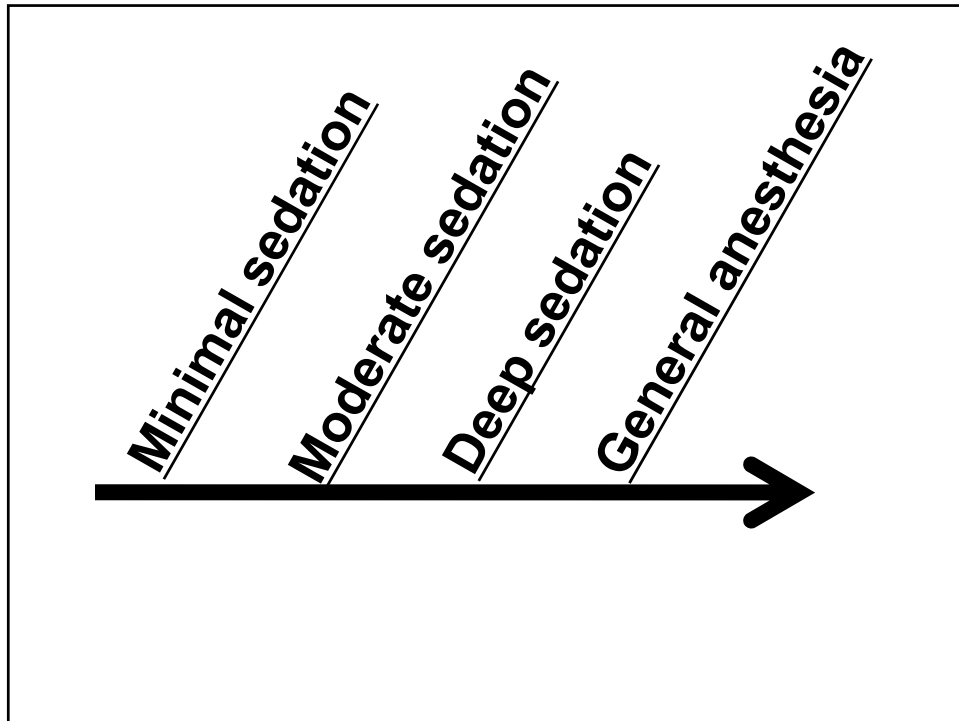
- **Depressed consciousness**
- **Patients respond purposefully to verbal commands**
- **No interventions are required to maintain airway**
- **Spontaneous ventilation is adequate**
- **Cardiovascular function is usually maintained**

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

How Does the ASA Define the Difficult Airway?

- **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**

Causes of Difficulty

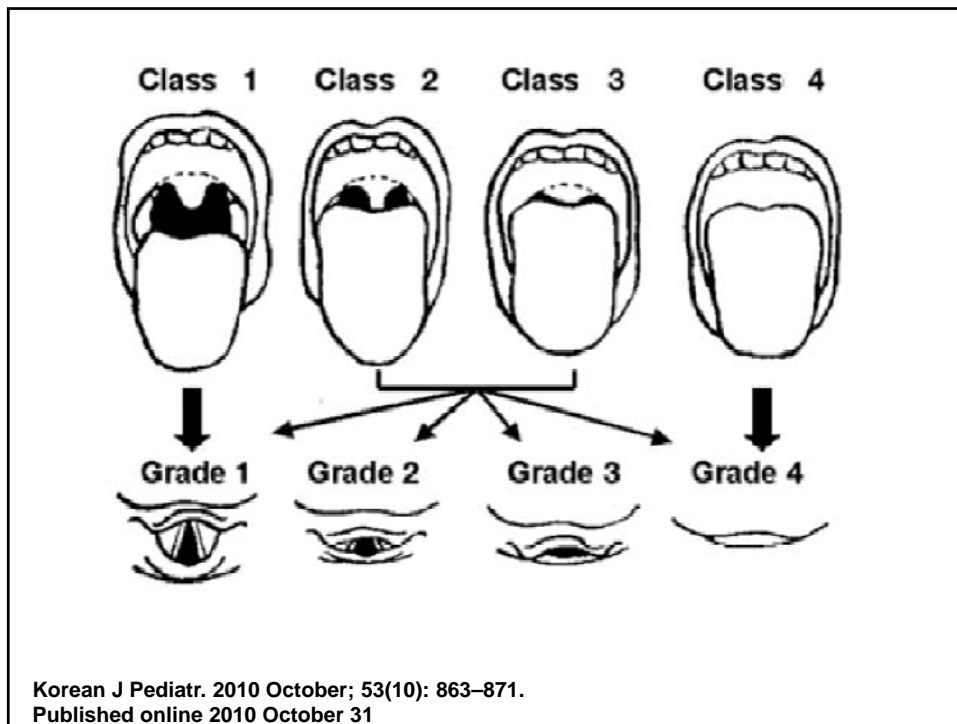
- **Acquired**
 - **Acute neck swelling: trauma, infection, post-operative bleeding**
 - **Restricted jaw opening: Trismus, fibrosis, rheumatoid arthritis, mandibular fracture**
 - **Restricted neck movement: osteoarthritis, scarring, C-spine tumor, ankylosing spondylitis**

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

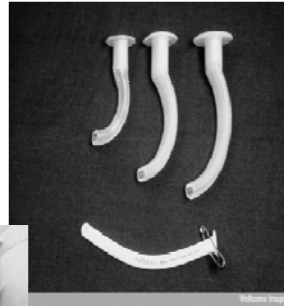
- Nasal cannula
- Simple mask
- Non-rebreather mask



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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



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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 (taxi do not count!)**

Pharmacology of Sedatives and Reversal Agents

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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 $t_{1/2}$

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 $t_{1/2}$

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 $t_{1/2}$ 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!

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” α_2 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
 - ✓ Intranasal
 - ✓ Nebulized
- Alternative combinations of medications
 - ✓ Ketamine + Propofol
 - ✓ Ketamine + Dexmedetomidine

	Onset (Min)	Peak (Min)	Duration (Min)	Elimination
Fentanyl	Immed	Immed	30-60	Hepatic
Midazolam	1-2	2-2.5	30	Hepatic + (Renal)
Etomidate	<1	1	3-5	Hepatic
Ketamine	1	1	15-20	Hepatic Active Metabolite
Methohexital	Immed	Immed	10-20	Hepatic
Propofol	½	1	3-10	Hepatic
Dexmedetomidine			4 hours	Hepatic

	Amnestic	Analgesic	Anxiolytic
Benzodiazepines	+	-	+
Opioids	-	+	-/+
Etomidate	+	-	+
Ketamine	+	+	Dissociative properties
Methohexital	-	-	+
Propofol	+/-	-	+
Dexmedetomidine	+	+	+

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

Flumazenil

- Onset of action 1-2 minutes
- Half life 41-79 minutes
- Flumazenil use requires 90 min monitored recovery time
- Hepatic clearance

Flumazenil

- Adverse Effects
 - ✓ Seizures
 - ✓ Panic attacks and emotional lability
 - ✓ Withdrawal symptoms
 - ✓ Dizziness
- Reversal of Procedural Sedation
 - ✓ 0.2mg IVP q 1 min prn to MAX of 1mg
 - ✓ Repeat every 20 min as needed

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**