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

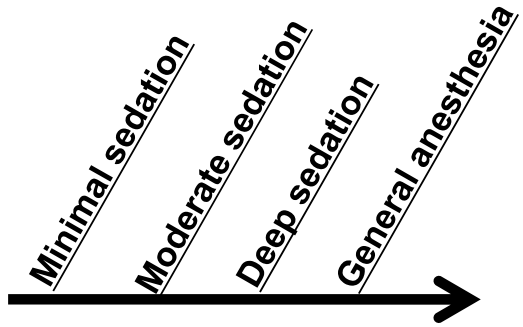
- Depressed consciousness
- Patients respond purposefully to verbal commands
- No interventions are required to maintain airway
- Spontaneous ventilation is adequate
- Cardiovascular function is usually maintained

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

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

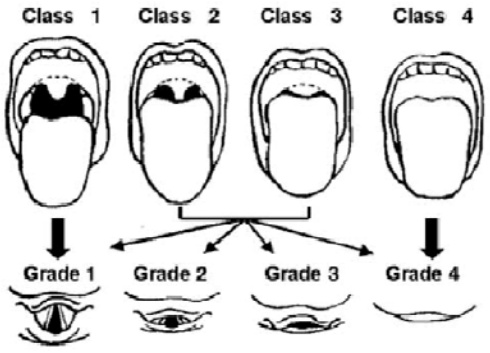
- Acquired
  - Acute neck swelling: trauma, infection, post-operative bleeding
  - Restricted jaw opening: Trismus, fibrosis, rheumatoid arthritis, mandibular fracture
  - Restricted neck movement: osteoarthritis, scarring, C-spine tumor, ankylosing spondylitis

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



Korean J Pediatr. 2010 October; 53(10): 863–871.
Published online 2010 October 31

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

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

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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 ½

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 ½

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 ½ 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" alpha$_2$ 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