Adult Moderate/Procedural Sedation Packet
Adult Moderate/Procedural Sedation Study Guide

Objectives

- Identify the 4 levels of sedation and analgesia as defined by the Joint Commission.
- Identify significant patient history that suggests an increased airway risk during sedation.
- Identify components of a normal and abnormal physical airway exam
- Identify 4 Mallampati classifications
- Identify the American Society of Anesthesiology (ASA) classifications
- Identify monitoring methods used during moderate/procedure sedation
- Identify complications of moderate/procedural sedation
- Identify interventions associated with the complications of moderate/procedure sedation
- Recall pharmacological information on agents used during moderate/procedure sedation
- Identify patient care needed from recovery to discharge of the patient who has received moderate/procedural sedation
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I. **Levels of Sedation**

Joint Commission has introduced standard definitions for 4 levels of sedation and analgesia.

1. Minimal Sedation (Anxiolysis)
2. Moderate Sedation/Analgesia
3. Deep Sedation/Analgesia
4. Anesthesia

Procedural sedation is an inclusive term defined as minimal, moderate or deep sedation.

The term “Conscious Sedation” is a term falling out of favor but generally implied sedation at the “Moderate” level.

**Minimal Sedation (Anxiolysis)**
1. Patients respond normally to verbal commands
2. Respiratory and cardiovascular functions are unimpaired
3. Cognitive function and coordination may be unimpaired

**Moderate Sedation/Analgesia**
1. Patients respond purposefully to verbal commands either alone or accompanied by light tactile stimulation
2. Cardiovascular functions are unimpaired
3. No intervention are required to maintain a patent airway
4. Spontaneous ventilation is adequate
5. This is the most common level of procedural sedation

**Deep Sedation/Analgesia**
1. Patients cannot be easily aroused, but responds purposefully following repeated or painful stimulation
2. Cardiovascular functions are maintained
3. The ability to independently maintain ventilatory function may be impaired
4. Spontaneous ventilation may be inadequate
5. Patients may require assistance in maintaining a patent airway
Anesthesia
1. Consists of general anesthesia, which means blunting or elimination of protective airway reflexes
2. Patients are not arousable, even by painful stimulation
3. Patients often require assistance in maintaining patent airway
4. Positive pressure may be required because of depressed spontaneous ventilation or drug-induced depression of neuromuscular function
5. Cardiovascular function may be impaired

Moderate/Procedural Sedation Guidelines
1. Sedation/analgesia may easily be converted to deep sedation and the loss of consciousness, and is directly related to:
   o Agents used
   o Patient’s physical status
   o Patient’s drug sensitivities
2. The administration of sedation/analgesia requires constant monitoring of the patient
3. The person administering sedation/analgesia must have the ability to respond immediately to any adverse reaction or complication
4. Vigilance of the administrator and the ability to recognize and intervene in the event complications or undesired outcomes arise are essential requirements for individuals administering sedation/analgesia

II. Airway Assessment / Management

Patients should be considered at increased risk for airway obstruction during sedation if:
1. They have any points mentioned in the significant history (see below) or if;
2. They have an abnormal airway exam (including Mallampati Class III or Class IV)

Patients will potentially have a difficult airway to manage if mask ventilation or intubation becomes necessary.
Significant History

The following items from a patient history suggest an increased risk for hypoxemia during sedation:

1. Stridor
2. Significant Snoring
3. Sleep Apnea
4. Advanced Rheumatoid Arthritis
5. Dysmorphic Facial Features
6. Down’s Syndrome
7. Upper Respiratory Infections
8. Lung Disease

Airway Examination

- **Normal Examination**
  1. Opens mouth normally (Adults: Greater than 2 finger widths or 3 cm)
  2. Able to visualize at least part of the uvula and tonsillar pillars with mouth wide open and tongue out with patient sitting
  3. Normal neck flexion and extension without pain/paresthesias

- **Abnormal Examination**
  1. Small or recessed chin
  2. Inability to open mouth normally
  3. Inability to visualize at least part of the uvula or tonsils with mouth open and tongue out
  4. High arched palate
  5. Tonsillar hypertrophy
  6. Neck has limited range of motion
  7. Low set ears
  8. Significant obesity of the face/neck

Mallampati Classification

Before patients receive moderate/procedural sedation, grade how much of the pharynx is obscured by the tongue.

When doing the exam, look at the size of the tongue in relation to the size of the oral cavity.
How to perform the exam:
1. The patient should be sitting, with head in a neutral to slightly extended position.
2. Have the patient open their mouth as widely as possible
3. Have the patient stick out their tongue as far as possible
4. The airway should be classified by which oropharyngeal structures you see

Class I
- Soft palate, fauces, entire uvula, tonsillar pillars

Class II
- Soft palate, fauces, uvula

Class III
- Soft palate, base of uvula

Class IV
- Soft palate only (uvula not seen)

The progression of classes from I to IV suggests increased difficulty in maintaining a patent airway without assistance during sedation.
ASA Classification
American Society of Anesthesiologists Patient Classification

- ASA I
  - A normal healthy patient. The pathological process for which procedure is to be performed is localized and does not entail systemic disease

- ASA II
  - A patient with systemic disease, caused by the condition to be treated or other pathophysiological process, but which does not result in limitation of activity

- ASA III
  - A patient with moderate or severe systemic disease caused either by the condition to be treated or other pathophysiological processes, which does limit activity

- ASA IV
  - A patient with severe systemic disease that is a constant threat to life

- ASA V
  - A patient who is at substantial risk of death within 24 hours, and is submitted to the procedure in desperation

- E – Emergency Status
  - This is added to the classification if the patient is undergoing an emergency procedure

III. Complications During Moderate/Procedural Sedation

The most common complications are related to preexisting comorbidities

With good pre-sedation assessment and selection, incidence of these problems can be kept to a minimum

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Over and Under Sedation

1. The most common complications
2. Newly trained clinicians frequently under-sedate patients in an effort to reduce the risk of over sedation
3. The effects of under-sedation can be just as undesirable as oversedation
4. The patient who is under-sedated experiences:
   - Increased amount of stress leading to an increased autonomic response
   - Increased heart rate and blood pressure
5. Certain populations are at increased risk for over and under-sedation
   - The young, old, and obese
   - Patients with liver and/or renal disease
   - Patients with high pre-procedural levels of anxiety
   - Can be prevented with proper:
     - Drug dosing
     - Dosaging techniques
     - Recognition of patients at risk
   - Administering drugs in small doses on a more frequent, as needed basis can help prevent this complication
   - Administration of a reversal agent can be utilized if overdose occurs

Respiratory Insufficiency

- Differentiating over-sedation from respiratory insufficiency can be challenging
- Respiratory insufficiency manifests as hypoxemia and hypercarbia
  - Sedation agents blunt the patient’s response to hypoxemia
  - The patient’s respiratory drive becomes insufficient to meet tissue oxygen demands
  - Obesity frequently amplifies respiratory compromise
- Respiratory insufficiency can usually be prevented by monitoring the patient’s respirations and oxygen saturation every 5 minutes
  - Stimulating the patient to breathe with each vital sign assessment can improve respiratory effort
  - Providing supplemental oxygen can prevent further development of significant hypoxemia
  - In severe situations, administration of a reversal agent, or terminating the procedure may be necessary to reverse this problem
Airway Obstruction
- More common in the obese, whose tongue is larger in proportion to mouth size
- The Mallampati Scale is a useful tool in evaluating patients at risk for airway compromise
- The airway may also become obstructed from vomitus, blood, or oral secretions
- Patients who are sedated with food in their stomachs are at increased risk for aspiration
  - Controlling secretions with suctioning and head position is imperative
- The loss of submandibular muscle tone during deep sedation can cause a slack jaw and partial or total airway obstruction. Deep sedation may also impair protective airway reflexes
  - The patient’s muscle tone and airway must be monitored at all times

Hemodynamic Instability
- Many of the sedating drugs cause hypotension, especially in combination
- The patient with a pre-existing compromised circulatory volume is at greater risk
- Recognition of patients at risk for hypotension allows supplementation of volume prior to sedation
- Other causes of hypotension:
  - Cardiac dysfunction
  - Histamine release from many depressant agents
- It is imperative that the cause of hypotension be identified

Dysrhythmias
- Most common in the elderly
- Most occur secondary to hypoxia or hypercarbia
  - Can be prevented or treated by increasing oxygen and improving ventilation
- Atrial dysrhythmias are quite common during procedural sedation

Cardiac Arrest
- Cardiac arrest is rare with good pre-sedation evaluation
- Code team may be activated to provide expert backup assistance in resuscitating the patient
Pain
- The use of the pain scale should be demonstrated prior to sedation so that patients are aware of their ability to inform the nurse of their pain
- Sedation agents with analgesic properties should be used on procedures known to be painful
- Use of nonsteroidal anti-inflammatory agents may be considered

Nausea and Vomiting
- Opiate use is known to produce nausea and occasionally vomiting
  - Increased vagal tone can produce the sensation of nausea
- The at risk patient should be recognized during the pre-procedural assessment
- Antiemetic administration may be beneficial, but can produce additional sedation

Paradoxical Reactions
- Agitation, dysphoria, and confusion can occur during sedation or upon recovery
  - At risk for self inflicted injury
- Most common in the elderly
- Hypoxia should be considered as a cause of agitation
- Administration of reversal agents may not reverse paradoxical reactions.

IV. Sedation Agents

Introduction
- The goal of sedation should be to have a patient that is:
  - Calm
  - Comfortable
  - Cooperative
  - Able to maintain a patent airway with adequate ventilation
- Allow sufficient time for first medication to exert full effect before administering additional doses
- Ensure that the patient receives analgesia before painful stimulus
- Sedatives are often synergistic. Be cautious of respiratory depression when combining sedatives
- Disinhibition can result in a less cooperative patient
- All sedation agents can cause unplanned deep sedation
- Reversal agents should be available during the procedure
Opioids

- Agents
  - Morphine
  - Hydromorphone (Dilaudid®)
  - Meperidine (Demerol®)
  - Fentanyl

- Mechanism of action
  - Exert effect on the central nervous system (CNS)
  - Act as agonists at the opioid receptors
  - Opioid receptors are present in high concentrations in the CNS
  - The effects of agonists are blocked by antagonists, such as naloxone
  - Several subtypes of receptors resulting in several beneficial and adverse effects

- Beneficial effects
  - Analgesia
  - Sedation
  - Alterations in mood and perception of one’s surroundings (euphoria or dysphoria)
  - Cough suppression

- Adverse effect
  - Respiratory
    - Decreased respiratory rate, apnea
    - Potential increase in pCO₂
    - Potential decrease in pO₂
  - Cardiovascular
    - Dose-dependent, vagally mediated bradycardia, especially with fentanyl (treat with atropine, if necessary)
    - Vasodilation due to histamine release (seen most often with morphine)
    - Hypertension or orthostatic changes
  - Gastrointestinal
    - Nausea and vomiting (aggravated by movement)
      - Incidence similar at equianalgesic doses among opioids, however individual patients may tolerate one opioid better than others
    - Decreased motility
    - Spasm of sphincter of Oddi and increased bile duct pressures
- Other
  - Dizziness, especially in ambulatory patients
  - Pruritus (which may not be due to histamine)
  - Urticaria and skin rashes are generally due to histamine release with morphine
    - Semi-synthetic and synthetic opioids are associated with little or no histamine release, respectively
    - True anaphylactic reactions are uncommon

**Pharmacokinetics**
- Lipid soluble
  - Rapidly and extensively distributed to tissues
  - Synthetic (e.g., fentanyl) and semi-synthetic (e.g., hydromorphone) opioids have a higher lipid solubility than morphine or meperidine
    - Allows them to cross blood brain barrier quickly leading to a more rapid onset
    - High concentrations are rapidly achieved in well perfused tissues (i.e., brain)
    - Maximum concentrations occur in fat 30 minutes after injection
    - Repeated or large doses of fentanyl lead to accumulation in adipose and muscle tissues
      - Leads to prolonged therapeutic and adverse effects
- Metabolism
  - Hepatic metabolism
    - Some active metabolites are renally eliminated.
  - Active metabolites of morphine and meperidine can accumulate in the presence of renal impairment
    - Dosage reduction should be considered in patients with hepatic or renal dysfunction
      - Regular dosages can lead to prolonged therapeutic and adverse effects

**Potency**
- Opioids can be compared to morphine when comparing potency
  - 10 mg of morphine equals:
    - 100 mg meperidine
      - Meperidine is approximately 1/10 as potent as morphine
    - 1 mg of hydromorphone
      - 10 times as potent as morphine
    - 0.1 mg of fentanyl
      - Fentanyl is approximately 100 times as potent as morphine
Drug Interactions
- Combination of opioids with other sedatives
  - Increased risk for respiratory depression and apnea
- Phenothiazines, tricyclic antidepressants, and other CNS depressants
  - May potentiate therapeutic and adverse effects of opioids
  - Consider reduction in opioid dosing
- Meperidine is contraindicated in patients currently on MAO inhibitors, or have taken them within the last 2 weeks
  - Can cause dangerous reactions such as:
    - Hypertension
    - Hyperthermia
    - Seizures
    - Death

Special Considerations – Age related
- Elderly
  - Usually more sensitive to effects of opioids
    - Lower doses may be indicted
  - Age-related changes
    - Decreased renal or hepatic elimination
    - Increased volume of distribution for fat soluble drugs – leads to longer duration of action

Benzodiazepines
- Agents
  - Midazolam (Versed®)
  - Diazepam (Valium®)
  - Lorazepam (Ativan®)
- Mechanism of action
  - Provides sedation and amnesia, but not analgesia
  - Benzodiazepines occupy receptors that modulate GABA (major inhibitory neurotransmitter in the brain)
  - Can be reversed by the antagonist flumazenil
- Beneficial Effects
  - Anxiolysis
  - Sedation
  - Amnesia
  - Anticonvulsant
- Adverse effect
  - Respiratory
    - Dose-related central respiratory system depression
    - Dose-related loss of muscle tone and consciousness; both are associated with progressive loss of ability to maintain and protect the airway
  - Cardiovascular
Hypotension and tachycardia, especially in:
- Elderly
- Severely ill patients
- Patients with unstable cardiovascular status

**Pharmacokinetics**
- Diazepam and lorazepam have significantly longer duration of action than midazolam
- Small doses of midazolam have a short duration of action due to its rapid redistribution out of the CNS
  - Repeated or large doses prolong the duration of action
- Metabolism
  - All benzodiazepines undergo hepatic metabolism
  - Active metabolites of diazepam and midazolam can accumulate in the presence of renal impairment
    - Dosage reduction should be considered in patients with hepatic or renal dysfunction

**Potency**
- Midazolam is approximately 3-4 times as potent as diazepam (10 mg diazepam = 2.5 or 3 mg midazolam)
- Lorazepam is approximately 5 times as potent as diazepam (10 mg diazepam – 2 mg lorazepam)

**Drug Interactions**
- Therapeutic (e.g., sedation) and adverse (e.g., respiratory depression) effects are often synergistic when benzodiazepines are administered with opioids or other CNS depressants

**Special Considerations**
- Elderly patients
  - Can see a clinically apparent age-related increase in potency
  - Time to onset of therapeutic effect and duration of action may be prolonged
- Pregnancy
  - Contraindicated due to risk of congenital malformations
- Diazepam injection
  - Contains propylene glycol which is irritating to the veins
  - Can cause pain, swelling, and thrombophlebitis, especially if administered in small veins
- Lorazepam
  - Can cause venous irritation and thrombophlebitis
Etomidate

- **Warning!**
  - This medication carries an increased risk of progression into deep sedation or general anesthesia

- **Mechanism of action**
  - Probably acts at the GABA receptor
  - Rapid onset of deep sedation and general anesthesia

- **Beneficial effects**
  - Minimal effects on hemodynamics
  - Brief duration of action
  - Relative lack of central respiratory depression

- **Adverse effects**
  - Loss of protective airway reflexes
  - Risk of aspiration
  - Loss of ability to maintain spontaneous ventilation

- **Pharmacokinetics**
  - More rapidly cleared from blood than thiopental
  - Elimination half-life about 3 hours

- **Pharmacodynamics**
  - Only transient, if any, decreases in heart rate and blood pressure after IV administration
  - Respiratory depression in dose-related fashion

- **Other side effects**
  - Myoclonic movements
  - Nausea and vomiting
  - Venous irritation

### Barbiturates

- **Warning!**
  - These medications carry an increased risk of progression into deep sedation or general anesthesia

- **Agents**
  - Sodium Thiopental (Pentothal®)
  - Methohexital (Brevital®)

- **Mechanism of action**
  - Barbiturates:
    - Depress the sensory cortex
    - Decrease motor activity
    - Alter cerebellar function
    - Produce dose-dependent drowsiness, sedation, and hypnosis
  - The effects of barbiturates occur by enhancing the actions of gamma-aminobutyric acid (GABA) in the central nervous system
  - Provides sedation, but not analgesia
  - Pentobarbital and methohexital are both short acting barbiturates
Beneficial effects
- Drowsiness
- Amnesia

Adverse effects
- Respiratory
  - Respiratory depression and apnea (especially with IV administration)
  - Laryngospasm, bronchospasm
- Cardiovascular
  - Arrhythmias, compensatory tachycardia, occasional bradycardia
  - Hypotension secondary to myocardial depression and peripheral vasodilation
- Central nervous system
  - Lethargy, CNS excitation or depression
  - Twitching or myoclonus may be observed (often mistaken for seizures)
  - Methohexital may lower seizure threshold

Propofol
- Warning!
  - Propofol carries an increased risk of progression into deep sedation or general anesthesia
- Propofol (Diprivan) is an alkyl phenol compound that is formulated in an egg lecithin emulsion. For this reason patients with an allergy to eggs should not receive propofol
- Mechanism of action
  - Propofol is presumed to exert its sedative – hypnotic effects via interaction with GABA receptors.
    - Provides sedation but not analgesia
    - Hepatic metabolism is rapid and extensive
    - Elimination half-time is 0.5 to 1.5 hours
    - Prompt recovery without residual sedation
    - Low incidence of nausea and vomiting
- Beneficial Effects
  - Drowsiness
  - Sedation
  - Amnesia
- Adverse Effects
  - Respiratory
    - Dose dependent depression of ventilation and apnea
  - Cardiovascular
    - Hypotension secondary to myocardial depression and peripheral vasodilation
Reversal Agents

**Naloxone (Narcan®)**
- **Mechanism of action**
  - Opioid antagonist
    - Binds to opioid receptors in the CNS
    - Displaces the opioid agonist (morphine, fentanyl, meperidine) from the receptor
- **Beneficial effects**
  - Reversal of respiratory depression and sedation
- **Adverse effects**
  - Precipitation of withdrawal symptoms, reversal of analgesia, nausea and vomiting
- **Pharmacokinetics**
  - Metabolized in the liver
  - Competes with opioids for receptor binding sites
  - May be displaced from the opioid receptor with additional doses of opioids
- **Precautions**
  - Patients receiving naloxone will need to undergo a longer period of monitoring
    - Opioid half life – 4-6 hours
    - Naloxone half life – can be as short as 30 minutes
    - When the initial dose of naloxone dissipates, the patient may again become “over-narcotized”
    - Repeat dosing of naloxone may be necessary
  - Adverse effects may be minimized by administering in incremental doses and titrating to effect

**Flumazenil (Romazicon®)**
- **Mechanism of action**
  - Benzodiazepine antagonist
    - Binds to benzodiazepine receptors in the CNS
    - Inhibits effects of benzodiazepines
- **Beneficial effects**
  - Reversal of sedation
  - Cessation of amnesia
  - Reversal of respiratory depression
    - Not effective in opioid induced respiratory depression
  - Reversal of paradoxical reactions (i.e., agitation)
- **Adverse effects**
  - Anxiety, tremors, headache
  - Nausea
o Pharmacokinetics
  ▪ Eliminated by the liver
  ▪ Clearance rate depends on hepatic blood flow
  ▪ Competes with benzodiazepines for receptor binding sites
  ▪ May be displaced from the benzodiazepine receptor with additional doses of benzodiazepines

o Precautions
  ▪ Reversal of benzodiazepine effects may be associated with onset of seizures in high risk patients:
    ➢ Physically dependent on benzodiazepines
    ➢ With underlying seizure disorder
  ▪ Patients receiving flumazenil will need to undergo a longer period of monitoring
    ➢ Benzodiazepine half life >12 hours
    ➢ Flumazenil half life- Can be as short as 45 minutes
    ➢ When the initial dose of flumazenil dissipates, the patient may again become over sedated
    ➢ Repeat dosing of flumazenil may be necessary
    ➢ Adverse effects may be minimized by administering in incremental doses and titrating to effect

V. Recovery
  o Time when recovery period starts is noted
  o Cardiopulmonary and neurological status are assessed
  o Oxygen saturation shall be monitored continuously
  o Vital signs, oxygen saturation, and sedation level should be recorded at regular intervals until:
    ▪ Effects of sedation and analgesia have resolved
    ▪ Return to baseline
      ➢ Level of consciousness
      ➢ Respiratory status
      ➢ Cardiovascular status
  o Duration of recovery should be individualized based on patient’s:
    ▪ Age
    ▪ Medical history
    ▪ Procedure
    ▪ Medications administered

  o Note
    ▪ Patients receiving naloxone or flumazenil should be recovered for a longer period of time to ensure that resedation does not occur
Discharge
- Brief discharge or transfer assessment should be made prior to patient discharge to home or unit
- Specific notation should be made of the:
  - Time
  - Vital signs
  - Cardiopulmonary status
  - Neurological status
  - Ability to tolerate PO fluids
  - Ability to ambulate or achieve preprocedure baseline
    - Specific notation should be made if patient’s condition does not meet pre-procedural baseline
  - Presence of a responsible adult to transport a patient home must be documented
  - Report must be given to a receiving nurse for patients being transferred to a unit

Patient and Family Education
- Patients may have difficulty retaining information after the procedure
- Discharge instructions should be shared in advance and reinforced with written material
  - Content should include:
    - Duration of time patient may remain sleepy
    - Dietary guidelines
    - Review of prescribed medications or over-the-counter analgesics
    - Procedural discharge instructions and activity restrictions
    - Phone number to contact for questions or emergencies
    - Follow-up plan