Chapter 004 – Procedural Sedation and Analgesia

NOTE: CONTENT CONTAINED IN THIS DOCUMENT IS TAKEN FROM ROSEN'S EMERGENCY MEDICINE 9th Ed.

Italicized text is quoted directly from Rosen's.

Key Concepts:

1. *Safe, effective procedural sedation requires high-level skills and information and sound protocols, including patient monitoring.*
2. *Patients should be discharged in the company of a responsible adult and should remain with a responsible adult for 4 to 8 hours after recovery and discharge*
3. *Propofol is the agent of choice for deep sedation in the ED but requires supplementation with an opioid analgesic when a painful procedure is planned.*
4. *Absence of a pre-procedure fasting period is not a contraindication to procedural sedation for an emergent and/or time-sensitive condition.*
5. *Pulse oximetry is mandatory during sedation, and end-tidal CO2 should be monitored if moderate or deep sedation is the goal. Oxygen should be administered to patients undergoing procedural sedation.*

Core Questions:

1. Define the following terms:
    - Anxiolysis
    - Dissociation
    - Procedural sedation and analgesia
2. Describe each stage of the American Society of Anesthesiologists' (ASA) continuum of sedation and analgesia (see Figure 4.1 and Table 4.1)
    - Minimal sedation (anxiolysis)
    - Moderate sedation and analgesia
    - Deep sedation and analgesia
    - General anesthesia
3. What are the five classes of physical status described in the ASA's Physical Status Classification system?
4. Describe your approach to pre-PSA patient assessment.
5. What are the recommended ASA fasting durations pre-sedation? What are the recommendations of the American College of Emergency Physicians?
6. What equipment do you need to safely and effectively provide procedural sedation and analgesia (see Box 4.2)?
7. When is it safe to discharge a patient post-PSA and what monitoring do they require at home?

8. Detail the class, main effects, and usual starting doses of the following medications used to achieve procedural sedation and analgesia (see Table 4.3).
    - Fentanyl
    - Morphine
    - Midazolam
    - Ketamine
    - Methohexital
    - Pentobarbital
    - Etomidate
    - Propofol
    - Ketofol
    - Alfentanil
    - Remifentanil
    - Dexmedetomidine
9. What are the reversal agents for opioids and benzodiazepines, and how are they dosed?
10. List some common drugs used for the following procedures (see Table 4.5):
    - Non-painful procedures
    - Low pain, high anxiety procedures
    - High pain, high anxiety procedures

Wisecracks:

1. What is Ketofol? Is using it better than using either of its constituent medications alone?
2. What is an emergence reaction, and how do we treat it?

Rosen's in Perspective

Providing procedural sedation and analgesia is something we do frequently in the emergency department. Our patients often need to undergo certain procedures that are anxiety provoking, painful, or generally unpleasant. Luckily, we have a vast array of medications at our disposal that can help patients tolerate these procedures. The following podcast will equip you with the baseline knowledge you will need to provide procedural sedation and analgesia for your patients in the future.

As with all of our podcasts, we have to say that the content we will present here is by no means comprehensive. The process of providing procedural sedation and analgesia is complex and your approach needs to be nuanced. You have to be able to take into account information about the patient's presenting condition, past medical history, and response to previous PSA agents to select the best sedatives and analgesics. We encourage you to read more about the pharmacologic agents presented here so you can select the best medications possible for your patients in the future.

Core Questions:

[1] Define the following terms:

- **Anxiolysis** - *a state of decreased apprehension concerning a particular situation in which the patient's level of awareness does not change*
- **Dissociation -** *a trancelike cataleptic state induced by an agent such as ketamine characterized by profound analgesia and amnesia. Protective reflexes, spontaneous respirations, and cardiopulmonary stability are retained.*
- **Procedural sedation and analgesia -** *a technique of administering a sedative or dissociative agent, usually along with an analgesic, to induce a state that allows the patient to tolerate painful procedures while maintaining adequate spontaneous cardiorespiratory function. It is intended to result in a depressed level of consciousness that allows the patient to maintain oxygenation and airway control independently and continuously. The drugs, doses, and techniques are not likely to produce a loss of protective airway reflexes.*

[2] Describe each stage of the American Society of Anesthesiologists' (ASA) continuum of sedation and analgesia (see Figure 4.1 and Table 4.1)

- **Minimal sedation (anxiolysis) -** in this state, the patient has been given medications that diminish a subjective sense of anxiety or apprehension. The patient is still able to respond normally to verbal commands, but their cognitive function and coordination may be impaired. It is important to note that the patient is able to maintain their own airway and have intact ventilatory and cardiorespiratory functioning in this state.
- **Moderate sedation and analgesia -** in this state, the patient experiences drug-induced depression of consciousness. They are typically able to respond to verbal commands alone or those accompanied by gentle tactile stimulation. Again, patients are able to maintain their own airway and have intact ventilatory and cardiorespiratory functioning in this state.
- **Deep sedation and analgesia -** in this state, the patient experiences a profound drug-induced depression of consciousness. Patients are unable to be easily roused, but can respond purposefully after repeated or painful stimulation. In this state, the patient may need some help maintaining their airway. Further, spontaneous ventilation may be impaired. Generally, a patient's cardiovascular function is well-maintained.
- **Dissociative sedation -** in this state, the patient is largely amnestic. While dissociated, they are not responsive to painful stimuli. The patient is able to maintain their own airway, and can independently ventilate. Their cardiovascular functioning is maintained.
- **General anesthesia -** in this state, the patient has loss of consciousness. The patient is not arousable and will not respond to painful stimulation The patient generally requires help maintaining and protecting their airway. Ventilatory functioning is often impaired. Cardiovascular functioning is often impaired.

Reference: Table 4.1 - Definition of Levels of Sedation and Analgesia

Parameter	Minimal Sedation	Moderate Sedation and Analgesia	Deep Sedation and Analgesia	Dissociative Sedation	General Anesthesia
Responsiveness	Normal	Purposeful response to verbal or tactile stimulation	Purposeful response to repeated or painful stimulation	Unrousable, even with painful stimulus	Unrousable, even with painful stimulus
Airway	Unaffected	No intervention required	Intervention may be required	Intervention may be required	Intervention often required
Spontaneous Ventilation	Unaffected	Adequate	May be inadequate	Adequate	Frequently inadequate
CV Functioning	Unaffected	Usually maintained	Usually maintained	Elevated	May be impaired

[3] What are the five classes of physical status described in the ASA's Physical Status Classification system?

Reference: Table 4.2 - American Society of Anesthesiologists Physical Status Classification

Class	Description	Examples	Sedation Risk
I	Normal, healthy patient	No PMHx	Minimal
II	Mild systemic disease without functional limitations	Mild asthma, controlled DM	Low
III	Severe systemic disease with functional limitations	PNA, poorly-controlled seizure disorder	Intermediate
IV	Severe systemic disease that is a constant threat to life	Advanced cardiac disease renal failure, sepsis	High
V	Clinically moribund patient who may not survive without procedure	Septic shock, severe trauma	Extremely high

[4] Describe your approach to pre-PSA patient assessment.

For the patient undergoing procedural sedation, consider following this approach:

- **History**
  - Age
  - Current illness
  - Past medical history and underlying medical problems
  - Previous problems with PSA or general anesthesia
  - Drug allergies
  - Current medications
  - Tobacco, alcohol, and illicit drug use
  - ASA Physical Status Classification

- **Physical Examination**
  - Vital signs
  - Cardiovascular examination
  - Respiratory examination
  - HEENT examination
  - Assessment of airway using mnemonics described in the airway podcast:
    - LEMON - predictors of difficulty with intubation
    - MOANS - predictors of difficulty with BVM
    - RODS - predictors of difficulty with SGA placement
    - SMART - predictors of difficulty with surgical airway

[5] What are the recommended ASA fasting durations pre-sedation? What are the recommendations of the American College of Emergency Physicians (ACEP)?

According to Rosen's, the American Society of Anesthesiologists recommends the following fasting times:

- Two hours after ingestion of clear liquids before PSA
- Four hours after ingestion of breast milk before PSA
- Six hours after ingestion of other liquids (e.g., infant formula, non-human milk) OR solids before PSA

NOTE: The ASA guidelines specifically state that emergent sedations are excluded from fasting requirements.

Unfortunately, these recommendations were made after considering data from studies that looked at risk of aspiration when patients received sedation to the level of general anesthesia. Consequently, the American College of Emergency Physicians (ACEP) noted these

recommendations to be level B (i.e., equating to a moderate level of certainty). ACEP notes that procedural sedation in adult and pediatric populations should not be delayed based on fasting times, as there is no demonstrated reduction of risk of emesis or aspiration risk with fasting.

[6] What equipment do you need to safely and effectively provide procedural sedation and analgesia (see Box 4.2)?

Reference: Box 4.2 - Equipment for Procedural Sedation and Analgesia

Equipment for Procedural Sedation and Analgesia

• High-flow oxygen source
• Suction
• Airway management equipment
• Monitoring equipment
  ○ Pulse oximeter
  ○ ECG monitor, defibrillator, transcutaneous pacemaker
  ○ Blood pressure monitor
  ○ Capnography supplies
• Vascular access equipment
• Reversal agents
• Resuscitation drugs
• Adequate staff

[7] When is it safe to discharge a patient post-PSA and what monitoring do they require at home?

Before you are sending a patient home post-PSA, you need to consider a few things.

- First, you need to assess baseline cognitive and motor functions.
- You patient should be capable of following commands, be able to speak clearly, and should be able to ambulate without issue.
- The patient's vital signs and respirations should have returned to baseline.
- Pain, nausea, and vomiting should be addressed.

When they are discharged, they should be in the care of a responsible adult for at least 4-8 hours. Further, they should NOT drive, operate heavy machinery, or "participate in dangerous activities" for approximately 12-24 hours. For children, light play is about as good as it gets. They should not be swimming, riding bicycles, or engaging in other dangerous activities.

Patients should return if:

- Concerning symptoms arise that have to do with their initial presenting complaint
- Any confusion or respiratory symptoms arise

[8] Detail the class, main effects, and usual starting doses of the following medications used to achieve procedural sedation and analgesia (see Table 4.3).

- **Fentanyl**
- **Morphine**
- **Midazolam**
- **Ketamine**
- **Methohexital**
- **Pentobarbital**
- **Etomidate**
- **Propofol**
- **Ketofol**
- **Alfentanil**
- **Remifentanil**
- **Dexmedetomidine**

Agent	Class	Main Effect	Route of Administration	Usual Starting Dose
Fentanyl	Opioid	Analgesic	IV	1 mcg/kg
Morphine	Opioid	Analgesic	IV	0.1 mg/kg
Midazolam	Benzodiazepine	Sedative, amnestic	IV	0.05 mg/kg
Methohexital	Barbiturate	Sedative, amnestic	IV	1 mg/kg
Pentobarbital	Barbiturate	Sedation, amnestic	IV/IM	2 mg/kg IV 4 mg/kg IM
Ketamine	Phencyclidine Derivative	Dissociative, analgesic, sedative, amnestic	IV/IM	1-2 mg/kg IV 4.5mg/kg IM
Etomidate	Imidazole Derivative	Sedative, amnestic	IV	0.1 mg/kg
Propofol	Alkylphenol Derivative	Sedative, amnestic, antiemetic	IV	0.5 mg/kg
Ketofol	Ketamine - Propofol Combination	Dissociative, analgesic, sedative,	IV	1:1 mixture Initial dose:

		amnestic		0.075 ml/kg, over 15-30 seconds; repeat if needed at half-dose with 0.375 mg/kg after 1-3 minutes to achieve desired sedation
Alfentanil	Opioid Analogue	Analgesic	IV	3-8 mcg/kg over 3 minutes, then 3 mcg/kg q5-20 minutes
Remifentanil	Semisynthetic Mu Opioid Receptor Agonist	Analgesic	IV	0.1-0.15 mcg/kg/min infusion; supplement boluses of 1-2 mcg/kg increments
Dexmedetomidine	Alpha-2 Adrenergic Agonist	Analgesic, sedative	IV	1 mcg/kg over 10 min, then 0.2-0.7 mcg/kg/hr

[9] What are our reversal agents for opioids and benzodiazepines, and how are they dosed?

Opioid Reversal Agent: Naloxone

- Competitive antagonist of opioids
- Reverses opioid-related respiratory depression
- Rapid onset, half life of 45 minutes
    - Clinical effects only for 15-30 minutes - MAY NEED TO RE-DOSE
- Can be dosed IV/IM
    - Should only dose enough to reverse opioid respiratory depression
    - Consider initial IV doses of 0.04-0.1 mg q 1-2 minutes
    - Complete reversal usually occurs with 1-2 mg IV
- Risks
    - Few, largely rare complications

- Pulmonary edema, seizure, and dysrhythmias have been described

Benzodiazepine Reversal Agent: Flumazenil

- Competitive antagonist of benzodiazepines
- Reverses sedation, but is NOT EFFECTIVE for reversing respiratory depression
- Rapid onset, peak effect in 5-10 minutes
  - Clinical effects only for 30-90 minutes
- Can be dosed IV
  - Consider initial IV doses of 0.1-0.2 mg q 1-2 minutes
  - Maximum dose of 1 mg is generally sufficient
- Risks
  - Use with caution - really not indicated unless acute exposure
  - Can cause refractory status epilepticus if the patient has a history of benzodiazepine dependence

[10] List some common drugs used for the following procedures (see Table 4.5):

- **Non-painful procedures**
- **Low pain, high anxiety procedures**
- **High pain, high anxiety procedures**

Reference: Table 4.5 - Adult Drug Selection Strategies

Procedure Type	Examples	Recommendation	Alternatives	Comments
Non-painful	Radiologic Imaging	Midazolam (IV)	Propofol (IV)	Midazolam has considerable support and safety
Low pain, high anxiety	Central line placement, LP	Midazolam (IV)	Propofol or Ketamine	Analgesia may be accomplished frequently with local or topical agents
High pain, high anxiety	Fracture or joint reduction, abscess drainage, burn debridement, cardioversion, chest tube	Midazolam + Fentanyl Propofol + Fentanyl Ketamine	Etomidate + Fentanyl Ketofol	There are far more data supporting fentanyl and midazolam, although the other choices

	placement			have significant support

Wisecracks:

[1] What is Ketofol? Is using it better than using either of its constituent medications alone?

Ketofol - a combination of ketamine and propofol - is a relatively common mixture used during procedural sedation. The reason these medications are used together is because they are thought to counteract each others adverse effects while highlighting the others positive attributes. Propofol's capacity to cause respiratory and cardiovascular depression is thought by some to be countered by ketamine's stimulating effects. Further, ketamine provides analgesia, making up for propofol's lack of analgesic capacity. Propofol is thought to reduce post-procedure nausea and vomiting and recovery hallucinations typically associated with ketamine.

Unfortunately, several studies have shown that this mixture is not all it is cracked up to be. Airway complications and respiratory depression were no less frequent than when either ketamine or propofol was used in isolation. There was, however, better provider satisfaction, sedation quality, and decreased emesis with ketofol.

[2] What is an emergence phenomenon, and how do we treat it?

Emergence phenomenon - an event during which a *patient awakens with unpleasant vivid dreams or hallucinations or reports nighttime awakenings as a result of unpleasant dreams for several days after the administration of ketamine.* The emergence phenomenon is more commonly seen in female patients, adults, and those in their adolescent years. Additionally, those with psychiatric illness are more likely to experience this phenomenon. Children, on the other hand, are less likely to experience this.

If the patient is experiencing an emergence phenomenon, administer midazolam.

NOTE: It used to be recommended that everyone receiving ketamine be given midazolam prophylactically; however, this is no longer the case. There is no evidence to support this practice. Only give midazolam to reduce pre-procedure anxiety or to treat an emergence reaction that is occurring acutely.