VA NATIONAL CENTER FOR PATIENT SAFETY

Moderate Sedation Toolkit for Non-Anesthesiologists

Curriculum Guide

Content Produced by
The Durham VAMC Patient Safety Center of Inquiry (PSCI)

Moderate Sedation Curriculum Guide

Introduction

- ### Objectives of Sedation Practice
  - Decrease anxiety, pain, discomfort
  - Amnesia to the extent possible, but not guaranteed
  - Minimize risk (optimize risk/benefit ratio)
  - Rapid recovery
- ### Clinical Settings
  - Outpatient clinics and inpatient procedural areas
    - Pulmonary, GI, dental, minor surgery, interventional radiology, interventional cardiology/electrophysiology
  - Emergency room
    - Fracture/dislocation reduction, suturing of wounds, examinations
  - Operating room
    - Procedures under sedation with local anesthesia by surgeon
- ### Contraindications
  - History of allergy to medications
  - Hemodynamic instability
  - High risk of pulmonary aspiration of gastric contents
  - High risk of sedation failure, requiring assistance of anesthesiology service

Levels of Sedation, a Continuum

	Minimal Sedation	Moderate Sedation	Deep Sedation	General Anesthesia
Response (to simulation)	↔ *	Purposeful** response to verbal/tactile	Purposeful** response to tactile/painful	Unarousable
Airway	↔	No intervention	Intervention often required	Intervention required
Spontaneous Ventilation	↔	Adequate	Possibly adequate	Inadequate
Vital Signs	↔	↔	↔	May be impaired

*↔ Indicates normal or minimal change from baseline
**Localization to pain does not qualify as purposeful response

- **Joint Commission Standards**
  - Standards apply for sedation and anesthesia when patients receive "in any setting for any purpose, by any route, moderate or deep sedation as well as general, spinal or other major regional anesthesia."
  - "…must be able to manage a compromised airway…"
  - Standards do not apply to minimal sedation
    - Example (PO Diazepam [Valium] prior to MRI scan)

Pharmacology

- **General Considerations**
  - Sedation medications usually cause
    - Decreased hypoxic and hypercarbic respiratory drive
    - Decreased tone in upper airway leading to increased risk of upper airway obstruction
    - Decreased protective airway reflexes causing increased risk of pulmonary aspiration and laryngospasm

- Duration of sedative drug effect usually due to redistribution of drug rather than metabolism, but dependent on other drugs in chronic use

Drug	**Dose**	**Onset**	**Peak Effect** (min)	**Duration** (min)
Fentanyl	25 - 50 mcg IV	3 – 5 min	5 – 15 min	30 – 180 min
Midazolam	0.5 - 2 mg IV	1 – 2 min	1 - 2 min	20 – 40 min
Naloxone *	0.1 – 0.2 mg IV***	1 - 2 min ***	5 – 15 min	30 – 45 min
Flumazenil**	0.2 mg IV (Max 1 mg)	1 – 2 min	6 – 10 min	45 – 60 min

*Use with care in patients on chronic opioids
**May precipitate seizures
*** Naloxone may be given IM, 0.4 mg IM with onset 2-5 min

• Opioids

- **Fentanyl,** 25 to 50 mcg bolus doses
  - Ultra-short-acting relative of morphine [80-100 X potency of morphine]
  - Physiologic effects
  - Potent respiratory depressant resulting in severe hypoventilation and apnea that may require assisted ventilation or tracheal intubation
  - Cardiovascular depressant
  - Bradycardia and hypotension
  - Euphoria
  - **HIGHLY SYNERGISTIC WITH BENZODIAZEPINES**

• Benzodiazepines

- **Midazolam** (Versed), 0.5 to 2 mg bolus doses
  - Water soluble, related to diazepam
  - Duration of action determined by redistribution
  - Physiologic effects
    - Anxiolysis, amnesia
    - Mild respiratory and cardiac depressant
    - Minimal respiratory depressant when given *ALONE* unless given in large doses; powerful depressant if given with opioid
    - Suppresses seizures
    - May cause paradoxical dis-inhibition and agitation

- In elderly or malnourished, decrease dose significantly (95 percent protein bound)
- **HIGHLY SYNERGISTIC WITH OPIOIDS**

• Other Drugs Used for Sedation

- **Propofol** (Diprivan)
  - Lipid soluble hypnotic, ultra-short acting
  - Bolus dosing highly likely to result in complete loss of protective airway reflexes, airway obstruction and apnea
  - No pharmacologic reversal
  - Potent cardiovascular depressant causing significant hypotension and decreases in cardiac output
  - No analgesic properties
  - Mild antiemetic activity
  - Current use in VHA restricted to anesthesia-trained providers, consistent with drug package insert

• Adjuvant Medications

- **Lidocaine (topical)**
  - Useful as mucosal topical anesthetic for endoscopy
  - Viscous (2 percent) or spray (atomized, 4 percent)
  - Maximum suggested dose: 400 mg (10 ml 4 percent or 20 ml 2 percent)

• Reversal Agents

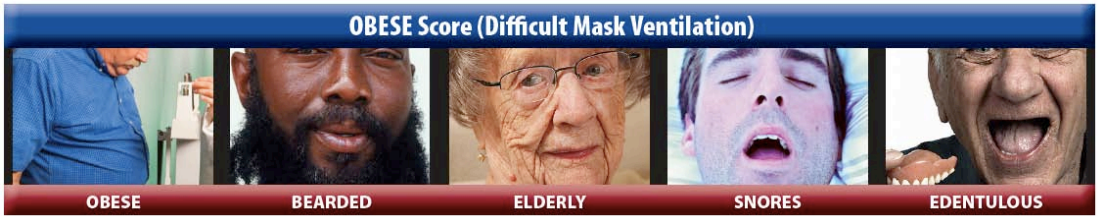
- Routine use is NOT recommended
- These drugs should be available whenever moderate or deep sedation is administered
- Use should be considered in conjunction with other rescue maneuvers (e.g. supplemental oxygen administration, patient stimulation, airway support or device use)
- After use, patient should be observed for 90 to 120 minutes to ensure event does not recur
- **Naloxone** (Narcan), 0.1 to 0.2 mg bolus dose, up to 0.4 mg typical maximum
  - Opioid antagonist
  - May precipitate acute withdrawal in opioid dependent patient
  - May precipitate pulmonary edema in some cases
  - Initial dose can be as small as 0.04 mg (40 mcg)
  - Larger dose, 0.4 mg (400 mcg) IV, should **ONLY** be used for emergency rescue in the apneic patient

- **Flumazenil** (Romazicon), 0.2 mg bolus dose, up to 1 mg maximum
  - Benzodiazepine antagonist
  - May cause headache, confusion, flushing, dysrhythmias and hypertension
  - May precipitate seizures

Anatomy and Physiology

• Evaluation of the Airway

- Airway evaluation should include:
  - **Quick look**
    - Gross deformities, scarring of neck or face, large beard, other obvious issues that would make management of airway (ventilation or intubation) difficult
  - **Mouth opening**
    - Three fingerbreadths between teeth
    - Chipped, loose or missing teeth
    - Ask about subluxation of jaw (pushing lower jaw forward), which predicts easy intubation (ask “can you bite your upper lip?”)
  - **Mallampati score** (relative tongue/palate size)
    - Class I predicts successful intubation
    - Class IV predicts difficult intubation
    - Class II and III is not predictive
  - **Neck extension** (mainly occipito-atlanto-axial motion)
    - Minimum 35 degrees
    - Limited extension may predict difficult intubation, but not necessarily difficult ventilation
  - **Chin size** (thyromental distance)
    - Distance from upper border of thyroid cartilage to chin
    - Should exceed three fingerbreadths or 6 cm
    - Shorter distance associated with receding chin, short, thick neck, predicts difficult intubation, but not necessarily difficult ventilation
  - Predictors of difficult **MASK *VENTILATON***: **OBESE SCORE**



- Predictors of difficult **TRACHEAL INTUBATION: LEMON SCORE**

LEMON Score (Difficult Intubation)

The score with a maximum of 10 points is calculated by assigning one point for each of the following LEMON criteria. A LEMON score ≥ 5 predicts difficult intubation.

L = Look externally (facial trauma, large incisors, beard or moustache, large tongue) (4 points)

E = Evaluate the "3-3-2 rule" (inter-incisor distance < 3-finger breadths, hyoid-mental distance < 3-finger breadths, thyroid-floor of mouth distance < 2-finger breadths (3 points)

M = Mallampati (Mallampati score ≥ 3) (1 point)

O = Obstruction (presence of any condition like epiglottitis, peritonsillar abscess, trauma) (1 point)

N = Neck mobility (limited neck mobility) (1 point)

• Effects of Sedation on the Airway

- Decreased hypoxic and hypercarbic respiratory drive
  - Predisposes to hypoventilation and apnea
- Loss of motor tone in upper airway
  - Predisposes to upper airway obstruction
- Loss of tone in submandibular muscles
  - Predisposes to obstruction by tongue and soft palate
- Diminished airway protective reflexes
  - Predisposes to pulmonary aspiration of oral secretions or gastric contents

• Risks of Aspiration

- Recent oral intake
- Gastroesophageal reflux disease (GERD), hiatal hernia
- Conditions that slow gastric emptying (pregnancy, diabetes, bowel obstruction, etc.)
- Previous esophageal surgery (HIGH RISK)
- Conditions associated with increased intragastric pressure (obesity, bowel obstruction, abdominal compartment syndrome, etc.)
- Altered level of consciousness or decreased ability to protect airway for another reason (e.g. over sedation, chronic bulbar neuromuscular disease, etc.)

• Effects of Changes in Position

- Changes in position may make spontaneous ventilation or airway management more or less challenging

- Lateral position decreases upper airway obstruction by shifting the relaxed airway structures off the posterior pharynx, but will probably make mask ventilation more difficult
- Upright position partially relieves upper airway obstruction by shifting obstructing tissue away from posterior pharyngeal structures

Pre-Procedure Assessment

- **Purpose**
  - Clinical utility
    - Transmission of useful clinical information to other care providers
    - To establish baseline patient condition and suitability for planned procedure and sedation
    - Assess need for additional testing, consultation or intervention prior to procedure
  - Documentation and communication
    - Must be accurate
    - If not done immediately prior to the procedure, INTERVAL CHANGES occurring since the pre-procedure assessment was performed must be documented
    - On occasion, changes in patient condition may alter planned procedure or sedation
- **Components**
  - Past medical history
    - Height, weight, allergies, medications
    - History of receiving sedation or anesthetics, any problems noted
    - Indication for procedure
    - Use of tobacco, ETOH, other drugs/OTC/alternative medications
    - Significant co-morbidities
      - Severity, stability, recent changes in condition
      - Relative contraindications to moderate sedation (may vary slightly for urgent vs. elective procedures)
        - Severe, untreated hypertension
        - Hemodynamic instability
        - Decompensated heart failure
        - Unstable angina
        - Acute dyspnea
        - Recent PO intake
        - Significant dysrhythmia or electrolyte disturbance

- Documented or high suspicion of intoxication from prescribed medications, legal or illicit substance use, or high risk of withdrawal syndrome
- Altered mental status or other inability to cooperate during procedure

- Focused physical exam
  - Baseline vital signs (BP, HR, RR, SpO_2, height, weight, BMI)
  - Heart, lungs, mental status, body habitus
  - Airway exam
  - Physical restrictions to positioning required for procedure
  - Other physical findings as relevant to intended procedure
- Pre-procedure testing, consultations
  - As indicated by history and physical exam
  - No “routine” laboratory testing indicated (rarely changes management and does not improve outcome)
- Documentation
  - Consent, evaluation notes
- Summary

  ASA classification. This method of categorizing patient physical status prior to surgery is a useful and simple method to summarize patient condition. When making this assessment, one should be considering risk for Moderate Sedation and Intended Procedure (rather than risk for anesthesia and surgery). Severely ill and medically compromised patients will almost always be ASA Class III or IV.

American Society of Anesthesiologists Physical Status Classification	
I	Normal healthy patient
II	Patient with mild systemic disease without significant impact on daily activity and small risk of impact on anesthesia or surgery
III	Patient with significant or severe systemic disease that affects daily activities and will likely have an effect on anesthesia or surgery
IV	Patient with severe systemic disease that is a constant threat to life or requires intensive therapy and will have a major impact on anesthesia or surgery.
V	Moribund patient who is not expected to survive 24 hours with our without surgery
VI	Brain dead organ donor
* Adding E indicates emergency procedure	

- Identification of high-risk patients
  - High risk defined as:
    - High risk of procedural complication
    - High risk of sedation complication
    - High risk of sedation failure
  - Who is high risk?
    - Anticipated or difficult airway management
    - H/o obstructive sleep apnea
    - Morbid obesity (BMI > 35 kg/m^2)
    - Drug or alcohol abuse
    - Chronic opioid use
    - ASA ≥ 3
    - Elderly (> 70 years)
    - History of failed sedation or failed procedure
- Patient education
  - Expectations for moderate sedation must be clearly explained to patient (moderate anxiolysis, sedation, analgesia, possibly some amnesia)
  - NPO and medication instructions (unless contraindicated by procedure)
    - Clear liquids may be taken up to two hours prior to sedation
    - A light meal may be taken up to six hours prior to sedation (unless contraindicated by the planned procedure (e.g. gastroduodenoscopy)
    - A heavy meal (fried/fatty foods or meat) should not be taken eight hours (or preferably longer) prior to sedation
    - All oral medications normally prescribed should be taken as indicated with sips of water on schedule
  - Designated driver for post-procedure transportation
  - Written instructions preferred
  - Procedure-specific instructions
    - e.g. bowel prep
- On day of procedure
  - Confirm NPO and medication status
  - Vital signs, β-HCG if relevant
  - Confirm driver or competent adult is available to accompany patient after procedure and clinic discharge
  - Document interval changes

Monitoring

- ### Why Monitor?
  - To document patient vital signs and sedation level monitoring
  - To provide a permanent record of the sedation procedure that may assist patient care during future procedures
- ### Alarms
  - Should be turned **ON** during procedure, especially if person administering sedation will be assisting with other minor tasks
  - Volume should be set high enough to be heard over ambient sounds in the room and should be tailored to individual patient parameters.
- ### Minimum Staffing Requirements
  - During moderate sedation procedures, the person administering sedation MAY assist with MINOR tasks while maintaining adequate patient monitoring once the patient's level of sedation has been stabilized
  - The clinician monitoring the patient should not be the same individual who is performing the procedure
  - "Deep sedation" is generally defined as a state wherein there is a purposeful patient response to tactile/painful stimulation but no patient response to verbal stimulation. This is not moderate sedation. Persons providing this level of sedation should be trained in anesthesiology and should have NO additional responsibilities other than the conduct of the deep sedation or anesthesia.
- ### Documentation Standards
  - Prior to start of sedation
  - Every five minutes or more frequently during the procedure
  - At completion and prior to discharge
- ### Monitoring Modalities
  - Minimum standards
    - Non-invasive blood pressure (NIBP)
    - Respiratory rate (RR)
    - Electrocardiography (ECG)
    - Pulse oximetry (SpO_2)
    - Level of consciousness (LOC)
  - Optional additional monitors
    - Capnography (end-tidal CO_2) – strongly recommended
    - Pain assessment

- Specific monitors
  - Blood pressure by NIBP (non-invasive blood pressure)
    - Most automated systems use oscillometry to measure mean pressure and calculate systolic and diastolic pressure.
    - May be inaccurate in patients with irregular rhythms (e.g. atrial fibrillation)
    - Cycle times should be between two and five minutes.
    - STAT mode should be used only in emergencies as it causes venous stasis and is less accurate than the regular time-cycled measurements.
  - Respiratory rate can be determined by several methods
    - Impedance pneumography (derived from ECG equipment)
    - Capnography
    - Manual palpation, visual inspection
  - ECG
    - A three-lead or five-lead system is acceptable for moderate sedation cases
    - Lead II is the best single lead to display and record an accurate HR and rhythm
    - Other leads are acceptable, but a clear P wave and QRS complex should be discernable on the monitor. (P waves may not be present if the patient has an abnormal rhythm, such as atrial fibrillation.)
  - SpO_2
    - Excellent measure of hemoglobin saturation and patient oxygenation
    - Requires pulsatile flow for analysis
    - Confounded by bright lights, poor perfusion, cold extremities, motion, certain dyes used in medical procedures (methylene blue, indigo carmine, etc.), and high levels of methemoglobin
  - Level of consciousness
    - Most IMPORTANT of all the monitored parameters in patients receiving moderate sedation
    - Assessment of depth of sedation mandatory for titration of pharmacologic agents against current or anticipated stimulation level
    - Ramsay Scale: Traditional six-point scale most frequently used
    - Richmond Agitation Sedation Scale (RASS): may be preferable as it involves objectively measurable variables

Monitoring: Sedation Scales

Richmond Agitation Sedation Scale

Sedation Level	Description
4	Combative, Dangerous to Staff
3	Aggressive, Pulling at Lines
2	Frequent Nonpurposeful Movement
1	Anxious, Apprehensive
0	Alert, Calm
-1	Awakens to Voice for > 10 Sec
-2	Sedated, Awakens to Voice for < 10 Sec
-3	Moderate Sedation, Movement to Voice, No Eye Contact
-4	Deep Sedation, No Response to Voice
-5	Unarousable

Ramsay Scale

Sedation Level	Description
1	Anxious, Agitated
2	Cooperative, Oriented
3	Responds to Verbal Command Only
4	Asleep, Responds to Light Stimulation
5	Asleep, No Response to Light Stimulation
6	Unresponsive

- Capnography
  - Excellent method for monitoring respiratory rate and early detection of apnea
  - Not an accurate measure of minute ventilation or arterial PCO_2 in non-intubated patients, as dilution with room air (with negligible CO_2 content) will artificially lower CO_2 concentration.
- Pain VAS
  - Most useful to assess before and after procedure
  - Difficult to apply when patient is moderately sedated

Intra-Procedural Guideline

S	suction
O	oxygen
A	airway
P	pharmacy
M	monitors
E	equipment

- **Equipment (SOAPME Acronym)**
  - **S**uction (separate from that used for procedure)
  - **O**xygen (nasal cannula, face mask, capnography tubing incorporated if possible)
  - **A**irway (nasal/oral airways, face mask, bag-valve mask assembly, tongue blades, lubricating gel; intubation equipment, possibly laryngeal mask airways should be available for use by skilled airway providers if necessary)
  - **P**harmacy (sedative medications and others likely to be needed for the procedure, such as atropine for treating bradycardia during colonoscopy)
  - **M**onitors (as listed above, available and working, with required disposables, such as ECG electrode pads, pulse oximeter finger probe pad, etc.)

- **E**quipment (other equipment as need for the procedure)

• Procedure to Call for Assistance

- A "Call for Help Card" should be posted in the procedural area to assure that all providers are aware of local protocols for gaining advanced airway and resuscitation support (as in calling a "code blue")

• Patient Positioning

- Must allow access to IV
- Padding and protection of vulnerable body parts to avoid iatrogenic injury (e.g. eyes, nose, ears, fingers)

• Medication Administration

- Bolus dosing vs. continuous infusion
  - Bolus dosing
    - Best technique for fentanyl and midazolam administration
    - Provides quicker clinical effect than continuous infusion
    - More likely to result in overdose with airway obstruction or cardiovascular and respiratory depression if bolus doses are too large
  - Continuous infusion
    - Only appropriate for ultra short acting drugs, such as propofol
    - Allows consistent plasma levels to be achieved
    - Ideal for long procedures
    - Inappropriate technique for longer acting medications or procedures with rapidly changing levels of stimulation because
      - Drug accumulation will result in overdose
      - Unable to change serum plasma levels quickly
      - Requires a dedicated IV with a carrier solution running at a steady rate to prevent unintentional administration of a drug bolus
- Titration of midazolam and/or fentanyl to balance changing levels of patient stimulation during the procedure
  - Administration based on small bolus doses, allowing adequate time intervals between doses to achieve onset of clinical effect
  - Clinical effect of sedation is balanced by procedural stimulation, such that timing of drug administration is critical.
  - Drugs often given in combination for synergistic effect
  - Allows for finely controlled level of sedation but requires cooperation and communication between the individual providing sedation and the individual performing the procedure. Overall, a smaller amount of total medication is used but patience and timeliness of administration are crucial.

- ## Airway Management
  - Recognition of patient with “high-risk” airway
  - Recognition of airway obstruction or hypoventilation
  - Airway support maneuvers
  - Consider pharmacologic reversal to improve the patient’s level of consciousness and restore ventilatory drive
  - If significant airway or breathing problems develop, inform physician performing procedure of difficulty and CALL FOR HELP
- ## Complications
  - Airway obstruction
    - Oropharynx and glottis are the most common sites for airway obstruction
    - Maneuvers to relieve obstruction
      - Increase auditory/manual stimulation (call patient’s name and shake gently)
      - Reposition head
      - Chin lift or jaw thrust
      - Use of airway adjuncts (oral or nasal airways)
      - Assist ventilation as needed
      - Use assistant for two-person ventilation if necessary for effective ventilation
      - Consider CALL FOR HELP
    - Oral airways are preferred for the patient with complete upper airway obstruction or apnea
    - Oral airways or very long nasal airways may stimulate gag reflex and initiate vomiting or laryngospasm
    - Nasal airways are easier to place than oral airways in the sedated but not totally unconscious patient and are better tolerated once in place
    - Nasal airways should be lubricated with water soluble gel and never forced into the nasal passage against resistance
  - Laryngospasm
    - Usually initiated by mechanical stimulus, such as secretions or blood in the airway or mechanical stimulation from anything placed into the back of the throat
    - May be complete (no airflow whatsoever) or partial (dyspnea, inspiratory stridor)
    - May result in development of pulmonary edema from negative pressure exerted by the respiratory muscles against a closed glottis
    - Treatment of laryngospasm

- Discontinue the initiating stimulus
- Suction the oropharynx if secretions, gastric content, or blood are present
- Attempt to ventilate with bag and mask, timing positive pressure ventilatory assistance with the patient's inspiratory effort

- Consider lidocaine 1 mg/kg IV
- If laryngospasm is severe, may require endotracheal intubation
- CALL FOR HELP

- Hypoxia
  - Etiology
    - Low FiO_2
    - Hypoventilation (over sedation, upper or lower airway obstruction)
    - O_2 diffusion problems (rarely develop acutely)
    - V/Q mismatch (pulmonary edema, aspiration)
  - Diagnosis: usually with pulse oximetry, but cyanotic skin color should raise clinical suspicion
    - Severely anemic patients will not develop cyanosis despite severe hypoxemia
  - When in doubt, TRUST PULSE OXIMETER and TREAT
  - Treatment
    - INITIAL RESPONSE
      - Verify pulse oximeter probe placement and waveform
      - Verbal stimulation (encourage patient to take a deep breath)
      - Chin lift/jaw thrust
      - Increase oxygen flow or change to high flow oxygen mask
      - Check for clinical signs of effective ventilation, respiratory distress or cyanosis
      - Check vital signs frequently
    - FOLLOW-UP RESPONSE
      - Inform the team
      - Place nasopharyngeal or oral airway as needed
      - Initiate bag-mask ventilation if no respiratory efforts
      - Place patient in the supine position
    - THINGS TO CONSIDER
      - Suspend the procedure
      - Administer reversal agents

- Aspiration risk?
- Should the case be rescheduled and performed in consultation with anesthesiology?

- CALL FOR HELP

- Hypotension
  - Often defined clinically in relation to the patient's baseline blood pressure (e.g. a chronically severely hypertensive patient [210/120] may be considered relatively hypotensive at normal blood pressures [120/80])
  - Etiology
    - Decreased preload (hypovolemia, dehydration, venodilation)
    - Decreased afterload (pharmacologic effect, sepsis, anaphylaxis)
    - Heart failure (ischemia, drugs, chronic)
    - Dysrhythmia
    - Significant valvular disorder (particularly unrecognized aortic stenosis)
  - Treatment
    - INITIAL RESPONSE
      - Check rhythm and confirm BP reading
      - Assess mental status by verbal and tactile stimulation
      - Ensure adequate oxygenation and ventilation
      - Administer a fluid bolus
    - FOLLOW-UP RESPONSE
      - If no response to fluid bolus, inform the team and suspend the procedure
      - Turn to supine position
      - Call for assistance
    - THINGS TO CONSIDER
      - Suspend the procedure
      - Was anything done during the procedure that may be causing the hypotension?
      - Does the patient have any comorbidities that may explain the hypotension?
      - Admission or ED referral if hypotension is severe and sustained
    - CALL FOR HELP
- Hypertension
  - Often defined clinically in relation to the patient's baseline status or in terms of the magnitude of the increase in blood pressure during the procedure

- Frequently related to regular anti-hypertensive medications not taken on day of procedure
- Presence of hypertension or an increase in blood pressure during the procedure does not necessarily indicate inadequate sedation level
- Treatment
  - INITIAL RESPONSE
    - Check rhythm and confirm BP reading
    - Differentiate baseline HTN from procedural stimulation or inadequate sedation
    - Titrate sedation to desired level
  - FOLLOW-UP RESPONSE
    - Inform team
    - Define acceptable BP range and suspend procedure if BP exceeds this range
  - THINGS TO CONSIDER
    - Suspend the procedure
    - Did the patient miss routine antihypertensive medications that may be administered orally after the procedure?
    - Admission or ED referral if HTN is severe and sustained
  - CALL FOR HELP

- Brady/Tachycardia, other Dysrhythmia
  - Most important to identify rhythm (see Appendix A for sample rhythm strips)
  - In all cases, determine whether blood pressure is adequate and assess mental status (surrogate for cerebral perfusion)
  - Evaluate stage of procedure as a cause of the heart rate or rhythm change (e.g. excessive procedural stimulation causing tachycardia or dysrhythmia, or peritoneal traction causing bradycardia)
  - Treatment depends on etiology of dysrhythmia
    - Discontinue causative procedural stimulation and reevaluate
    - Consider a fluid bolus if hypovolemic
    - THINK: Are comorbidities responsible for dysrhythmia? Did the rhythm change or merely the heart rate? Did the patient miss doses of anti-dysrhythmic medications (e.g. beta blockers)?
    - If dysrhythmia is persistent and/or patient is hypotensive, abort procedure
    - Start ACLS protocol if severe, symptomatic and persistent
    - CALL FOR HELP

- Agitation or inability to sedate
  - Potential etiologies include drug interactions, drug abuse or tolerance, poor titration of sedation to match procedural stimulation, paradoxical (agitated) response to sedative medications, hypoxia, hypercarbia, myocardial ischemia, pulmonary edema, delirium, other drug toxicities (e.g. local anesthetics)
  - Treatment
    - INITIAL RESPONSE
      - Provide verbal reassurance
      - Allow adequate time for drug onset
      - Slowing titrate drugs to desired effect
      - Check vital signs frequently
    - FOLLOW-UP RESPONSE
      - Do not start the procedure until conditions are adequate
    - THINGS TO CONSIDER
      - Suspend the procedure
      - Hypoxia and hypoxemia as causes of agitation
      - Is the patient on chronic opioid or benzodiazepine medications?
      - Comorbidities may delay the time to peak effect for certain sedative agents
      - Local anesthesia toxicity alters mental status
      - Should the case be rescheduled and performed in consultation with anesthesiology?
    - CALL FOR HELP
- Pulmonary Aspiration
  - Inhalation of oral or gastric contents into the tracheobronchial tree
  - Diagnosis: Coughing, laryngospasm, hypoxia, bronchospasm, gastric contents in the mouth or pharynx
  - Treatment
    - Immediately discontinue procedure, turn patient laterally
    - Suction oropharynx
    - Administer supplemental oxygen if hypoxemia is present
    - Monitor patient for minimum of two to four hours
      - May be discharged home if no adverse events in two to four hours
      - If hypoxia develops, admit to monitored setting

- If suspect particulate matter aspiration, further treatment may be indicated (including tracheal intubation, bronchoscopy and lavage, with removal of aspirated material)
- Consultation is required when significant aspiration has occurred

•• CALL FOR HELP

- Resuscitation from adverse events (see Appendix B)
  - Treatment of significant dysrhythmia
  - Treatment of severe hypotension
  - CPR
  - Meds: atropine, epinephrine, vasopressin, lidocaine

Post-Procedure Management

• Recovery

- Phase I: Post Anesthesia Recovery Score (PARS)
  - Recovery in designated, monitored area until PARS ≥ 9. (Recovery for a minimum of 15 minutes)

points	***Activity***	***Circulation***	***Oxygenation***	***Respiration***	***Consciousness***
2	Moves 4 extremities	± 20 mmHg of baseline BP	SpO_2 > 92% on RA	Adequately ventilating	Fully awake
1	Moves 2 extremities	± 50 mm Hg of baseline BP	$SpO_2 \geq$ 90% with O_2	Hypoventilating	Arousable
0	No spontaneous movement	BP > 50 mm Hg from baseline	SpO_2 < 90% with O_2	No respirations	Unarousable

- Phase 2: Readiness for discharge
  - Must be discharged into the care of a responsible adult
  - Instructions and follow-up given in writing

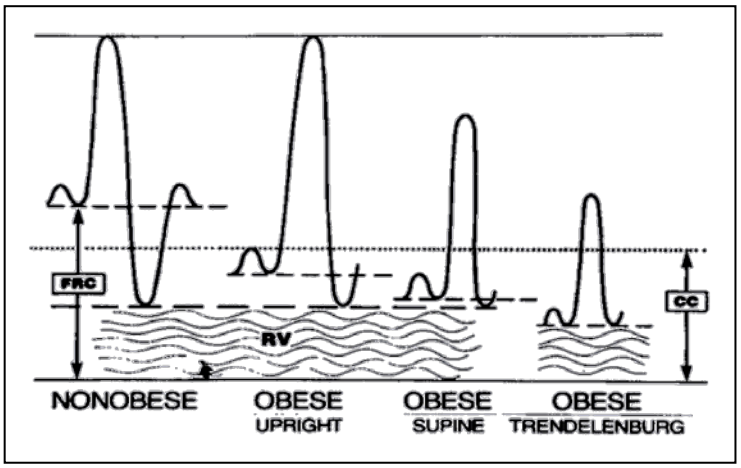
Special Situations

- ### Obese Patients

  - Physiologic changes

Pulmonary	Cardiovascular	Gastrointestinal
↑Chest Wall Mass	↑ Cardiac Output	↑ Risk of Aspiration
↑CO_2 Production	↑ Stroke Volume	↑ Residual Gastric Contents
↓ FRC	Systemic Hypertension	↑ Intra-Gastric Pressure
↓ Pulmonary Compliance	Pulmonary Hypertension	↑ Intra-abdominal Pressure
↑ Risk of OSA	Right Heart Failure	
↑ Risk of Difficult Airway	Difficulties with Monitoring	
↑ Total O_2 Consumption		
↑ Work of Breathing		

  - Pulmonary dysfunction
    - Increased prevalence of obstructive sleep apnea and decreased functional residual capacity. This decreases the time that an obese patient can be apneic or hypoventilating prior to becoming hypoxic



- Aspiration
  - Increased risk for aspiration due to increased gastric pressure and volume
- Airway management often complicated
  - Ventilation often difficult due to increased mass of tissue around face and jaw, poor mask fit, increased pharyngeal and palatal tissue and decreased chest wall compliance due to increased chest wall mass
  - Intubation often difficult due to small mouth opening and submental fat, airway often narrowed due to increased pharyngeal tissue and large tongue, neck extension decreased due to increased cervical and thoracic fat pads. Also, detection of receding jaw obscured by increased neck size.
- Pharmacokinetics and pharmacodynamics
  - Increased adipose tissue results in longer elimination times for lipophilic drugs
  - Increased sensitivity to CNS depressants
  - Unpredictable sensitivity to sedatives and hypnotics
- Obstructive sleep apnea
  - Cessation of airflow during sleep causing fragmented sleep, daytime hypersomnolence, headache, cognitive dysfunction, cyclical hypoxemia/hypercarbia, polycythemia, hypertension and eventually pulmonary hypertension and right heart failure.
  - Most successfully treated with use of nasal CPAP or BiPAP during night-time sleep
  - Increased incidence in obese patients
  - **Increased sensitivity to CNS depressants**
- Monitoring difficulties
  - Blood pressure cuffs frequently do not fit well; a smaller cuff on the forearm may work better
- Implications for practice of moderate sedation
  - Titrate medications in very small increments
  - Dose on Ideal Body Weight (IBW) rather than Total Body Weight (TBW)

IBW = 105 lb + 6 lb/in (> 60 in) [males] → average 70-inch male = 165 lb = 75 kg

IBW = 100 lb + 5 lb/in (> 60 in) [females] → average 56-inch female = 130 lb = 60 kg

- Consider **decreasing** drug doses 30 to 50 percent
- Consider use of patient's own CPAP or BiPAP machine during or after sedation
- Consider prolonged post-procedural monitoring/observation if large doses of sedation have been administered

■ Most likely problems to encounter

- Hypoxia
- Upper airway obstruction
- Difficulty with rescue

• Elderly Patients

■ Physiologic changes

- General:
  - Decreased muscle mass, blood volume (20 to 30 percent), increased body fat
- Cardiovascular
  - Decreased vascular and ventricular compliance, decreased HR
- Pulmonary
  - Decreased muscle strength, cough, and ventilatory response to hypoxia and hypercarbia
  - Increased residual volume, chest wall rigidity and closing capacity
- Neurologic
  - Increased parasympathetic tone (vagal) and sensitivity to CNS depressants
- Hepatorenal
  - Decreased GFR and urine concentrating ability
  - Decreased albumin and enzymatic activity
- Airway
  - Decreased airway protective reflexes, neck extension and TMJ mobility

General/Metabolic	CV/Pulm
↓ blood vol (~25%)	↓max/resting HR
↑ risk of aspiration	↑ risk of CAD
↓GFR	dysrhythmias
↓metabolic rate	↑chest stiffness
↑risk of hypothermia	↓muscle strength
↓albumin, ↑unbound drug	↓response to hypoxia, hypercarbia
↓enzyme activity	
↑sens. CNS depressants	
↑parasymp tone	
↓ Drug Doses 30-50%	

■ Common comorbidities

- Hypertension, coronary artery disease, chronic obstructive lung disease, diabetes mellitus, chronic renal insufficiency, mild cognitive impairment

■ Polypharmacy

- Elderly patients are often on a variety of medications that may have significant interactions with sedation drugs. In addition, some patients are unsure what medications they are taking, and the history is often unreliable.

- Implications for practice of moderate sedation
  - Positioning
    - Joint stiffness, osteoporosis and osteopenia often make positioning for procedures difficult and risky, especially when the lateral or prone position is necessary.
    - Additional care should be taken with padding bony areas and preventing tearing of skin.
    - The patient is often the best source of advice on how to plan positioning of extremities, neck, and back to minimize the risk of injury.
  - Medications
    - Hypovolemia and changes in heart rate are more common due to decreased circulating blood volume and poor compliance and responsiveness of vascular system, while treatment with fluid boluses or vasopressors often results in large swings of both heart rate and blood pressure.
    - There is a high risk of post procedural delirium. Minimizing medication administration and maximizing familiar cues (voices, surroundings, family members) may help this. Doses of midazolam should be limited.
    - Smaller blood volume, slower redistribution, higher fraction of unbound drug and slower elimination all lead to unexpectedly high serum drug levels unless longer intervals between drug doses are allowed.

- Most likely problems encountered
  - Over sedation
  - Exaggerated hemodynamic changes with stimulation (BP and HR)

What does a High-Risk Patient Look Like?

- **High Risk is Defined as High Risk of Failure or High Risk of Adverse Event**

High-Risk Patients
>70 years
BMI >35kg/m^2
Obstructive Sleep Apnea
ASA Risk Class $\geq$ 3
Difficult Airway
Chronic Opioid Use?
Drug / ETOH Abuse

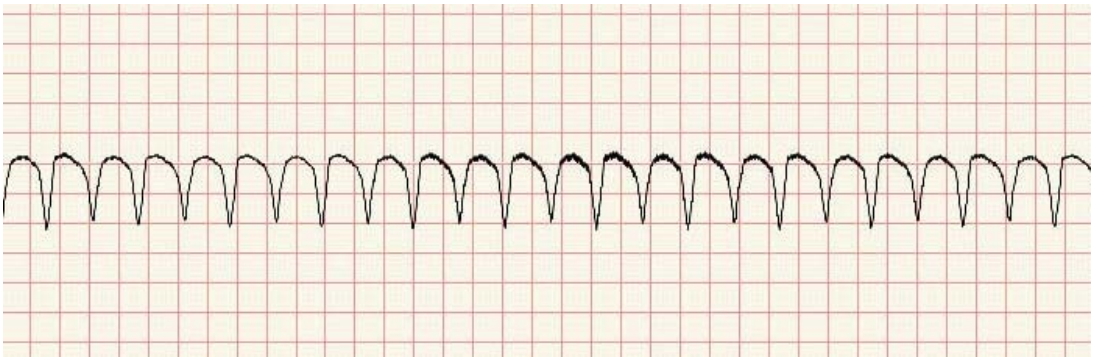
Most Common Reasons for Sedation Failure

- **Poor Patient Selection**
- **Drug Overdose**
- **Polypharmacy**
- **Inadequate Monitoring**
- **Under Appreciation of Potential Drug Interactions**
- **Inadequate Preoperative Assessment, Especially for Ill Patients in Hospital Settings**

Appendix A: Rhythm Recognition

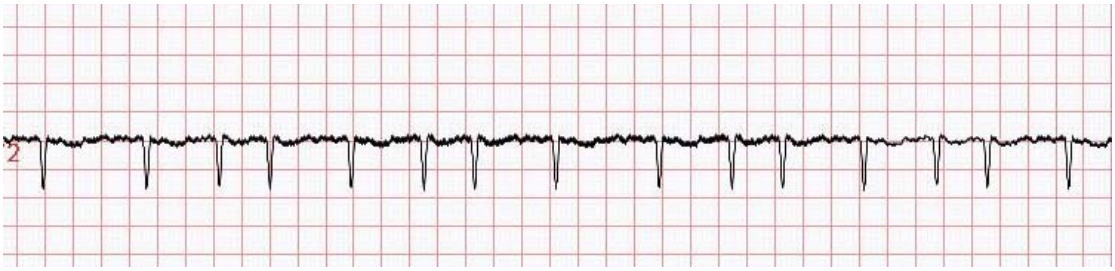
A.

B.



C.

D.



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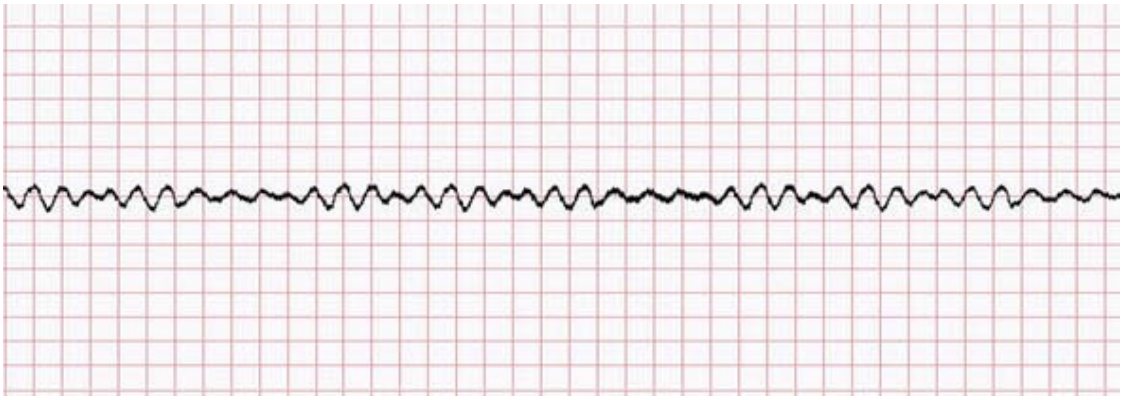

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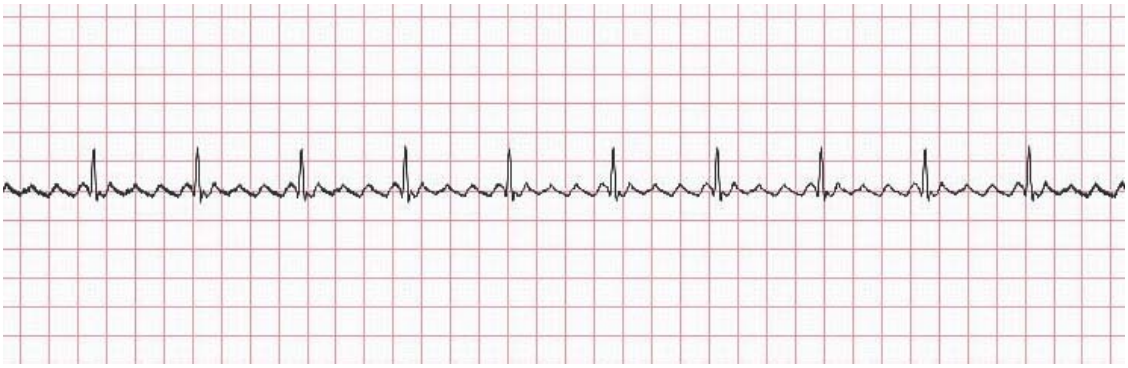

G.

Key: **A – Normal Sinus Rhythm**

B – Ventricular Tachycardia

C – Complete Atrioventricular Block

D – Atrial Fibrillation

E – Ventricular Fibrillation

F – Atrial Flutter

G – ST-Segment Depression

Appendix B: Resuscitation

(NOTE: This brief summary of primary resuscitation principles is not intended to replace implementation of standard ACLS protocols.)

Airway Management

- **Chin lift/jaw thrust, airway adjuncts (oral, nasopharyngeal)**
- **Assisted ventilation with bag and mask**
- **Is a more advanced airway technique such as endotracheal intubation or a laryngeal mask airway required for ventilation?**
- **Confirm adequate ventilation with chest movement and breath sounds**

Effective Basic CPR is KEY

- **Push hard and fast**
- **Immediate chest compressions while AED being applied**
- **Assess rhythm**
- **Shock if advised (within 3 min)**
- **IMMEDIATELY RESUME CPR**
  - 100 compressions/minute
  - Compression/ventilation ratio 30:2
  - First shock (biphasic) 200 J
  - Two minutes uninterrupted CPR (**LOOK AT CLOCK**)
  - Reassess rhythm and repeat
  - Check for pulse if rhythm other than VF

CALL FOR ASSISTANCE

- **Rapid response team or code team**

Drug Therapy

- **Atropine**
  - Symptomatic bradycardia, AV nodal block, ventricular asystole
  - 0.5 mg every three to five minutes
  - Ineffective s/p heart transplant
  - May be administered via endotracheal tube
  - Maximum dose 3 mg

- **Epinephrine**
  - For VF, pulseless VT or PEA
  - 0.5-1.0 mg IV push every three to five minutes if rhythm persists
  - May be administered via endotracheal tube
  - Maximum dose 5 mg
- **Vasopressin**
  - Acceptable alternative or adjunct to epinephrine for VF or pulseless VT
  - Single bolus dose of 40 units (half life 10 to 20 minutes)
- **Lidocaine**
  - For pulseless VT or VF (alternative is amiodarone)
  - 1 mg/kg every three to five minutes
  - Maximum dose 3 mg/kg in first hour
  - May be administered via endotracheal tube

Protocols

- **VF/pulseless VT**
  - Epinephrine

    ↓ ***(if no response)***

    Vasopressin (plus amiodarone, lidocaine, or magnesium?)
  - Compressions and ventilation
  - Defibrillation every two minutes
- **Pulseless Electrical Activity (PEA)**
  - Key is identifying the cause
  - Consider: Hypovolemia, infection, pulmonary embolism, tamponade, hyperkalemia, hypothermia, hypoxia, acidosis, drug overdose (tricyclics, beta blockers, calcium channel blockers, digoxin)
  - Epinephrine

    ↓ ***(if no response)***

    sodium bicarbonate

    ↓ ***(if no response)***

    Atropine (if rate is slow)
- **Asystole**
  - Dismal survival (two percent)

- CHECK the ECG to confirm
- Little evidence to support any specific therapy but…
  - Vasopressin → epinephrine → atropine → transcutaneous pacing (if done early)
- Consider: Is ventilation effective? Was it really asystole and not fine VF? Were atropine, vasopressin and epinephrine given?