Sedation Challenges in the Interventional Radiology Suite

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Content

• The focus of this presentation will be on the difficult to sedate patient

• A review of common medications used for moderate sedation in Interventional Radiology (IR)
Content Continued

• The subgroup that will be included and discussed:
  – The elderly patient
  – The obese patient
  – Patients with complex airway issues
  – Peri-operative wounds and safe positioning
Objectives

- The participant will become familiar with the basic pharmacokinetics of common sedation medications used in the IR suite
- The participant will become familiar with treatment strategies for these difficult to treat group of patients
- The participant will become familiar with safe dosing practices for the individual subgroups
Moderate Sedation

- The American Society of Anesthesiologists (ASA) and the Joint Commission on Accreditation of Health Organizations (JCAHO) define moderate sedation as the following:

ASA Task force on sedation and analgesia by non-anesthesiologists Anesthesiology 2002; 96:1004-1017
Moderate sedation is a drug induced depression of consciousness during which the patient responds purposefully to verbal commands either alone or accompanied by light tactile stimulation. No intervention is required to maintain a patent airway, spontaneous ventilation is adequate and cardiovascular function is maintained.
The Common Goal

• The end point
  – Provide adequate analgesia, sedation, anxiolysis and amnesia during procedure
  – Control unwanted motor behavior that may inhibit the performance of the diagnostic procedure
  – To rapidly return the patient to a state of consciousness
  – To minimize the risk of adverse events related to the provision of sedation and analgesia
Guidelines for sedation

- The ASA & JCAHO and our own institutions provide guidelines for safe practice in moderate sedation
- Sedation needs vary significantly based on patient condition and procedural needs
- Communication with all members of the IR team is paramount to ensure patient’s safety and comfort throughout the IR procedure
...and that is why we lift on three...

COMMUNICATION
<table>
<thead>
<tr>
<th>Drug Class</th>
<th>Drug</th>
<th>Effects</th>
<th>Incremental Dose*</th>
<th>Onset (min)</th>
<th>Duration (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypnotics</td>
<td>Midazolam</td>
<td>Sedation, anxiolysis, amnesia, motion control, no analgesia</td>
<td>1.0 mg</td>
<td>2</td>
<td>45–60</td>
</tr>
<tr>
<td></td>
<td>Diazepam</td>
<td>Sedation, anxiolysis</td>
<td>1.0–2.0 mg</td>
<td>2–3</td>
<td>6 h</td>
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<tr>
<td></td>
<td>Propofol</td>
<td>Anesthetic, sedation</td>
<td>25–75 µg/kg/min infusion</td>
<td>60 s</td>
<td>3–5</td>
</tr>
<tr>
<td></td>
<td>Ketamine</td>
<td>Analgesia, dissociation, amnesia, motion control</td>
<td>5–10 mg, repeat every 10 min with ½ dose</td>
<td>1–2</td>
<td>Dissociation: 15, recovery: 60</td>
</tr>
<tr>
<td>Analgesics</td>
<td>Fentanyl</td>
<td>Analgesia</td>
<td>25 µg/dose, repeat every 3 min to desired effect</td>
<td>2–3</td>
<td>30–60</td>
</tr>
<tr>
<td></td>
<td>Sufentanil</td>
<td>Analgesia</td>
<td>2 µg/dose</td>
<td>2–3</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Remifentanil</td>
<td>Analgesia</td>
<td>0.1–0.2 µg/kg/min</td>
<td>3–5</td>
<td>5–7</td>
</tr>
<tr>
<td></td>
<td>Morphine</td>
<td>Analgesia</td>
<td>2 mg/dose</td>
<td>3–10</td>
<td>3–4 h</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>Nitrous oxide</td>
<td>Anxiolysis, analgesia, sedation, amnesia</td>
<td>Preset mixture, self-administered</td>
<td>1–2</td>
<td>&lt;5 min after discontinuation</td>
</tr>
<tr>
<td>Reversal agents</td>
<td>Naloxone</td>
<td>Opioid reversal</td>
<td>40 µg/dose, repeat every 2 min as required to maximum of 2 mg</td>
<td>2</td>
<td>20–40</td>
</tr>
<tr>
<td></td>
<td>Flumazenil</td>
<td>Benzodiazepine antagonist</td>
<td>200 µg/dose, repeat every 1 min to maximum of 1 mg</td>
<td>1–2</td>
<td>30–60</td>
</tr>
</tbody>
</table>

* Doses are intravenous unless otherwise specified.
Sedation medications commonly used at MSK

- Midazolam 0.5-1mg IV
- Fentanyl 25-50mcg IV
- Meperidine 25-50mg IV
- Diphenhydramine 25-50mg IV
- Hydroxyzine 25-50 mg IVPB
Midazolam

• Short acting benzodiazepine onset 1-5min, duration less than 2 hours
  – Can last up to 6 hours
• GABA (gamma-amino-butyric acid) agonist
  – Causing sedation, anxiolysis, hypnosis, anti-convulsant and anterograde amnesia
• Metabolism cytochrome P450 3A4
Fentanyl

- Agonist of opiate receptors 100 times more potent than morphine
- Does not promote histamine release
- Cytochrome P450 3A4 metabolism
- Onset 1-3 min
- Duration 30-60 min
- Chest wall muscle rigidity with rapid administration
Meperidine

- Narcotic agonist-analgesic of opiate receptors
- Has anticholinergic properties which can lead to decreased cardiac contractility and increased heart rate
- Also stimulates histamine release
- Active metabolite normeperidine
- Onset 5 min duration 4 hours
Antihistamines: Diphenhydramine, Hydroxyzine

- Sedative effects not completely understood
- Significant concentration of histamine throughout the CNS especially hypothalamus
- Histamine seems to act as an excitatory neurotransmitter in the CNS so when blocked should lead to sedation
- Onset 2-3 min peak 60-90 min.
- Duration 3 hrs or more

Dexmedetomidine Hydrochloride

- Precedex® is a central alpha-2 adrenergic agonist
- Provides sedation without causing respiratory depression
- Has sedative, analgesic, anxiolytic and sympatholytic effects
- Dose: 1 mcg/kg loading dose over 10 min followed by continuous infusion of 0.2-1.0 mcg/kg/hr
Precedex

- Onset 10-15 min after loading dose
- Half-life 2 hours
- Near complete hepatic metabolism
- Less delirium, tachycardia and hypotension than midazolam but greater incidence of bradycardia
Safe positioning in the IR suite
Safe positioning in the IR suite

• Careful attention to safe positioning is important in any IR procedure
• Age, body habitus, post-operative drains and catheters can make safe positioning more challenging
• All members of the IR team are responsible for ensuring patient safety in the IR suite
<table>
<thead>
<tr>
<th>Position</th>
<th>Risks</th>
<th>Safety considerations</th>
</tr>
</thead>
</table>
| Suptile   | Pressure points, including occiput, scapulae, thoracic vertebrae, olecranon process, sacrum/coccyx, calcaneeus, and knees.  
Neural injuries of extremities, including brachial plexus and ulna, and pudendal nerves. | • Padding to heels, elbows, knees, spinal column, and occiput alignment with hips, legs parallel and uncrossed ankles.  
• Arm boards at less than 90-degree angle and level with floor.  
• Head in neutral position.  
• Arm board pads level with table pads. |
| Prone     | Head  
Eyes  
Nose  
Chest compression, iliac crests  
Breasts  
Male genitalia  
Knees  
Feet | • Maintain cervical neck alignment.  
• Protection for forehead, eyes, and chin.  
• Padded headrest to provide airway access.  
• Chest rolls (i.e., clavicle to iliac crest) to allow chest movement and decrease abdominal pressure.  
• Breasts and male genitalia free from tension.  
• Knees padded with pillow to feet.  
• Padded footboard. |
| Lateral   | Bony prominence and pressure points on dependent side  
Spinal alignment  
Hip and knee joint injury  
Lumbar and sacral pressure  
Vascular congestion  
Neuropathy of obturator nerves, saphenous nerves, femoral nerves, common peroneal nerves, and ulnar nerves.  
Restricted diaphragmatic movement  
Pulmonary region | • Axillary role for dependent axilla.  
• Lower leg flexed at hip.  
• Upper leg straight with pillow between legs.  
• Padding between knees, ankles, and feet.  
• Maintain spinal alignment during turning.  
• Padded support to prevent lateral neck flexion.  
• Place stirrups at even height.  
• Elevate and lower legs slowly and simultaneously from stirrups.  
• Maintain minimal external rotation of hips.  
• Pad lateral or posterior knees and ankles to prevent pressure and contact with metal surface.  
• Keep arms away from chest to facilitate respiration.  
• Arms on arm boards at less than 90-degree angle or over abdomen. |
Elderly
After 70 yrs u still address ur wife as Darling, Love, Honey. What's the secret?

Her name slipped from my mind 10 years ago and I'm scared to ask her what it is?
Challenges in the elderly population

- Concomitant illness: CV disease, HTN, respiratory disease, CVA, TIA
- Disability restricting mobility
- Dementia and cognitive dysfunction
- Increased sensitivity to hypovolemia and increased sympathetic tone can lead to hypotension
- Changes in drug metabolism and bioavailability can lead to longer duration of drug action
Treatment Strategies

• Reduce sedation doses on a mg/kg basis
• Limit the use of midazolam
  – Paradoxical effect on elderly
• Protect from pressure and shearing injuries
• Vertebrobasilar insufficiency leading to cerebral ischemia with neck extension
• Obtain a good baseline level of consciousness

Lackamp AN, Sieber FE, Principles and Practice of Geriatric Surgery, 2011, 291-303
Obese patient

Pannus

Head
Sedation challenges in the obese patient

- Increased risk for gastroesophageal reflux
- Increased risk of upper airway obstruction/OSA
- Increased risk of over-sedation
  - Increased risk of respiratory depression
  - Increased oxygen consumption and carbon dioxide production
    - Increased metabolic activity
- Reduced functional residual lung capacity
- Reduced lung compliance
Pathophysiology of OSA

• OSA is characterized by
  – Repetitive intermittent reduction of airflow
  – Associated collapse at the level of the pharynx
  – Ventilatory efforts continue
• Air prevented from entering the lungs
• During these periods hypoxemia is the major stimulus for arousal
  – CO₂ does not rise to a significant level
  – Arterial oxygen partial pressure falls rapidly
Pathophysiology of OSA

• Sedatives and opiate analgesics
  – Depress skeletal muscle tone
  – Relax the upper airway with an increased preponderance for collapse
During normal sleep, the muscles that control the tongue and soft palate hold the airway open.

When these muscles relax, the airway narrows. This can lead to snoring and breathing difficulties.

If the muscles over relax, the airway can collapse and become blocked, obstructing breathing.
Treatment strategies for the obese patient

• Use lean body mass index rather than total body mass index when calculating sedation doses
• Modify supine position whenever possible
• Avoid hyperflexion of head and neck
• Determine if patient has OSA or is at risk
  – STOP-BANG questionnaire
• Position with caution

Martin ML, Lennox PH, 2003 J Vasc Interv Radiol; 14:1119-1128
Relationship of TBW, fat weight, and LBW to BMI in a standard height male.

2010;105:i16-i23
Complicated airways
Airway challenges in IR

- Tumors of the head and neck
- Trismus
- SVC syndrome
- Tracheostomy vs. laryngectomy
Severe airway compromise

- Tumors that compress the trachea
- Mallampati IV
- Severe trismus
- Consider sedation by anesthesia
SVC syndrome

- 90% caused by bronchiogenic cancers
- Characterized by swelling of the face, head and neck and arms
- Development of swollen collateral veins on the chest wall
- May present with SOB, cough, difficulty swallowing, stridor, headache

Sauter A, Triller J, 2008 Cardiovascular and Interventional Radiology, 31:2,144-148
Mediastinal Mass
Sedation challenges SVC syndrome

- Positioning
- Functioning IV access
- Maintaining patent airway
- Minimize need for increased airway pressure
- Arrhythmia (can occur during stent placement)
Treatment strategies

• Avoid over sedating or the need for bag/valve/mask intervention

• If SVC blood flow occluded (acute SVC thrombus) consider femoral IV access or lower extremity peripheral IV until better access available

• Careful monitoring for arrhythmia during treatment
Tracheostomy vs. Laryngectomy

• Tracheostomy is an opening in the neck below the larynx that allows the patient to breathe while the upper airway remains intact.

• Laryngectomy is the removal of the larynx and separation of the airway from the mouth, nose, and esophagus. Results in a permanent stoma.
Treatment strategies

Know if your patient is a tracheostomy patient or a laryngectomy patient !!!!
Surgical removal of the larynx

Pre-operative condition
- Nasal cavity
- Air
- Oral cavity
- Food
- Tongue
- Pharynx
- Larynx
- Vocal cords
- Trachea

Post-operative condition
- Nasal cavity
- Oral cavity
- Food
- Air
- Stoma
- Trachea
Tracheostomy patient

• Get a thorough history from primary RN regarding history of trach, suctioning needs, baseline $O_2$ saturation and $O_2$ maintenance

• If patient currently has uncuffed trach it is preferred to have the team exchange for a cuffed trach for sedation in IR

• Be sure patient comes to the department with emergency equipment including obturator and tube of same size

• Suction catheter (we use red rubber catheter 14-16fr)
Other supplies

- Humidified \( O_2 \) set
- Extra corrugated tubing and connectors
- Trach mask for \( O_2 \) delivery
- Extra trach ties
Trach emergency

• Can attach BVM to trach to ventilate
• If trach is occluded can cover trach and ventilate via upper airway (if intact) until help arrives
Laryngectomy patient in IR

• As with tracheostomy patient obtain a complete history from primary care RN
  – Are there restrictions for placing tie around patient’s neck (i.e. post op free flap)
• Patient to come with #6 cuffed tracheostomy tube at bedside
• Humidified O₂, suction equipment and trach mask
Laryngectomy emergency

- Remember a laryngectomy patient only breathes through the stoma there is no connection to the upper airway structures
- Place cuffed trach into stoma to ventilate
- If cuffed trach unavailable use pediatric size BVM over stoma and ventilate until help arrives
Challenges of the Post Surgical patient

• Post surgical drains and positioning
• Maintenance of wound vac function
• Increased pain levels due to surgical site and positioning
• Concomitant use of multiple pain medications
• High anxiety
Strategies in managing Post Surgical Patients in IR

• Assess patient’s current pain management
  – Continuous PCA
• Be sure patient’s baseline pain is well managed before moving the patient
• Identify location of surgical sites and/or drains
• Be sure wound vac is fully functional
Positioning Post Surgical Patient

- If prone on surgical site, pad around drains and ensure direct pressure is off fresh surgical sites
- Maintain basal rate PCA through procedure if patient is not over sedated
- Administer monitored sedation with caution assessing patient’s respiratory rate frequently
"Your health insurance has limited surgical coverage, but you'd be amazed at what I can do with nail clippers and duct tape."
17 Year Old Female

- With newly diagnosed large anterior mediastinal mass associated with SVC syndrome
- Patient also diagnosed with bilateral pleural effusions, hypertension and tachycardia
- Transferred to MSK with fixed wing air transport, nicardipine infusion and nasal cannula oxygen without complication
17 Year Old Female

• Physical exam the patient:
  – Tachycardic at 130
  – Tachypneic at 36
  – BP 140/80
• Optiflow is 40-45%
• O₂ saturation of 94% in Fowlers position
Procedures

1- Placement of Bilateral Chest Drains
2- Placement of triple lumen catheter
3- Mediastinal Biopsy

Pre-procedure

1- 2mg midazolam
2- 25 mcg fentanyl
Total Exposure for Procedure

- 3.5 mg Midazolam
- 50 mcg Fentanyl

Ultrasound Guided Procedure
1-Drainage of Bilat Pleural Effusions (1100cc R, 750cc L)
2-Placement of bilateral 10 french pigtail catheters confirmed with Fluoroscopy

Fluoroscopic
1-Placement of triple lumen catheter, R femoral
2-Mediastinal Biopsy with CT guidance
64 Year Old Male

- With bilateral renal masses
- Referred to MSK for biopsy and possible ablation
- Genitourinary asymptomatic with previous treatment for urinary obstruction related to the prostate gland
- No acute hematuria, dysuria, or flank pain
- Previous history of renal stone removal procedure 1 week prior to admission
Past Medical History

- Hypertension
- Duodenal Ulcer
- Renal Lithiasis
- Obstructive Sleep Apnea
- Anxiety
- Obesity (363 lbs/165 kg, BMI 49.9)
Procedure

• 1-L Renal Biopsy
  – (1.9 cm lesion L lower pole)

Position

• Prone with arms up

Sedation

• 3 mg Midazolam
• 50 mcg Fentanyl

Endpoint

• 5 mg Midazolam
• 100 mcg Fentanyl
Conclusion

• Procedural sedation in the IR suite can often be a challenging experience
• Many patients come to IR with significant comorbidities and complex medical conditions
• The use of moderate sedation in the more complex patient population can result in profound hemodynamic and hemophysiologic responses
“Whoa! That was a good one! Try it, Hobbs — just poke Donna’s brain right where my finger is.”
<table>
<thead>
<tr>
<th></th>
<th>Minimum Sedation (anxiolysis)</th>
<th>Moderate Sedation “Conscious Sedation”</th>
<th>Deep Sedation</th>
<th>General Anesthesia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Responsiveness</td>
<td>Normal response to verbal stimulation</td>
<td>Purposeful response to verbal/tactile stimulation</td>
<td>Purposeful response to repeated/painful stimuli</td>
<td>Unarousable even to painful stimuli</td>
</tr>
<tr>
<td>Airway</td>
<td>Unaffected</td>
<td>No intervention required</td>
<td>Intervention may be required</td>
<td>Intervention usually required</td>
</tr>
<tr>
<td>Spontaneous Ventilation</td>
<td>Unaffected</td>
<td>Adequate</td>
<td>May be impaired; assistance may be required</td>
<td>Frequently impaired; assistance may be required</td>
</tr>
<tr>
<td>Cardiovascular function</td>
<td>Unaffected</td>
<td>Usually maintained</td>
<td>Usually maintained</td>
<td>May be impaired</td>
</tr>
</tbody>
</table>
Morphine

- Opioid Mu and Kappa receptor agonist (found along nerves in the brain, spinal cord and peripheral sensory neurons)
- Opioids mimic the effect of endogenous endorphins to interrupt pain signals.
- Onset 20 min duration 4-8 hours
- Metabolite morphine 6 glucuronide can accumulate in renal impaired patient leading to prolonged sedation and respiratory depression

(Donnelly et al., (2006). Anesthesiology and Critical Care Handbook (7th e) Hudson, OH; Lexi-Comp.)
STOP BANG Questionnaire

STOP Portion (to be completed by the patient)
1. Snoring: Do you snore loudly (louder than talking or loud enough to be heard through closed doors)?
2. Tired: do you often feel tired, fatigued, or sleepy during daytime?
3. Observed: has anyone observed you stop breathing during your sleep?
4. Blood Pressure: do you have or are you being treated for high blood pressure?
STOP BANG Questionnaire

• BANG Portion (to be completed by PST NP)

5. BMI greater than 35kg/m²?
6. Age over 50 years old?
7. Neck circumference : greater than 40 cm?
8. Gender: Male?
Relationship of TBW, fat weight, and LBW to BMI in a standard height male