



Memorial Sloan Kettering  
Cancer Center

# 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:



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







**Table 3**  
**Commonly Used Drugs for Sedation and Analgesia**

| Drug Class      | Drug          | Effects   | Incremental Dose*  | Onset (min) | Duration (min)                 |
|-----------------|---------------|---|--|-------------|--------------------------------|
| Hypnotics       | Midazolam     | Sedation, anxiolysis, amnesia, motion control, no analgesia | 1.0 mg   | 2           | 45-60                          |
|                 | Diazepam      | Sedation, anxiolysis  | 1.0-2.0 mg   | 2-3         | 6 h                            |
|                 | Propofol      | Anesthetic, sedation  | 25-75 $\mu\text{g}/\text{kg}/\text{min}$ infusion                                | 60 s        | 3-5                            |
|                 | Ketamine      | Analgesia, dissociation, amnesia, motion control            | 5-10 mg, repeat every 10 min with $\frac{1}{2}$ dose                             | 1-2         | Dissociation: 15, recovery: 60 |
| Analgesics      | Fentanyl      | Analgesia   | 25 $\mu\text{g}/\text{dose}$ , repeat every 3 min to desired effect              | 2-3         | 30-60                          |
|                 | Sufentanil    | Analgesia   | 2 $\mu\text{g}/\text{dose}$  | 2-3         | 15                             |
|                 | Remifentanyl  | Analgesia   | 0.1-0.2 $\mu\text{g}/\text{kg}/\text{min}$                                       | 3-5         | 5-7                            |
|                 | Morphine      | Analgesia   | 2 mg/dose  | 3-10        | 3-4 h                          |
| Miscellaneous   | Nitrous oxide | Anxiolysis, analgesia, sedation, amnesia                    | Preset mixture, self-administered  | 1-2         | <5 min after discontinuation   |
| Reversal agents | Naloxone      | Opioid reversal   | 40 $\mu\text{g}/\text{dose}$ , repeat every 2 min as required to maximum of 2 mg | 2           | 20-40                          |
|                 | Flumazenil    | Benzodiazepine antagonist                                   | 200 $\mu\text{g}/\text{dose}$ , repeat every 1 min to maximum of 1 mg            | 1-2         | 30-60                          |

\* 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<sup>®</sup> 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 1**

**INJURY RISKS AND SAFETY CONSIDERATIONS WHEN POSITIONING PATIENTS**

| Position  | Risks  | Safety considerations   |
|-----------|--|---|
| Supine    | Pressure points, including occiput, scapulae, thoracic vertebrae, olecranon process, sacrum/coccyx, calcaneae, and knees.<br><br>Neural injuries of extremities, including brachial plexus and ulna, and pudendal nerves.                                      | <ul style="list-style-type: none"> <li>• Padding to heels, elbows, knees, spinal column, and occiput alignment with hips, legs parallel and uncrossed ankles.</li> <li>• Arm boards at less than 90-degree angle and level with floor.</li> <li>• Head in neutral position.</li> <li>• Arm board pads level with table pads.</li> </ul>   |
| Prone     | Head<br>Eyes<br>Nose<br><br>Chest compression, iliac crests<br><br>Breasts<br>Male genitalia<br><br>Knees<br><br>Feet  | <ul style="list-style-type: none"> <li>• Maintain cervical neck alignment.</li> <li>• Protection for forehead, eyes, and chin.</li> <li>• Padded headrest to provide airway access.</li> <li>• Chest rolls (ie, clavicle to iliac crest) to allow chest movement and decrease abdominal pressure.</li> <li>• Breasts and male genitalia free from torsion.</li> <li>• Knees padded with pillow to feet.</li> <li>• Padded footboard.</li> </ul>                           |
| Lateral   | Bony prominence and pressure points on dependent side<br><br><br><br>Spinal alignment  | <ul style="list-style-type: none"> <li>• Axillary roll for dependent axilla.</li> <li>• Lower leg flexed at hip.</li> <li>• Upper leg straight with pillow between legs.</li> <li>• Padding between knees, ankles, and feet.</li> <li>• Maintain spinal alignment during turning.</li> <li>• Padded support to prevent lateral neck flexion.</li> </ul>   |
| Lithotomy | Hip and knee joint injury<br>Lumbar and sacral pressure<br>Vascular congestion<br><br>Neuropathy of obturator nerves, saphenous nerves, femoral nerves, common peroneal nerves, and ulnar nerves.<br><br>Restricted diaphragmatic movement<br>Pulmonary region | <ul style="list-style-type: none"> <li>• Place stirrups at even height.</li> <li>• Elevate and lower legs slowly and simultaneously from stirrups.</li> <li>• Maintain minimal external rotation of hips.</li> <li>• Pad lateral or posterior knees and ankles to prevent pressure and contact with metal surface.</li> <li>• Keep arms away from chest to facilitate respiration.</li> <li>• Arms on arm boards at less than 90-degree angle or over abdomen.</li> </ul> |



# 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



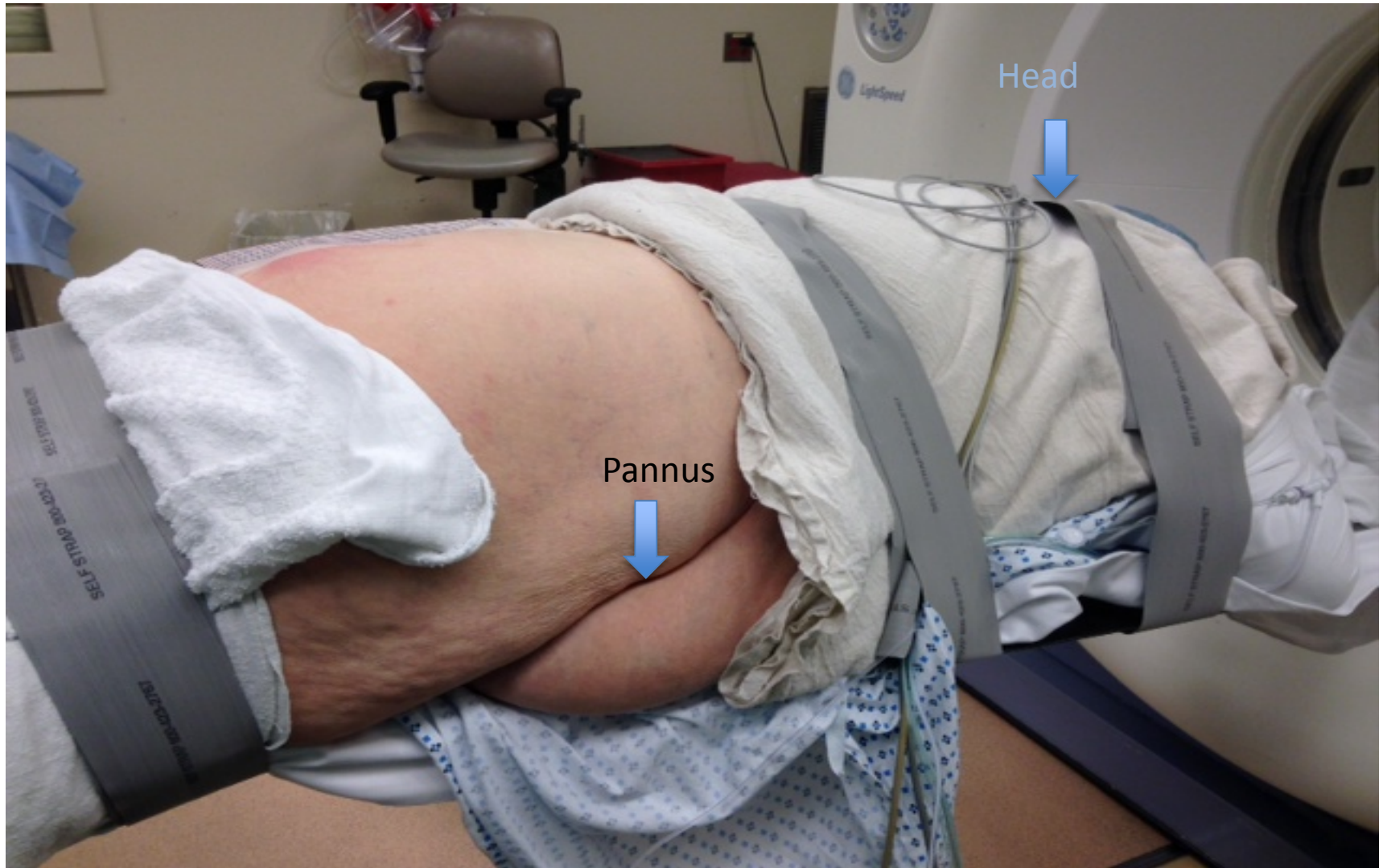
# Treatment Strategies

- 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





# Obese patient



# 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
  - $\text{CO}_2$  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



## Normal



During normal sleep, the muscles that control the tongue and soft palate hold the airway open.

## Snoring



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

## OSA



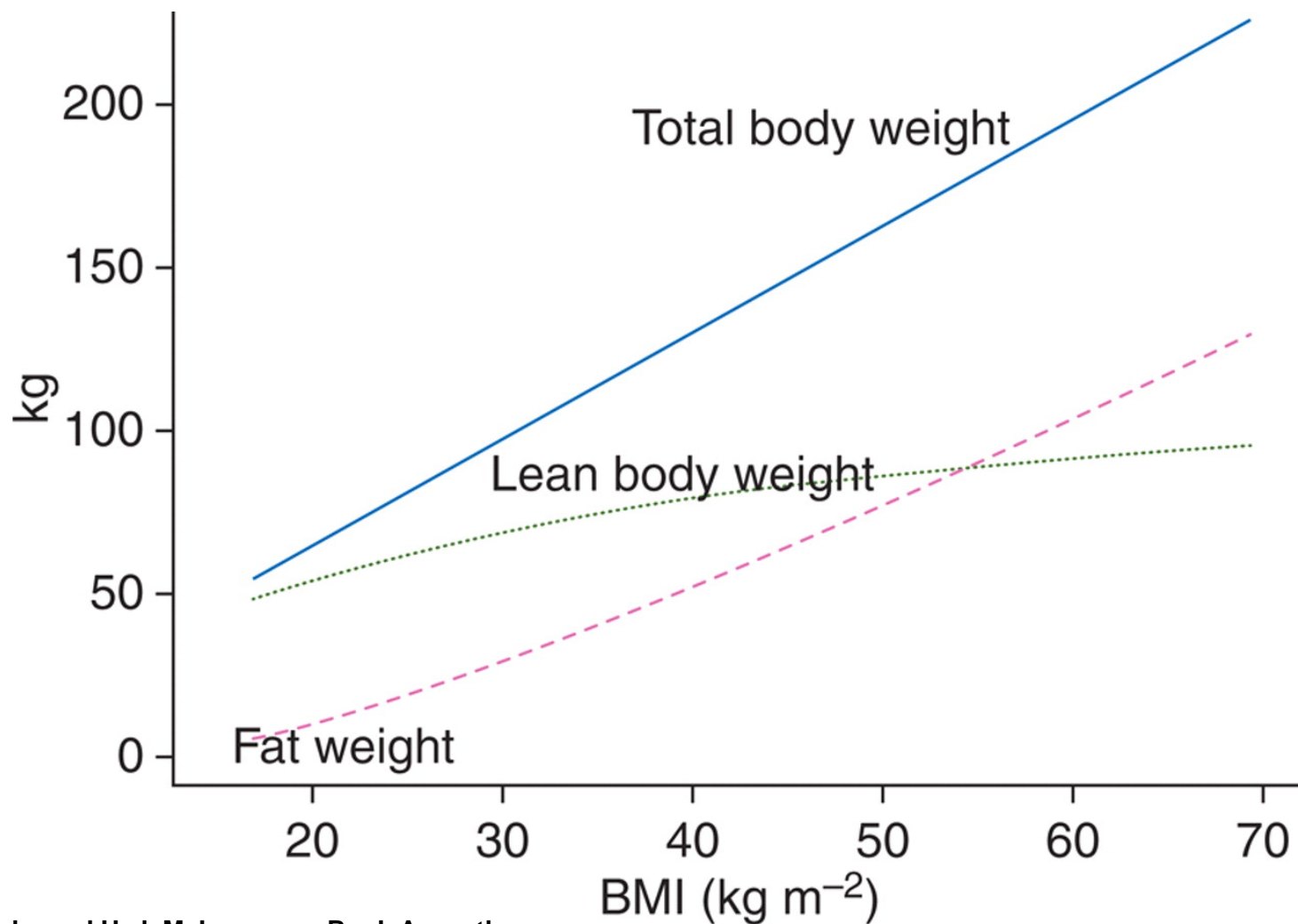
If the muscles over relax, the airway can collapse and become blocked, obstructing breathing.

# 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



## Relationship of TBW, fat weight, and LBW to BMI in a standard height male.



J. Ingrande, and H. J. M. Lemmens Br. J. Anaesth.

2010;105:i16-i23



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BJA British Journal of Anaesthesia



# Complicated airways



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# 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

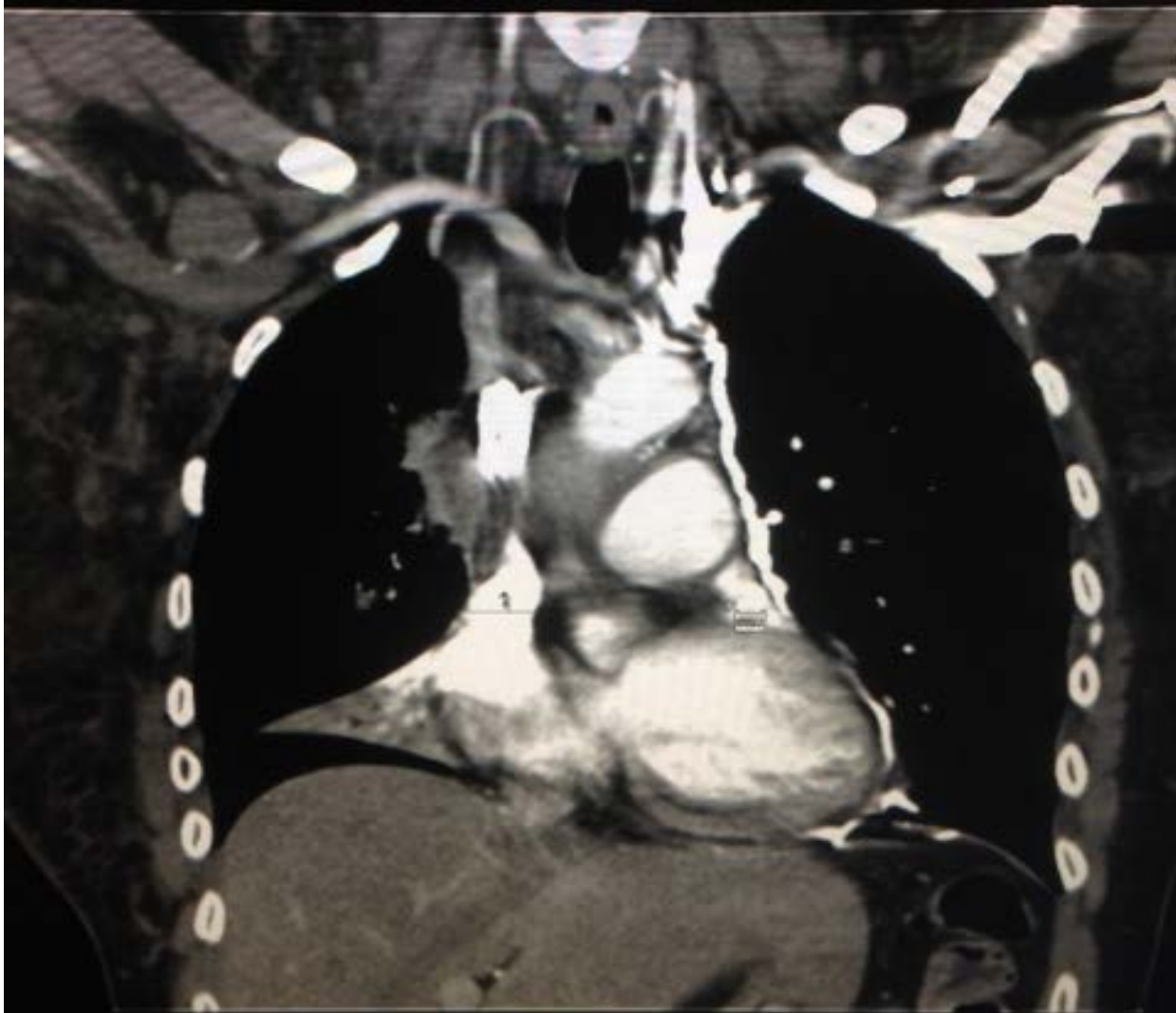


# SVC syndrome

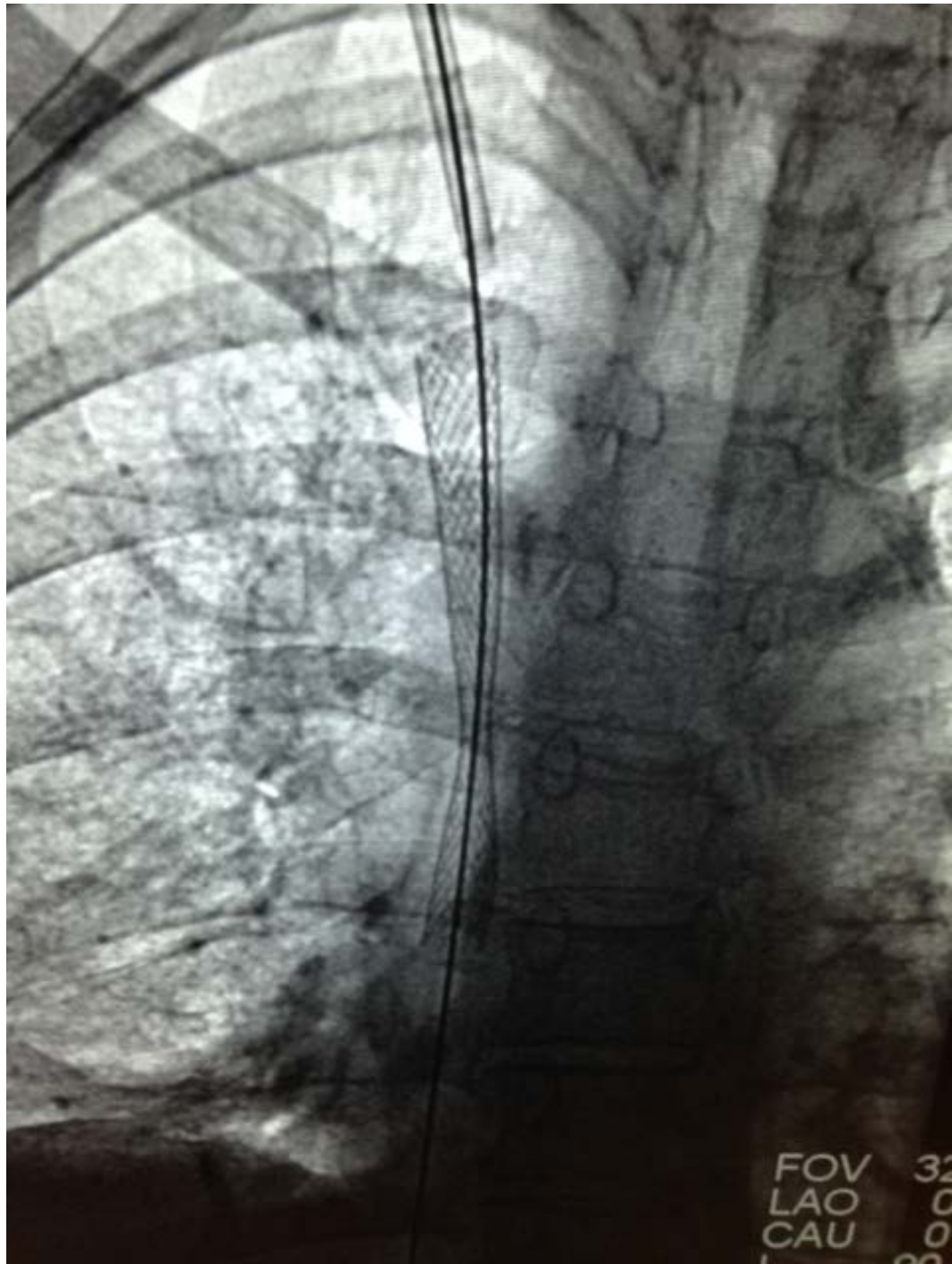
- 90% caused by bronchiogenic cancers
- Characterized by swelling of the face, head and neck and arms
- Development of swollen collateral veins on the chest wall
- May present with SOB, cough, difficulty swallowing, stridor, headache



# Mediastinal Mass







FOV 32  
LAO 0  
CAU 0  
1 00

# 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

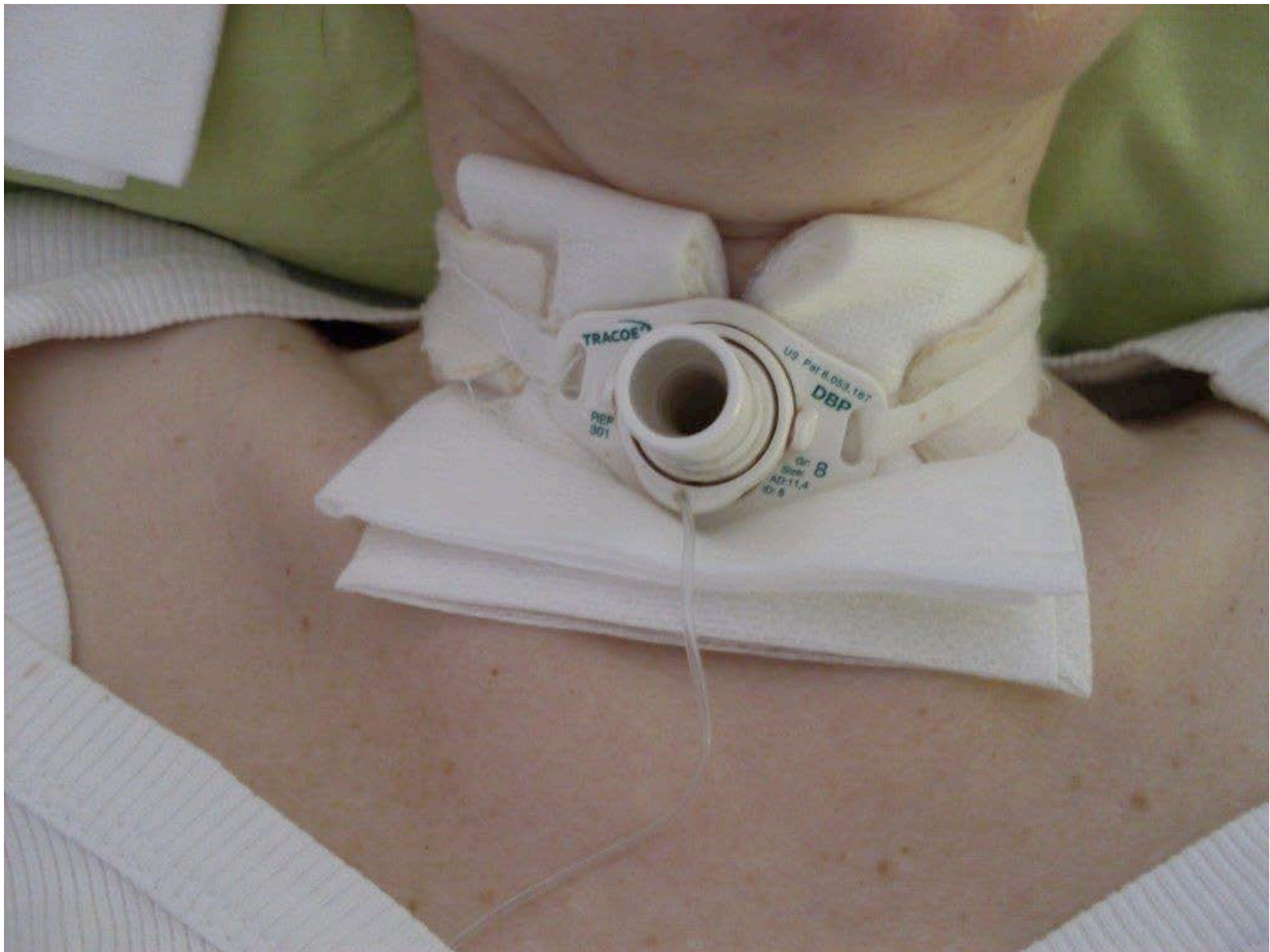




# Tracheostomy vs. Laryngectomy

- 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

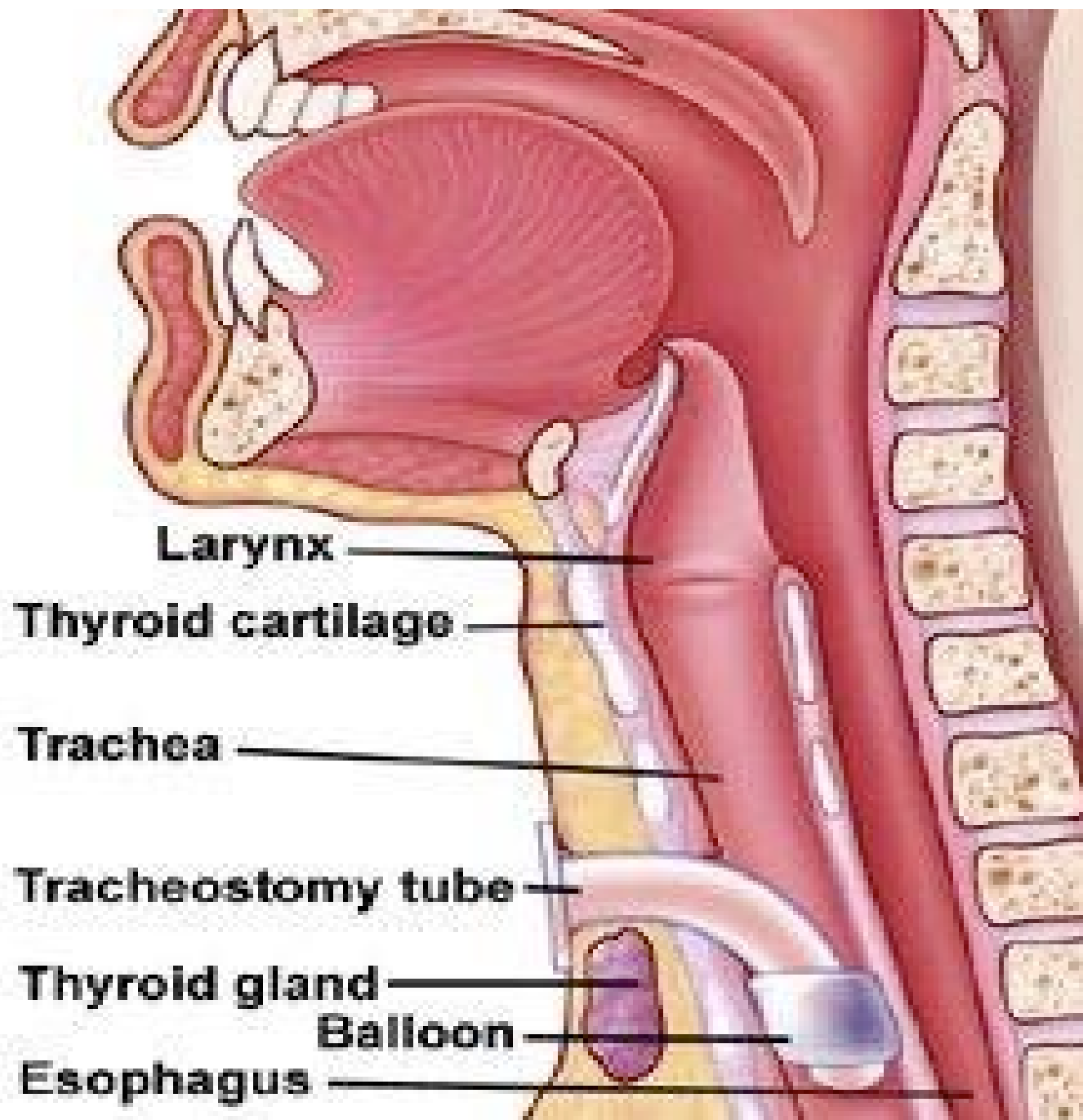




# Treatment strategies

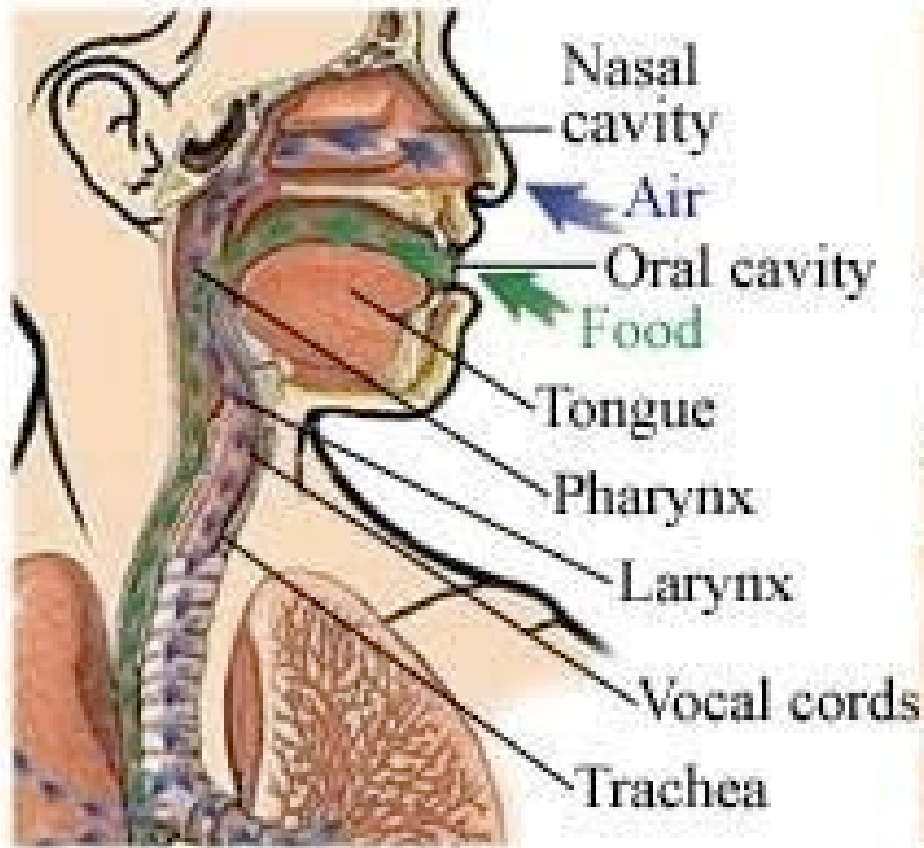
Know if your patient is a tracheostomy patient or a laryngectomy patient !!!!



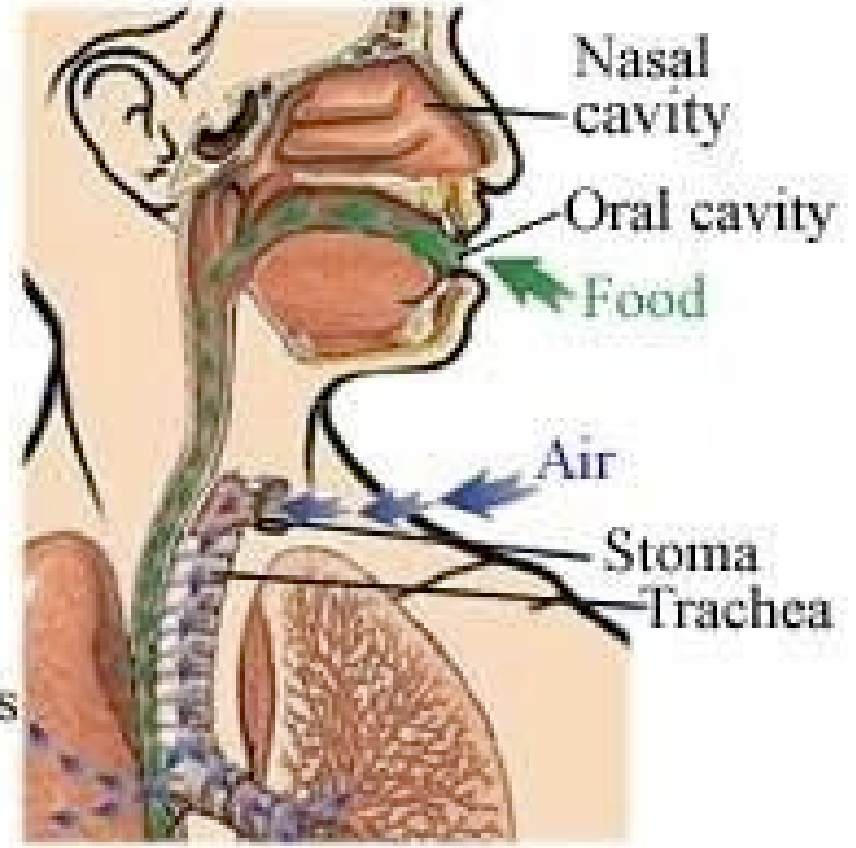


## Surgical removal of the larynx

Pre-operative condition



Post-operative condition



# Tracheostomy patient

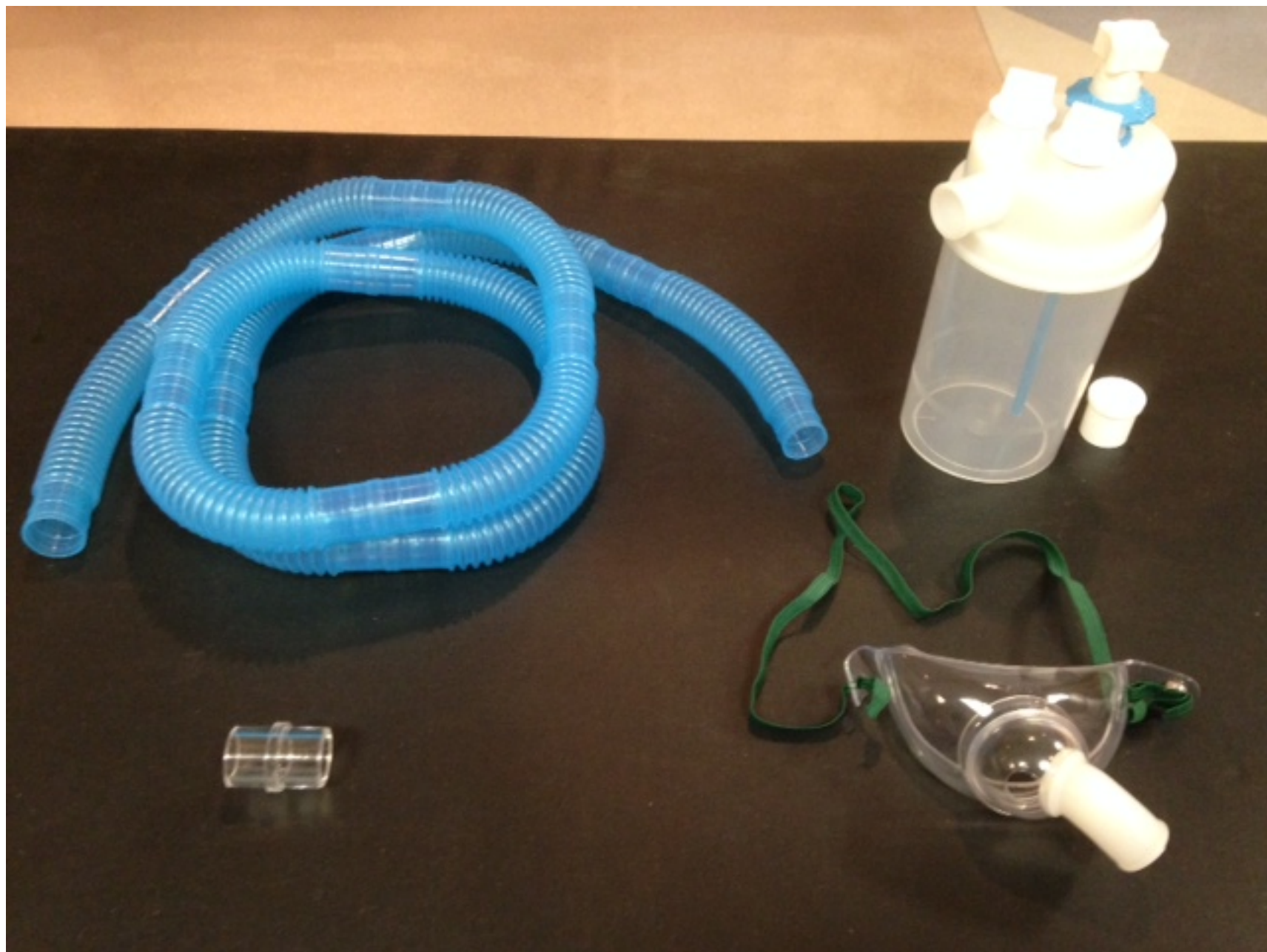
- Get a thorough history from primary RN regarding history of trach, suctioning needs, baseline  $O_2$  saturation and  $O_2$  maintenance
- If patient currently has uncuffed trach it is preferred to have the team exchange for a cuffed trach for sedation in IR
- Be sure patient comes to the department with emergency equipment including obturator and tube of same size
- Suction catheter (we use red rubber catheter 14-16fr)



# Other supplies

- Humidified O<sub>2</sub> set
- Extra corrugated tubing and connectors
- Trach mask for O<sub>2</sub> 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 O<sub>2</sub>, 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





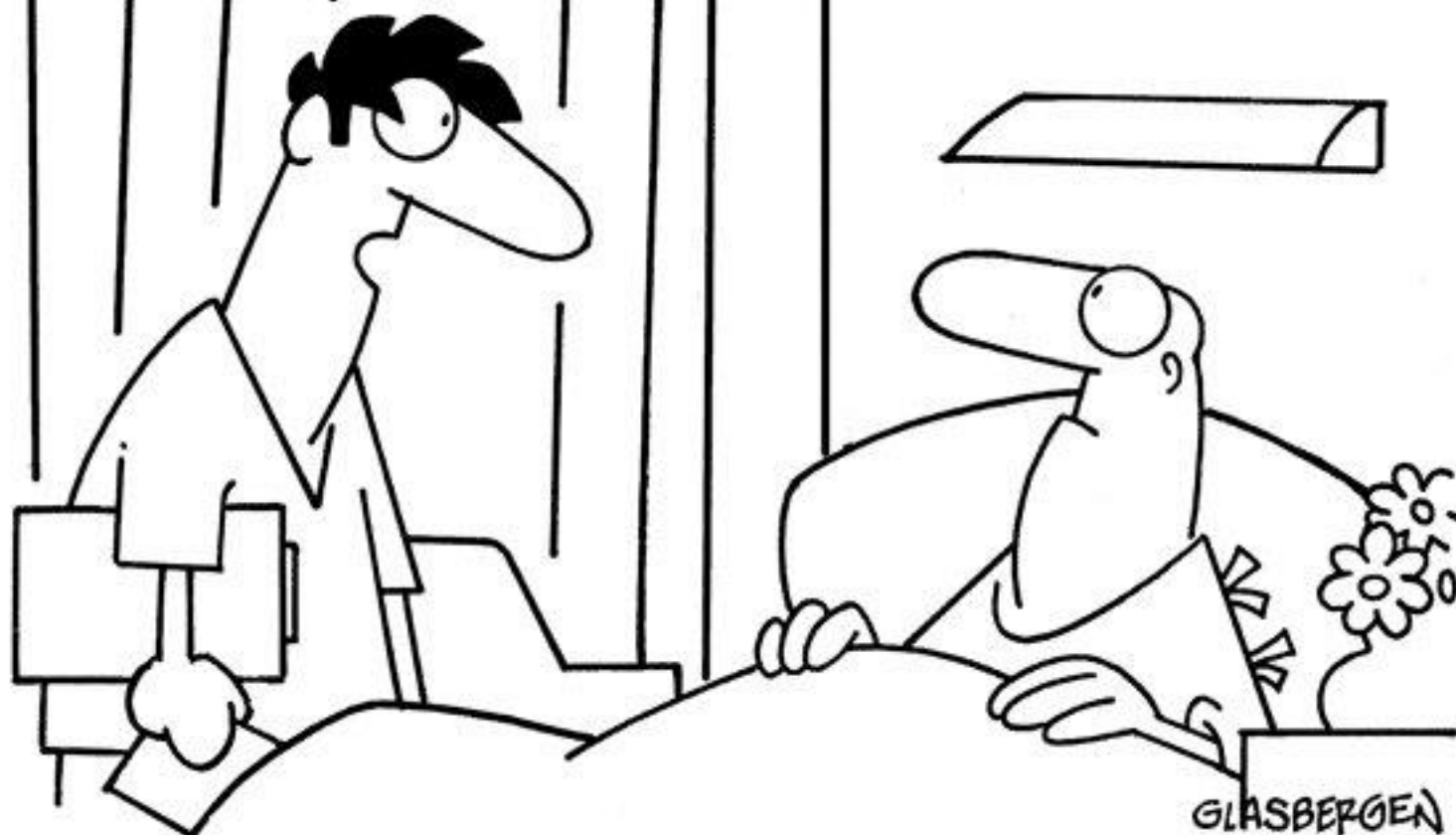




# Positioning Post Surgical Patient

- 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

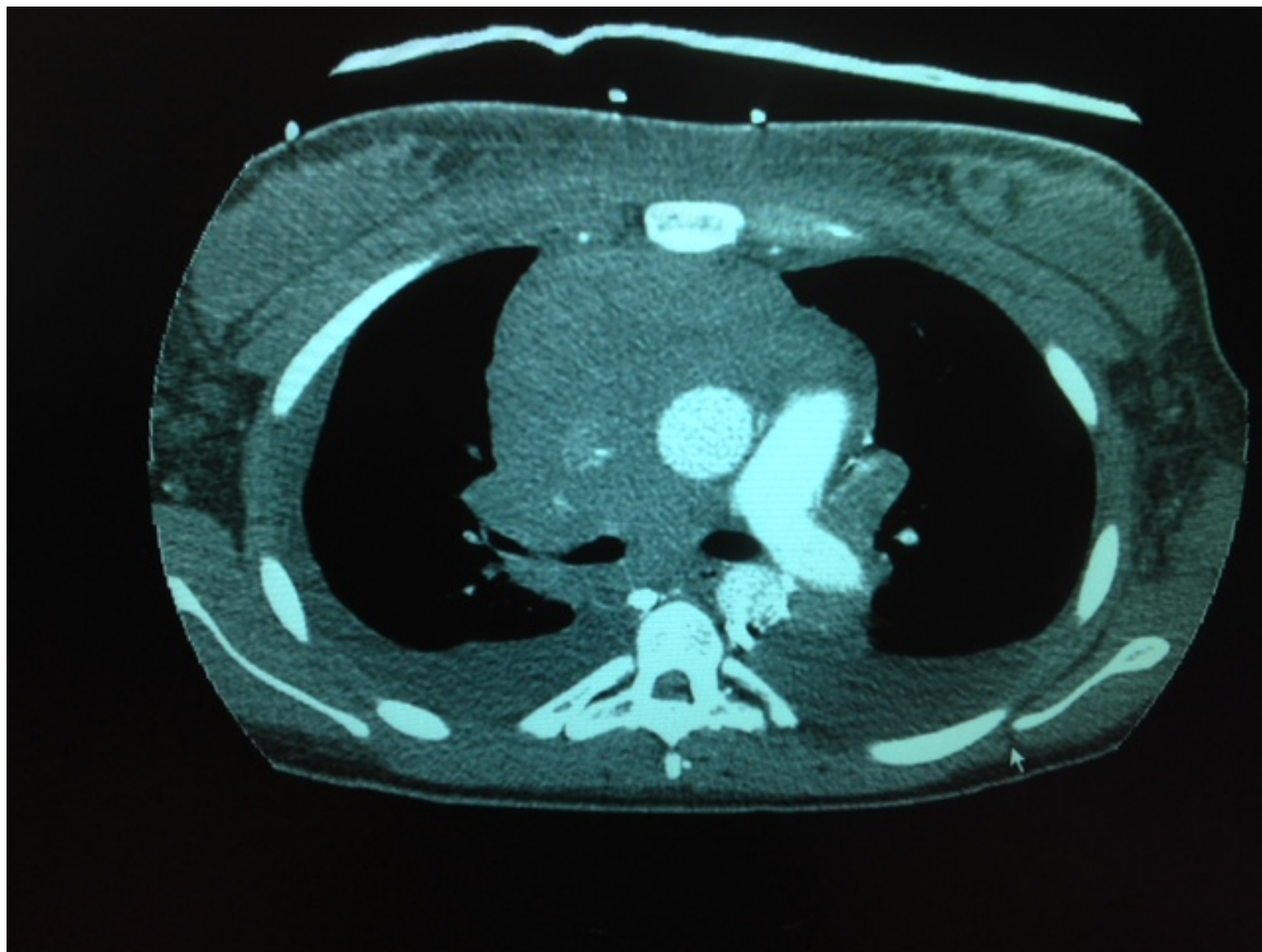


# 17 Year Old Female

- Physical exam the patient:
  - Tachycardic at 130
  - Tachypneic at 36
  - BP 140/80
- Optiflow is 40-45%
- O<sub>2</sub> 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

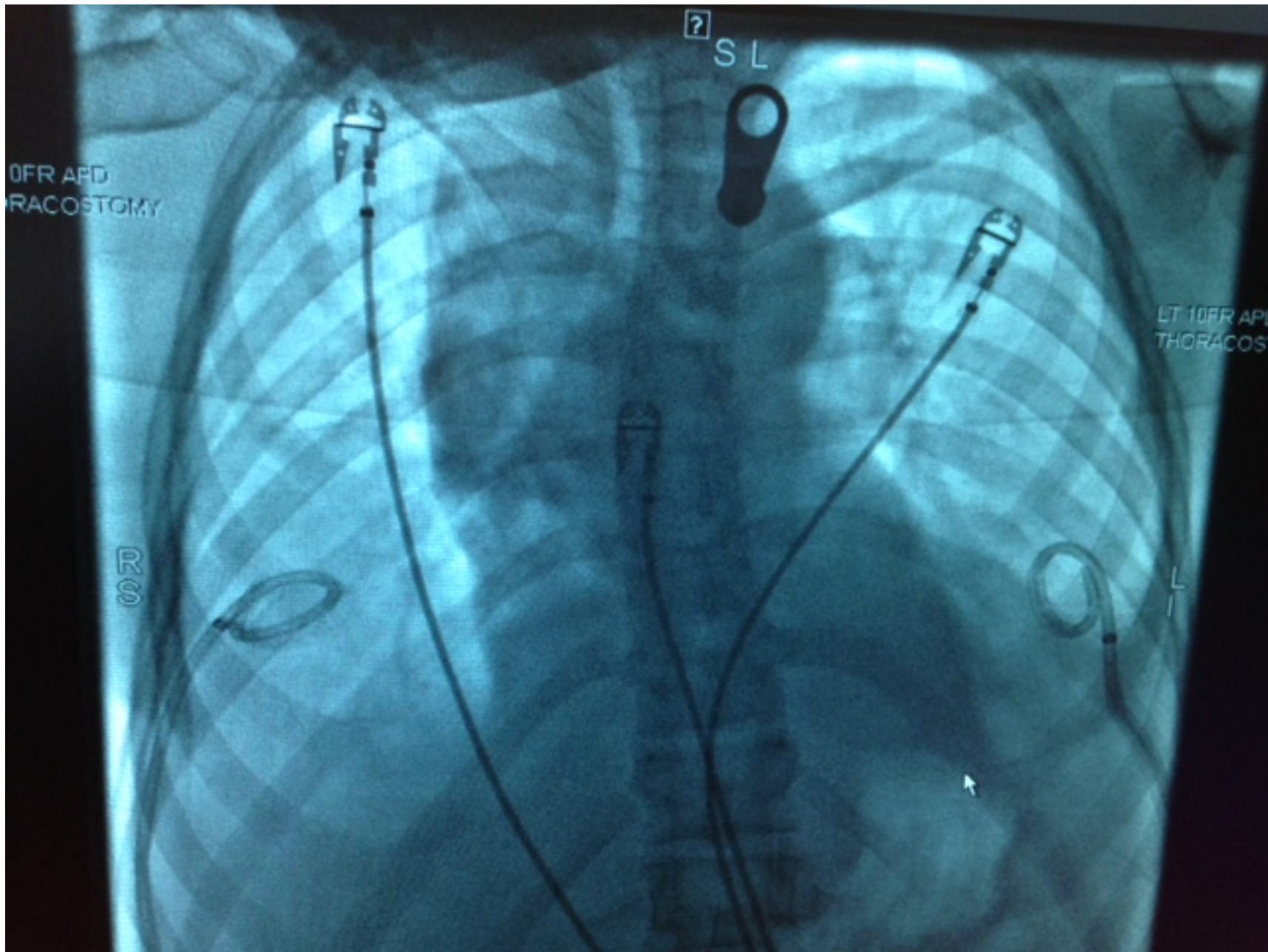
## Ultrasound Guided Procedure

- 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

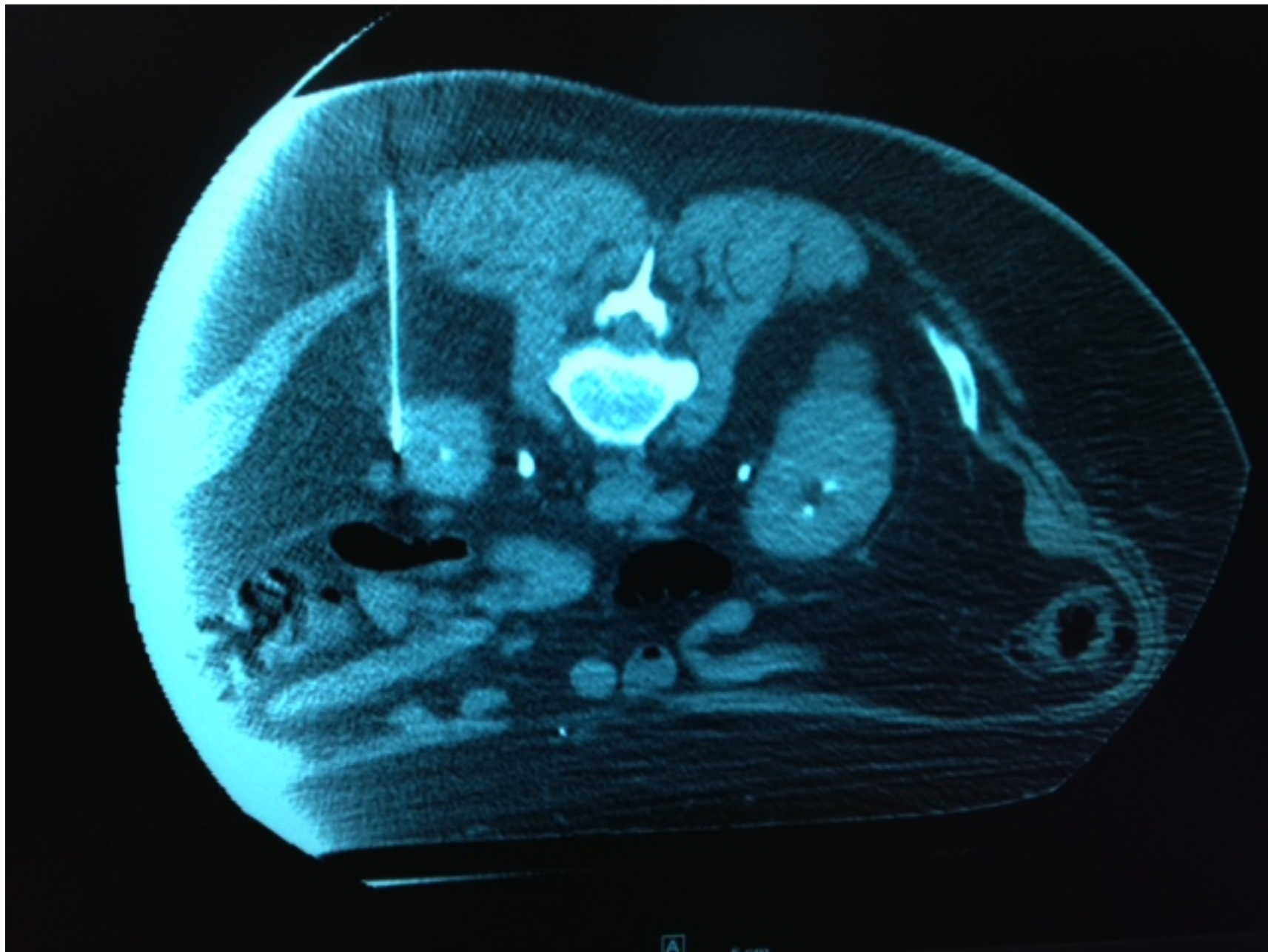
## Endpoint

- 5 mg Midazolam
- 100 mcg Fentanyl











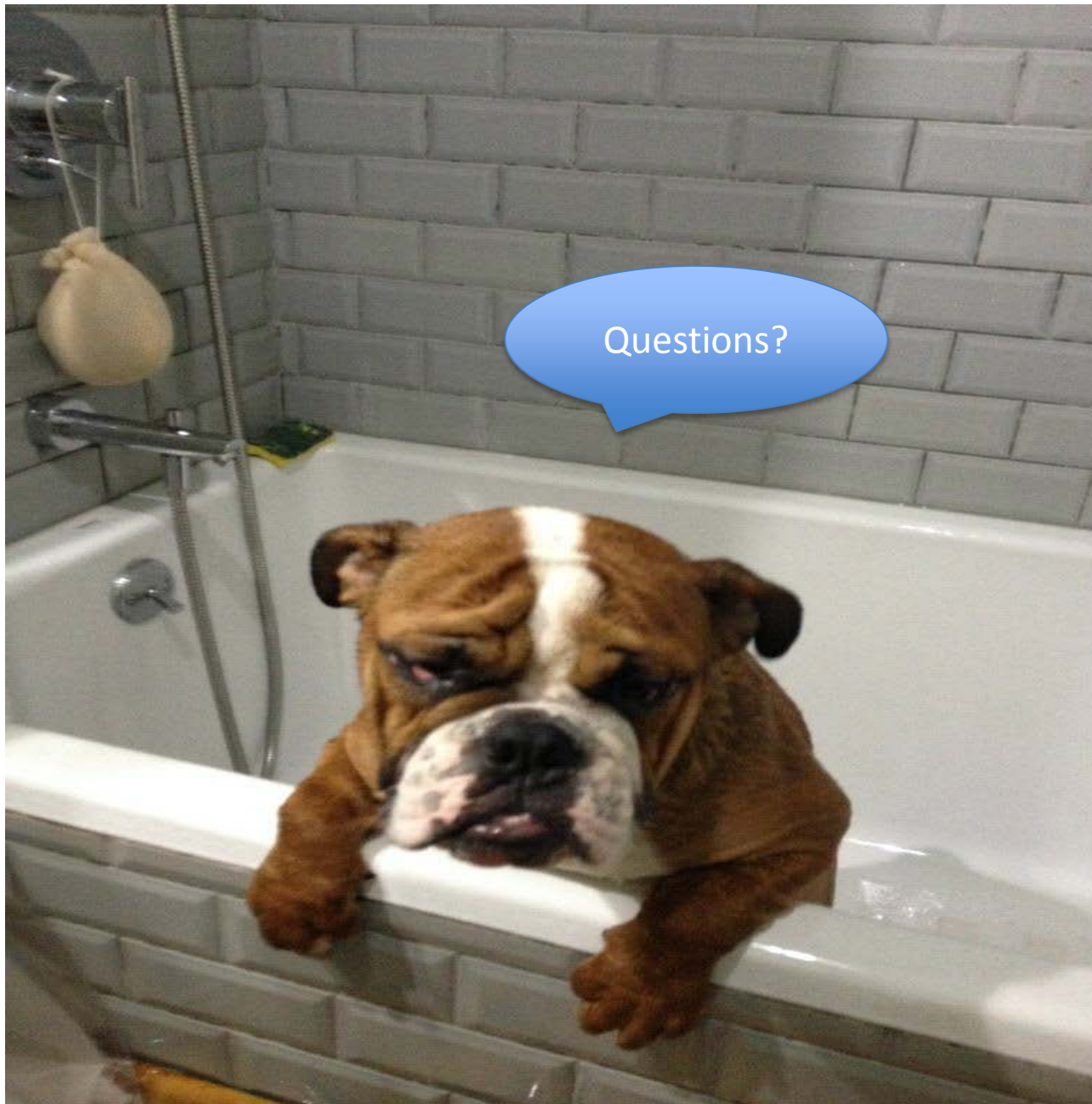
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# Conclusion

- 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







**"Whoo! That was a good one! Try it, Hobbs — just poke Donna's brain right where my finger is."**

| Table 1<br>Definitions and Characteristics of Levels of Sedation / Analgesia |                                       |   |   |   |
|--|---------------------------------------|---|---|---|
|  | Minimum Sedation (anxiolysis)         | Moderate Sedation “Conscious Sedation”            | Deep Sedation                                   | General Anesthesia                              |
| <b>Responsiveness</b>  | Normal response to verbal stimulation | Purposeful response to verbal/tactile stimulation | Purposeful response to repeated/painful stimuli | Unarousable even to painful stimuli             |
| <b>Airway</b>  | Unaffected                            | No intervention required                          | Intervention may be required                    | Intervention usually required                   |
| <b>Spontaneous Ventilation</b>   | Unaffected                            | Adequate  | May be impaired; assistance may be required     | Frequently impaired; assistance may be required |
| <b>Cardiovascular function</b>   | Unaffected                            | Usually maintained                                | Usually maintained                              | May be impaired                                 |

# 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



# 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/m<sup>2</sup>?
  - 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

