



Pediatric Moderate Sedation

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Pediatric Moderate Sedation



- *Why are you here?*

To fulfill the didactic requirement of the UMMC policy governing privileges for moderate sedation in pediatric patients

- *Why am I here?*

To educate you about sedation in infants and children,

without putting ***you*** to sleep for the next hour!

Pediatric Moderate Sedation



- UMMC policy
- Pre-procedure planning
- Conduct of pediatric sedation
- Pharmacology of sedative agents
- Patient safety & outcomes
- What's ahead for the future
- Case Studies

Pediatric Moderate Sedation



- **Who are the interested parties involved in credentialing pediatric moderate sedation?**
 - Regulatory bodies
 - JCAHO
 - Maryland State Board of Nursing
 - Institutional policy
 - UMMC
 - Academic framework
 - American Society of Anesthesiologists
 - American Academy of Pediatrics

Pediatric Moderate Sedation



- **What is expected from the credentialing process for moderate sedation privileges?**
 - Leadership from anesthesiologists
 - Uniform processes / consistent standards of care, *regardless of:*
 - Patient age
 - Procedure
 - Location
 - Provider
 - Effective & reliable system of rescue
 - Institutional sedation safety and efficacy

UMMC Moderate Sedation Policy



- Key definitions:
 - **Moderate Sedation**
 - **Licensed Independent Practitioner (LIP)**
- Core competencies
 - **fund of specialized knowledge**
 - **clinical / experiential components**
- Procedural requirements
 - **assessment, administration of medications, monitoring, recovery, & discharge**

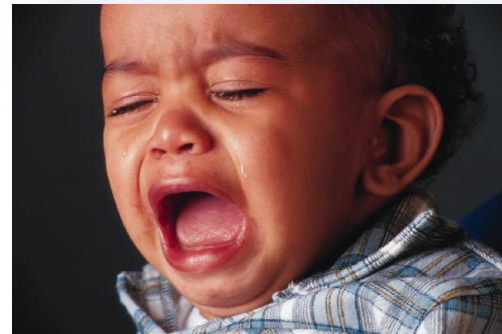
What is Moderate Sedation?

- Medically controlled state of depressed consciousness
- Protective airway reflexes are intact
- Airway patency & spontaneous ventilation are independently & continuously maintained
- Purposeful responses to physical stimulation are preserved

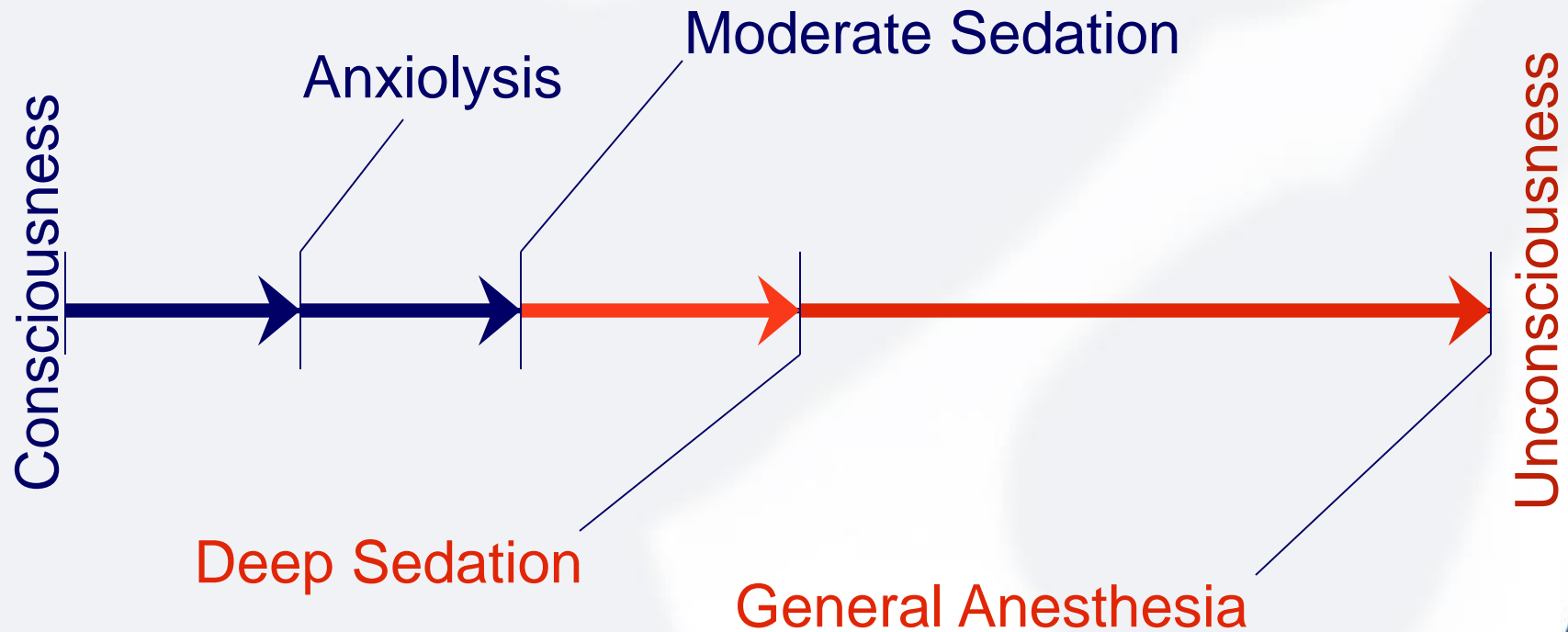


What is Moderate Sedation?

- Reduction of fear, anxiety, & stress
- Provision of comfort, safety, and a sense of well-being
- Induction of drowsiness or sleep
- Alteration of memory or amnesia
- Provision of pain control



Sedation occurs as a Continuum



Pediatric Moderate Sedation



- **We're not far and already we've encountered a sticky problem!!**
 - Practically speaking, much pediatric sedation *pushes* the envelop
 - Pediatric patients are often closer to a state of “*deep*” sedation than consciousness

Pediatric Moderate Sedation



Who is considered a Licensed Independent Practitioner (LIP)?

“Any individual permitted by law and the organization to provide care, treatment, and services, without direction or supervision, within the scope of the individual’s license and consistent with individually granted clinical privileges”

Pediatric Moderate Sedation



Who is considered a Licensed Independent Practitioner (LIP)?

- Attending physicians
- Nurse practitioners (CRNP's)
- Nurse anesthetists (CRNA's)
- Physician assistants (PA's)
- Resident physicians & fellows *after* successful completion of didactic and experiential training, including performance of 5 supervised sedations

Is 5 enough ?

What is expected of the LIP vis-à-vis credentialing?



- Attend an educational seminar devoted to moderate sedation ***every 2 years***
- Establish & maintain competency in basic airway management & resuscitation (PALS /BLS)
- Successfully perform 5 cases with supervision then *maintain* on-going clinical competency
- Supervise resident physicians and fellows until they achieve independent credentialing

What is expected of the LIP vis-à-vis procedural sedation?



- During the administration of sedatives:
 - be physically present with the patient
 - supervise the nurse or other trainee who is administering medications & monitoring the patient
- During the recovery phase of sedation:
 - be immediately available on the unit

What is expected of the LIP vis-à-vis procedural sedation?



- You must remain “immediately available”, that is you cannot leave or be engaged in any other un-interruptible activity or task
- You must know how to
 - Rescue from over-sedation
 - support the airway with BVM ventilation
 - stabilize hemodynamics
 - Summon the emergency response team
#8-2911 – “Pediatric Arrest”

Documentation Responsibilities



- Informed consent for sedation
- History and Physical completed in chart
- Pre-sedation assessment
- Universal protocol / “time-out”
- Medication orders signed
- “special procedures” note complete
- Verify recovery/discharge criteria met
- Officially discharge patient from moderate sedation

Nuts & Bolts!



- Goals:

- Safety
- Comfort
- Efficacy
- Efficiency

- Tools:

- Knowledge
- Practical skills
- Organization
- Self sufficiency
- Flexibility
- Resourcefulness

Preliminary Planning



Pre-procedure checklist of the 4 “P” s:

1. Patient
2. Procedure
3. Personnel
4. Pharmacology

Patient Considerations



Patient Considerations



- Co-morbidities?
 - Prematurity – PCA
 - OSA / Enlarged T&A / Malacias
 - O2 needs / Asthma
 - Trouble swallowing / GERD
 - Current URI / cough / fevers
 - Cardiac issues / CHD / HTN
 - Hyperactivity disorder / Autism

Patient Considerations



- Current Medications?
- Drug allergies?
- Results of diagnostic tests / labs?
- LMP? pregnant?
- Prior response to sedatives or anesthetic agents?

Patient Considerations

- Chronologic / developmental age
- Baseline level of responsiveness
- Baseline Vital Signs
- Anxiety / cooperativeness
- Focused physical exam
- Risk for loss of protective reflexes, airway obstruction, cardio-pulmonary or neurologic decompensation
- **Airway evaluation**



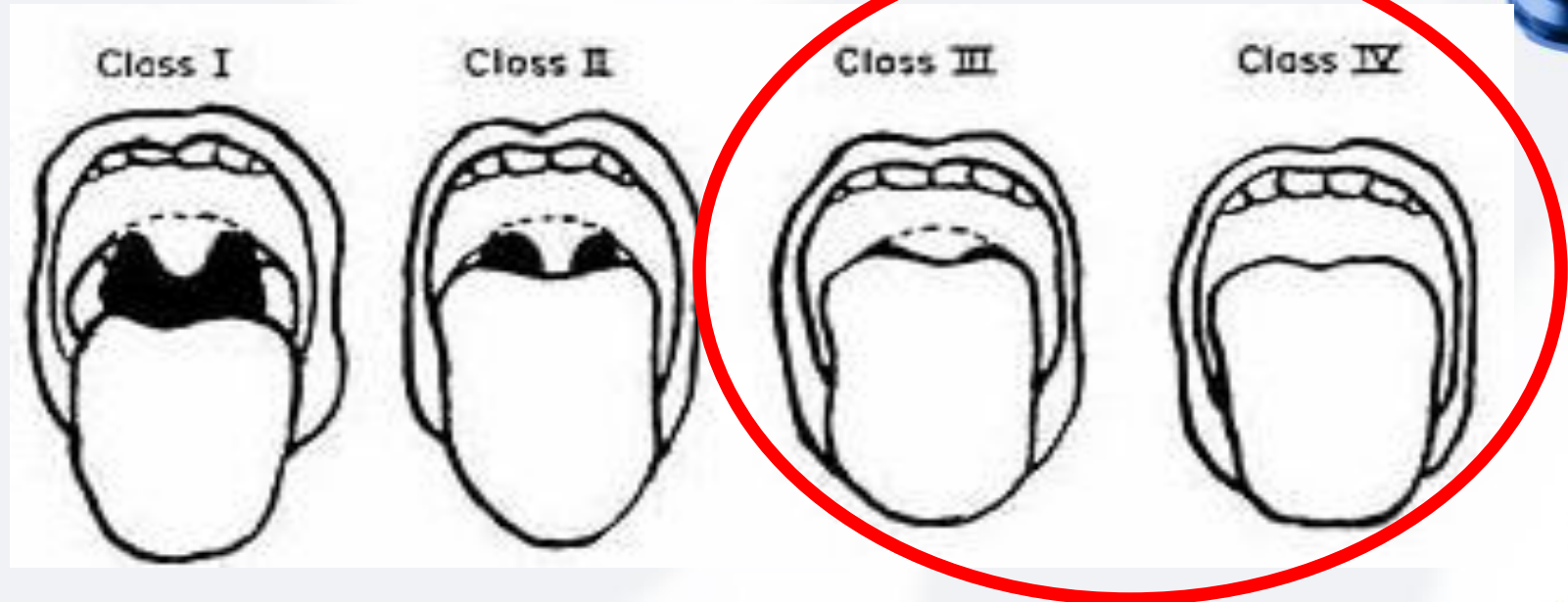
Patient Considerations:

What's crucial in the airway evaluation?

- known difficulty
- mouth opening
- nares patent
- tongue size and mobility
- neck mobility, especially in extension
- recessed chin or micrognathia
- cranio-facial anomalies
- airway malacias
- adeno-tonsillar hypertrophy
- obesity
- OSA



Mallampati Airway Assessment



- Mallampati airway classification predicts high risk or difficult airways (Class III or IV warrant consultation with an anesthesiologist)

ASA Physical Status Classification System



- **PS 1** - normal healthy patient
 - **PS 2** - patient with mild systemic disease, no functional limits
 - **PS 3** - patient with severe systemic disease, some functional limits
 - **PS 4** - patient with severe systemic disease that is a constant threat to life
 - **PS 5** - patient not expected to survive for 24 hours with or without the procedure
-
- These definitions appear in each annual edition of the ASA Relative Value Guide.® There is no additional information that will help you further define these categories.

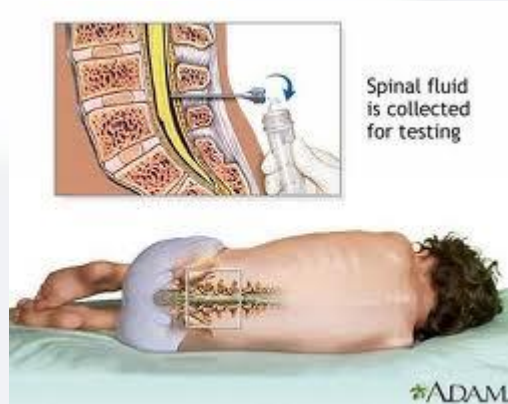
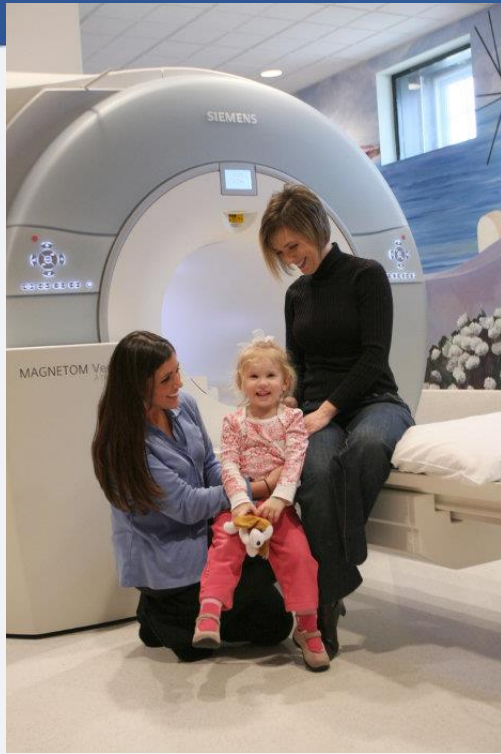
Patient Considerations



- Fasting / “NPO” guidelines:
 - 2 hrs: clear liquids
 - 4 hrs: breast milk for infants < 6 mos
 - 6 hrs: non-human milk or formula
 - 6 hrs: light meal (ex: dry cereal + clears)
 - 8 hrs: all other solids, gum, & candy

No Deviations!

Procedure Related Considerations



Procedure Related Considerations



First, determine your needs:

Sedation?

Analgesia?

Anxiolysis?

Immobility?

Amnesia?

ALL of these?

Procedure Related Considerations

- Many locations are very user-unfriendly for the patient and the sedation giver
- Procedure rooms are usually built to optimize imaging quality, and are often **not** constructed for the needs of a sedated or anesthetized patient



Procedure Related Considerations

- Be prepared for:
 - Fixed obstacles / restricted space
 - Limited, poorly lit access to the patient
 - Cold, cramped & noisy conditions
 - Few power supplies for extra equipment
 - Safety issues (radiation, magnetic field)
 - No piped gases (O_2) or scavenging



Procedure Related Considerations



- Where is it to be performed?
- Transport issues?
- Expected duration? Short or lengthy?
- Invasive or non-invasive?
- Level of stimulation?
- Painful?

Procedure Related Considerations



- Patient positioning?
- Access to the patient?
- Potential complications?
 - respiratory decompensation
 - positioning injuries
 - pain
 - bleeding
 - nausea/vomiting

Procedure Related Considerations

- Radiation safety (patient & personnel)
- Equipment compatibility (esp. in MRI)
- Scheduling constraints
 - Early enough to allow for a comfortable fasting interval & adequate time for recovery & discharge!
- Location & expected length of recovery



Essential equipment for sedation

- Goal is self-sufficiency in an emergency !



Essential equipment for sedation



- **Suction** apparatus & catheters
- Wall-source &/or portable **oxygen** cylinders
- **Positive-pressure delivery system**
 - (proper sized bag-valve mask , AMBU)
- **Airways**: masks, oral & nasal airways
- **Endotracheal intubation equipment**

Essential equipment for sedation



- **Intravenous access supplies**
- **Resuscitation drugs:**
 - “code” drugs
 - reversal agents (flumazenil & naloxone)
- **Defibrillator**
- **Portable monitor / video monitor**

Monitoring the sedated patient



Continuously monitored parameters

- Adequacy of ventilation / oxygenation
- Hemodynamic stability
- Level of consciousness / responsiveness

Monitoring the sedated patient



Adequacy of ventilation / oxygenation

- airway patency
- rate, depth, & pattern of ventilation
- oxygen saturation / pulse oximetry
- capnography / end-tidal CO₂

Monitoring the sedated patient



- Recognizing airway obstruction:

- Snoring
- Retractions
- Laryngospasm
- Scary silence or Deadly Quiet!
- Absent or ↓ CO₂

- Relieving airway obstruction:

- “Sniffing” position
- Shoulder roll
- Prop mouth open
- Jaw lift
- Nasal airway
- CPAP



Monitoring the sedated patient



Hemodynamic stability:

- heart rate
- non-invasive blood pressure
- electrocardiography (EKG)

Monitoring the sedated patient



Level of consciousness

- responds to verbal command?
- responds to tactile stimulus?
- protective reflexes intact?
- pain assessment (as appropriate)

Caveat: reflex withdrawal to pain is ***not*** considered a purposeful response!

Richmond Agitation and Sedation Scale (RASS)



Score	Term	Description
+4	Combative	Overly combative, violent, immediate danger
+3	Very Agitated	Pulls or removes tubes or catheters aggressive
+2	Agitated	Frequent non-purposeful movement
+1	Restless	Anxious but movements not aggressive
0	Alert and Calm	
-1	Drowsy	Not fully alert, but has sustained awakening (eye-opening/eye contact) to <i>voice (>10seconds)</i>
-2	Light sedation	Briefly awakens with eye contact to <i>voice (<10 seconds)</i>
-3	Moderate sedation	Movement or eye opening to <i>voice (but no eye contact)</i>
-4	Deep sedation	No response to voice, but movement or eye opening to <i>physical</i> stimulaton
-5	Unarousable	No response to <i>voice or physical</i> stimulation

Monitoring the sedated patient



Monitoring & Documentation of vital signs

- **Initially** to establish baseline
- Every **5 minutes** during time of induction and throughout procedure
- Every **15 minutes** after procedure and through recovery phase and discharge criteria are met

Vigilant observation is essential for ensuring patient safety!!

Personnel Considerations



Personnel Considerations



- Level of experience for this procedure?
- Availability of staff & equipment for:
 - patient transport
 - administration of sedation & monitoring
 - rescue / resuscitation
 - recovery

Personnel Considerations



- readiness for unexpected complications
- "back-up" admission planning
- identification and availability of responsible primary physician
- often the proceduralist is a consultant!

Strategies for successful sedation practice in pediatrics



- Outcomes improve when services are provided by dedicated, appropriately configured, and experienced teams using clear guidelines / protocols
- Sedation teams are an example of “practice makes perfect”

2011 UMMC Pediatric Model



- Medical direction, protocol development, & “rescue” from Pediatric Anesthesiology
- 5 weekdays LIP clinical support from credentialed Nurse Practitioner (CRNP)
- Sedation nurses with specialized training & extensive clinical experience in pediatrics

2011 UMMC Pediatric Model



- Pediatric Moderate Sedation Team
 - Available weekdays 0700 – 1500
 - Mostly scheduled outpatients
 - Some inpatients
 - Call them ahead of time to arrange coverage for in-patients

- You!! once you become credentialed

2011 UMMC Pediatric Model



- Pediatric Moderate Sedation Team:
 - Dyana Conway, CRNP
 - Pager (410) 232-5225
 - Diane Constantine, RN
 - Janet Braun, RN
 - Pager (410) 389-0815
 - phone ext. / voice-mail: (410) 328 – 0211
- Resources on the UMMC intra-net:
 - Pediatric Moderate Sedation Protocol
 - Institutional Moderate Sedation Policy

2011 UMMC Pediatric Model



- Powerchart – Careset
 - Peds Moderate Sedation Plan
 - VS / Monitoring orders
 - Activity orders
 - Patient care orders
 - Food and Nutrition orders
 - Continuous fluid orders
 - Medication orders
 - Sedation meds
 - Side effect meds
 - Antidote meds
 - Allergic reaction meds
 - Respiratory orders

Strategies for successful sedation practice in pediatrics



Choose **single-agent regimens** for non-painful, non-invasive imaging studies, and reserve **combination regimens** for procedures which require both *analgesia* and sedation.

Strategies for successful sedation practice in pediatrics



Caveat: **combining** sedative / hypnotics or general anesthetics with opioids significantly **increases the risk** for loss of the airway, hypoventilation, hypoxia, and bradycardia

Strategies for successful sedation practice in pediatrics



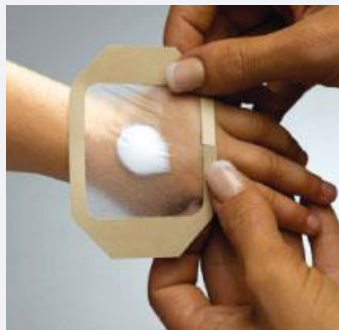
Non-pharmacologic techniques can reduce the need for extreme doses of drugs:

- guided imagery
- music / distraction / videos in MRI
- relaxation techniques
- parental presence
- calm atmosphere and personnel

Strategies for successful sedation practice in pediatrics



For painful procedures or vascular access **routinely employ topical and infiltration local anesthesia** or even regional anesthesia, and thereby reduce the need for opioids or large doses of anxiolytics / sedatives



Strategies for successful sedation practice in pediatrics



For urgent / emergent procedures in **non-fasted patients** use agents to promote gastric emptying, increase lower esophageal sphincter tone, and reduce gastric acidity & volume
(metoclopramide & H2-blocker)

Strategies for successful sedation practice in pediatrics



If **aspiration risk** is felt to be **high**
strongly consider **endotracheal**
intubation for procedures requiring
deep sedation or unconsciousness.

Strategies for successful sedation practice in pediatrics



- **Titrate** frequent, appropriate doses at appropriate intervals when using potent intravenous sedatives and analgesics.
- **Be patient** and give agents time to work! Reduce initial doses when combining agents of different classes.

Strategies for successful sedation practice in pediatrics



Never sedate pediatric patients at home or at locations remote from skilled caregivers to avoid mishaps during transport or when the child is not watched by a trained observer.

Be down a head of time prior to actual test or procedure!

There's a lot to think about here!



Characteristics of an “Ideal” Sedative Agent



- versatile and painless routes of delivery
- rapid onset
- predictable offset
- option for repeated doses / titration
- wide therapeutic index (safety)
- few significant drug interactions
- few & minor side-effects
- reversal agent
- limited potential for tolerance / physical dependence

Pharmacology



Refer to the tables appended to the UMMC institutional-approved Pediatric Moderate Sedation protocol for drugs & dosages, as well as information on reversal agents!

Chloral Hydrate

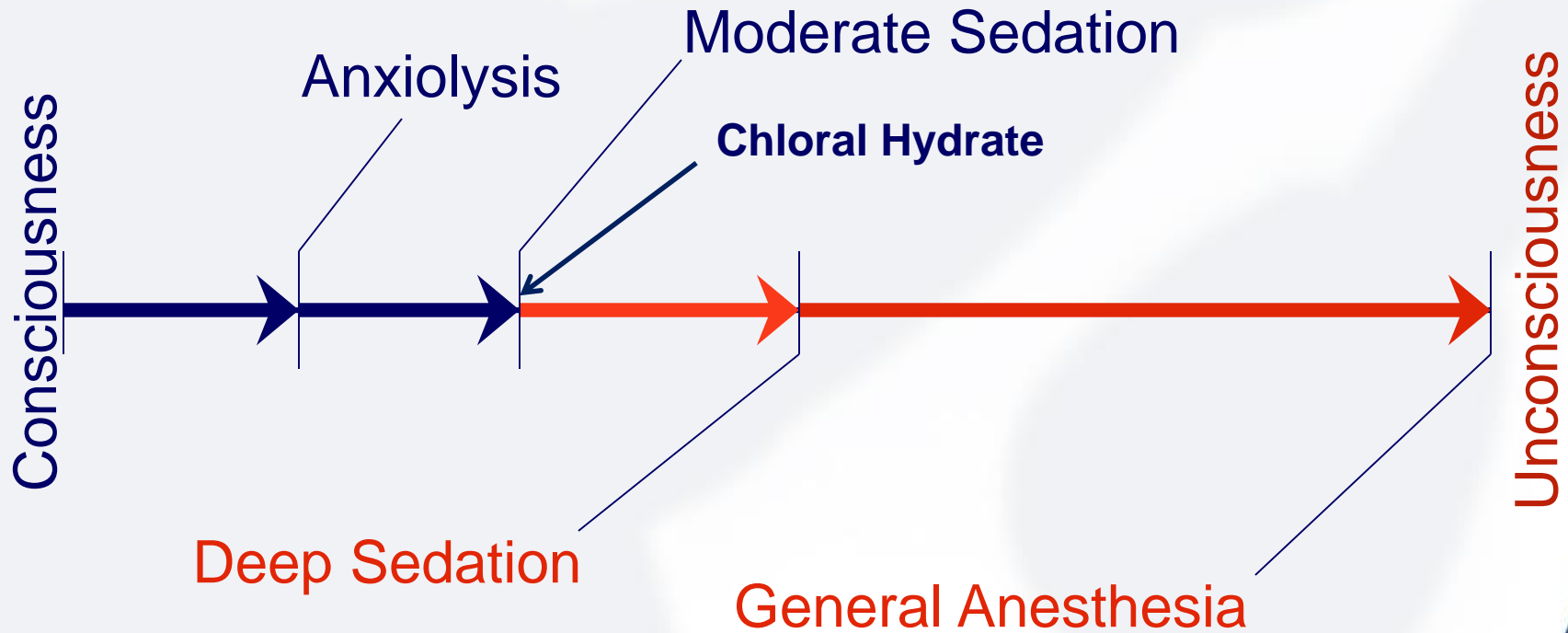


- Moderate duration procedures (30 - 90")
- Non-painful procedures (has no analgesia)

Advantages:

- Simple route of administration (po)
- Rapid absorption
- IV access not usually required
- Long history of safety & efficacy

Sedation occurs as a Continuum



Chloral Hydrate



- Current application @ UMMC:
 - Infants < 12 kg or < 18 months
 - No IV access
 - Indication : MRI or CT scan
 - Typical dose
 - <6 months – 50 mg/kg
 - >6 months – 60 mg/kg
 - Expected onset: 20 minutes
 - Expected duration: 90 minutes

Chloral Hydrate



Disadvantages:

- delayed onset (up to 45 -60")
- failure rate of up to 30 - 40%
- paradoxical excitement / delirium
- Some patients are irritable during induction
- potential for prolonged sedation ("hangover")
- lacks analgesia
- mucosal irritation / vomiting & diarrhea
- no reversal agent

Midazolam



- Short to moderate duration procedures
- PO / PR for longer duration
- titrate IV, or continuously infuse for longer procedures
- non-painful procedures (has no analgesia)
- combine with opioids for painful procedures

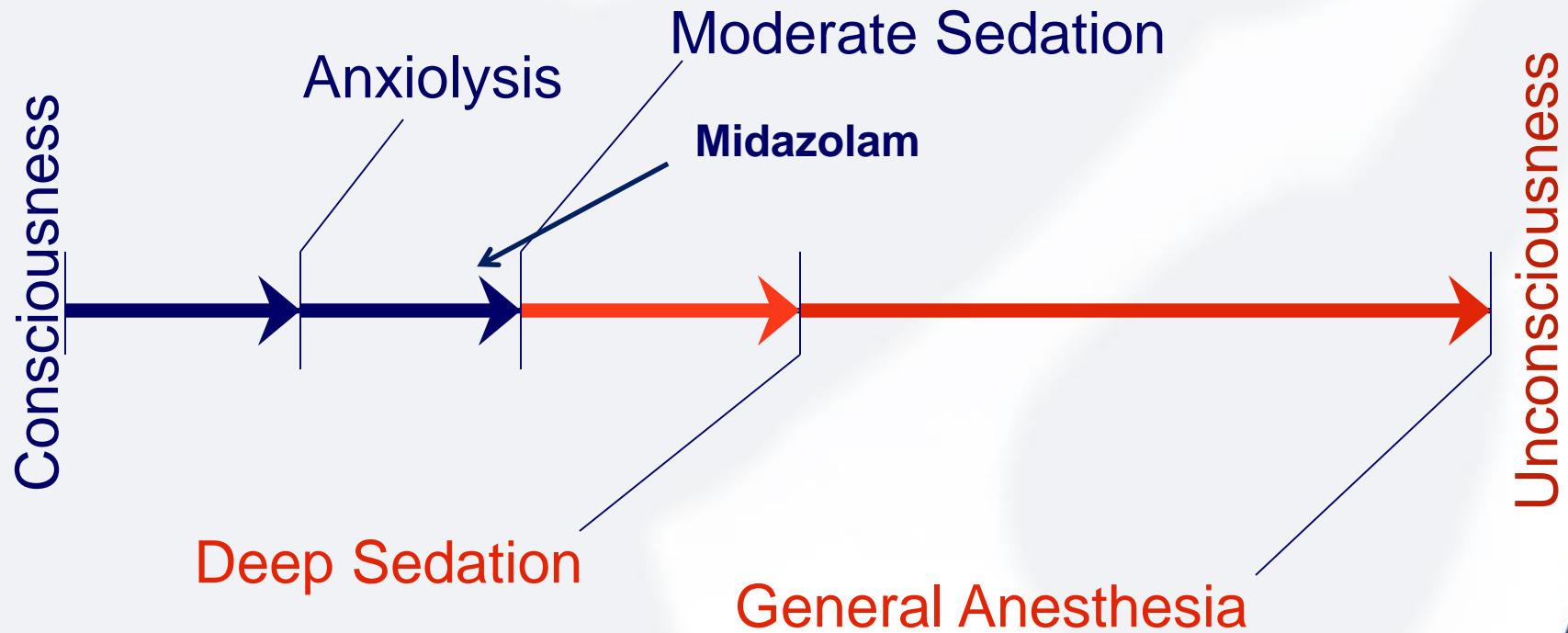
Midazolam



Advantages

- Versatile & painless routes of administration
- Rapid onset & relatively rapid offset
- Anxiolysis *plus* amnesia
- Anti-convulsant
- Hemodynamic stability
- Reversible with flumazenil (specific antagonist)
- Produces "**true**" moderate sedation in children

Sedation occurs as a Continuum



Midazolam



- Current application @ UMMC:
 - Oral dosing – 0.5 to 0.7 mg/kg one dose only
 - Expected onset: 15 – 30 minutes
 - Rectal dosing – 1 mg/kg one dose only
 - Expected onset: 5 – 15 minutes
 - Maximum Dosing for both PO / PR – 20mg
 - Expected duration: 60 – 90 minutes
 - IV dosing – 0.05 to 0.1 mg/kg q 3-5 minutes
 - Expected onset: 1-3 minutes
 - Maximum dosing: 0.2 mg/kg or 5mg total dose
 - Expected duration: 30 minutes

Midazolam



Disadvantages:

- lacks analgesic properties
- increased risk for ***respiratory complications*** when combined with opioids
- tolerance & physical dependence
- benzyl alcohol preservative

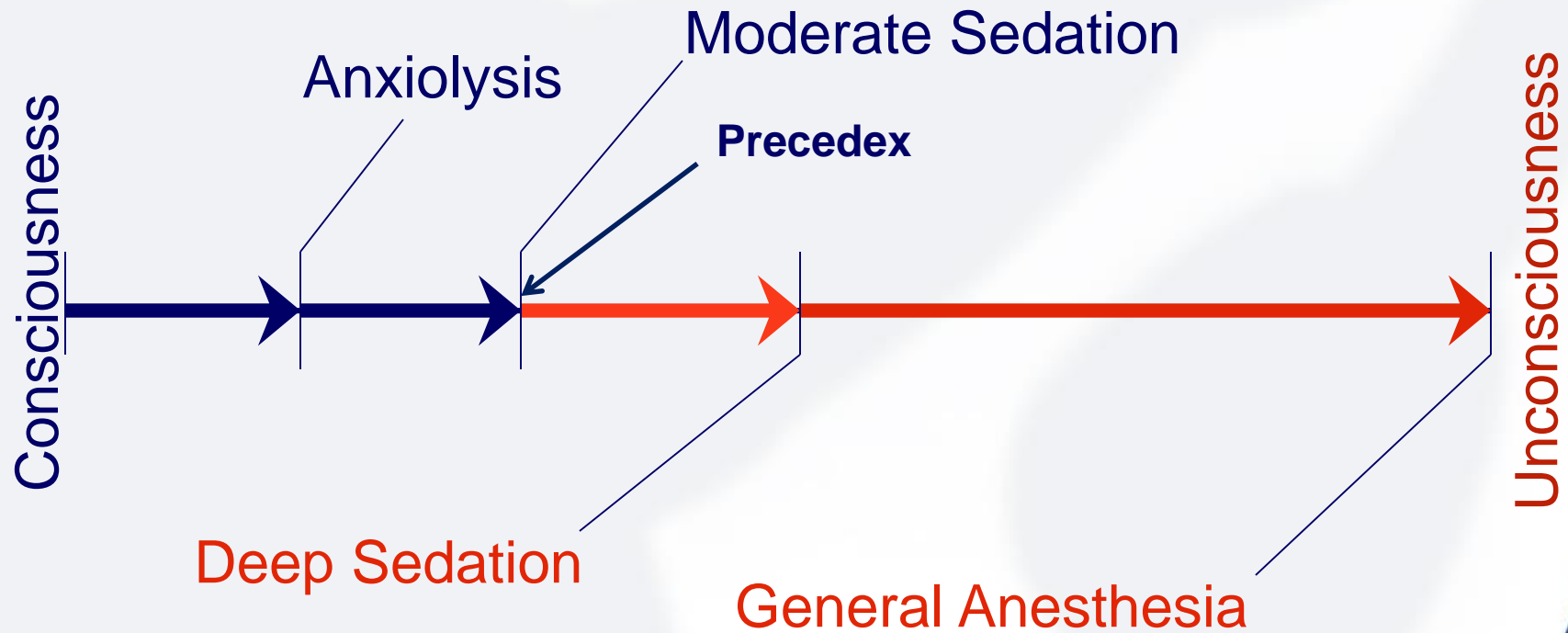


Dexmedetomidine



- the newest sedative-analgesic agent
- an alpha-agonist (similar to clonidine)
- Demonstrated effective in a “high-dose” technique as a single agent for imaging sedation (MRI)
- Significant hemodynamic side-effects occur at these doses (\downarrow HR & BP), as well as slower emergence / recovery
 - Antidote for \downarrow HR with instability - Atropine

Sedation occurs as a Continuum



Dexmedetomidine



- Current application @ UMMC:
 - Longer imaging (MRI + contrast)
 - Dilute vial to 4 mcg/ml (1 vial/50 ml)
 - If using as the sole agent:
 - Bolus: 2 mcg/kg over 10 min
 - Infuse @ 1-2 mcg/kg/hr
- May re-bolus up to 3 times prn
- May combine w/ midaz or ketamine

Dexmedetomidine



Advantages:

- More controlled onset and relatively rapid offset
- Running as a drip after bolus will provide the sedation needed for longer diagnostic test
- Provides adequate sedation for MRIs

Disadvantages:

- Little analgesic effects
- Need to be careful when administered to patients with Cardiac disease
- Longer duration and higher doses may cause significant hemodynamic side-effects
- no reversal agent

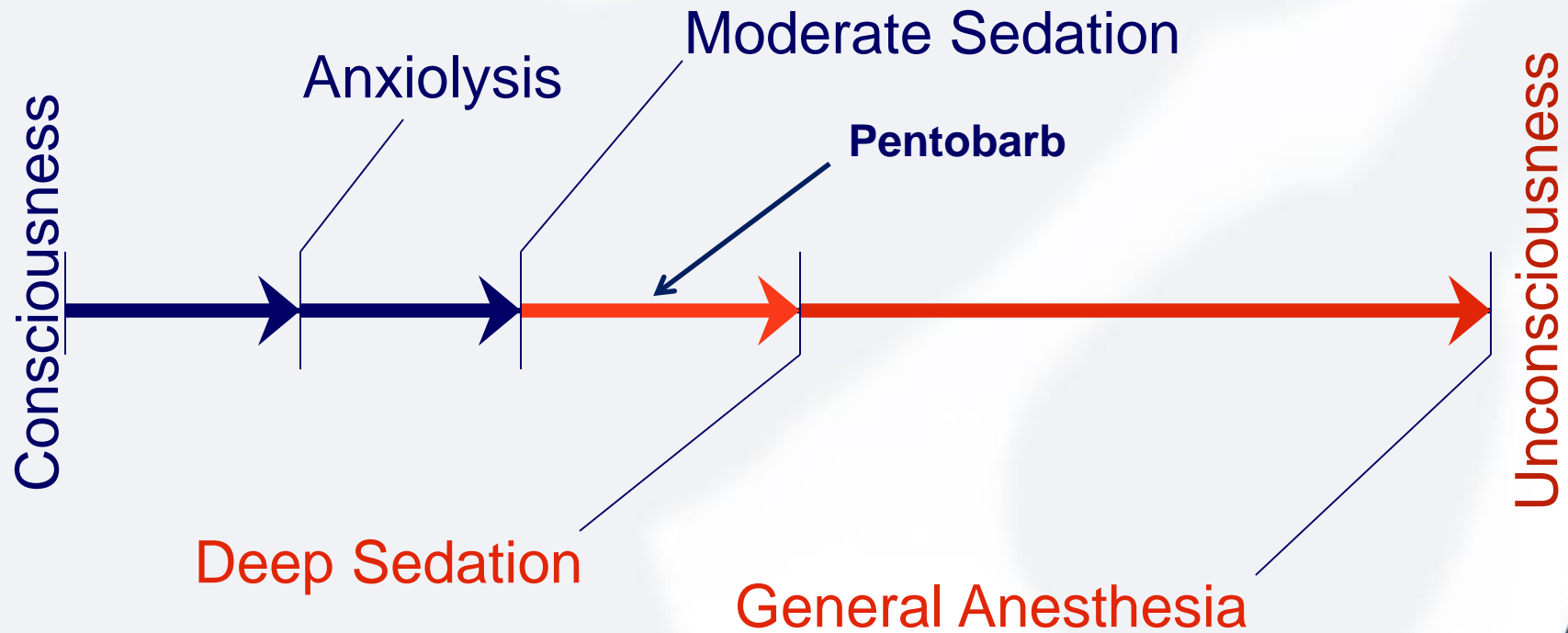


Pentobarbital



- Patients ineligible for Dexmedetomidine
- MRI
- Initial Bolus 2 mg/kg
- Supplement prn w/ 1 – 2 mg/kg **q3** to 5 minutes 'til sleeping
- Upper dose limit = 7 mg/kg
- Optional: Midazolam IV 0.05 – 0.1 mg/kg

Sedation occurs as a Continuum



Pentobarbital



Advantages:

- an intermediate acting sedative hypnotic
- provides immobility for longer procedures
- an anti-convulsant

Disadvantages:

- lacks analgesia (may even be *antalgic*)
- can produce resp. depression & “hangover”
- tolerance / dependence with repetitive use
- no reversal agent



Fentanyl

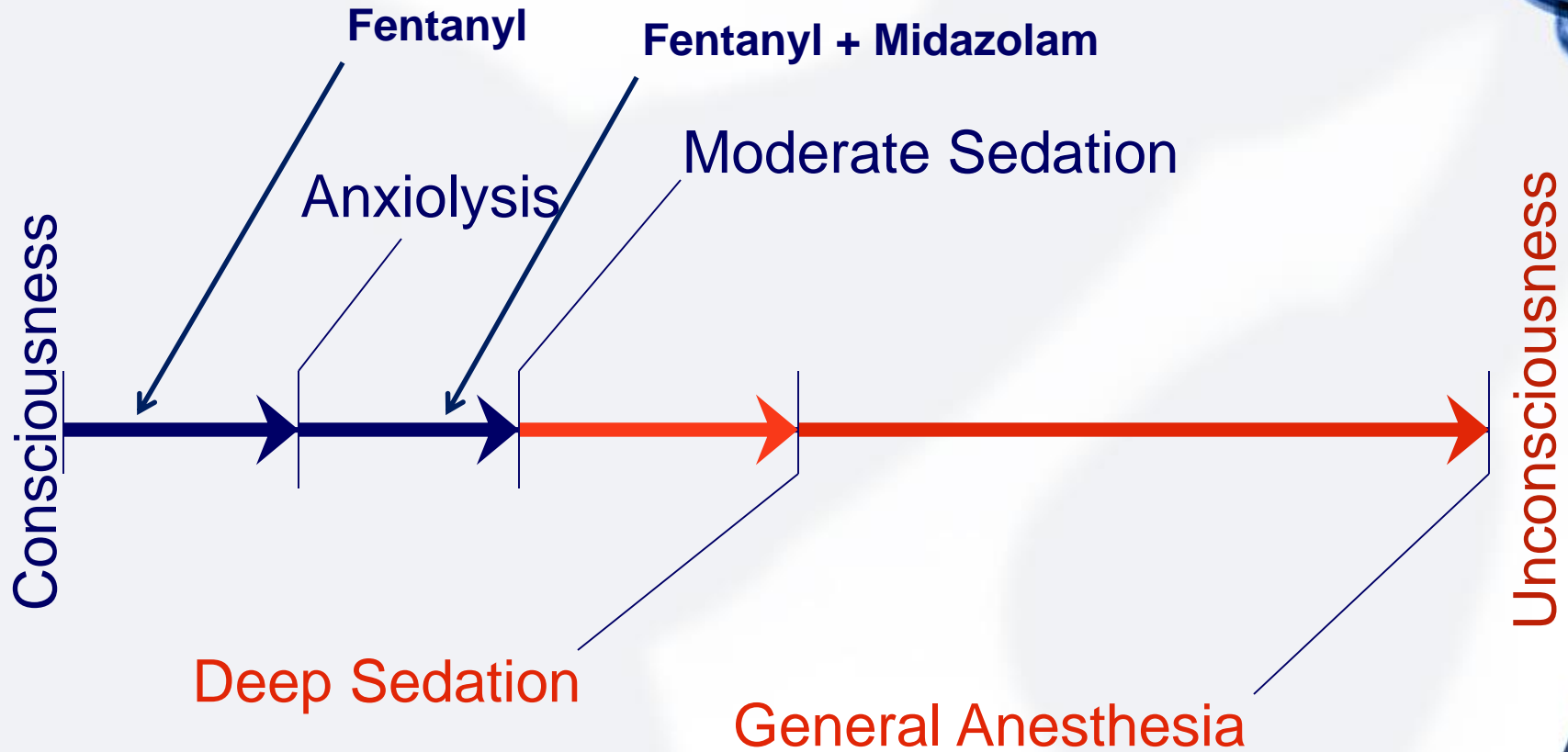


- Reserve for procedures requiring analgesia
- Intensify by combining w/ local anesthetics (decreases risk for respiratory depression)

Advantages

- Intense analgesia of moderate duration
- Versatile & painless routes of administration
- Rapid onset & relatively rapid offset
- Hemodynamic stability
- Reversible with **naloxone** (specific antagonist)

Sedation occurs as a Continuum



Fentanyl



- Current application @ UMMC:
 - Given for painful procedures
 - IV dosing – 0.5 to 1 mcg/kg q 3-5 minutes
 - Expected onset: 1-3 minutes
 - Maximum dosing: 3 mcg/kg or 250mcg total dose
 - Expected duration: 30 - 45 minutes
- May combine w/ midazolam
- Will produce more severe respiratory depression if combined with other agents

Fentanyl



Disadvantages:

- Hypoventilation, apnea, & bradycardia
- Potential for prolonged clinical effects in neonates & infants
- Nausea, vomiting, & urinary retention
- Tolerance / physical dependence

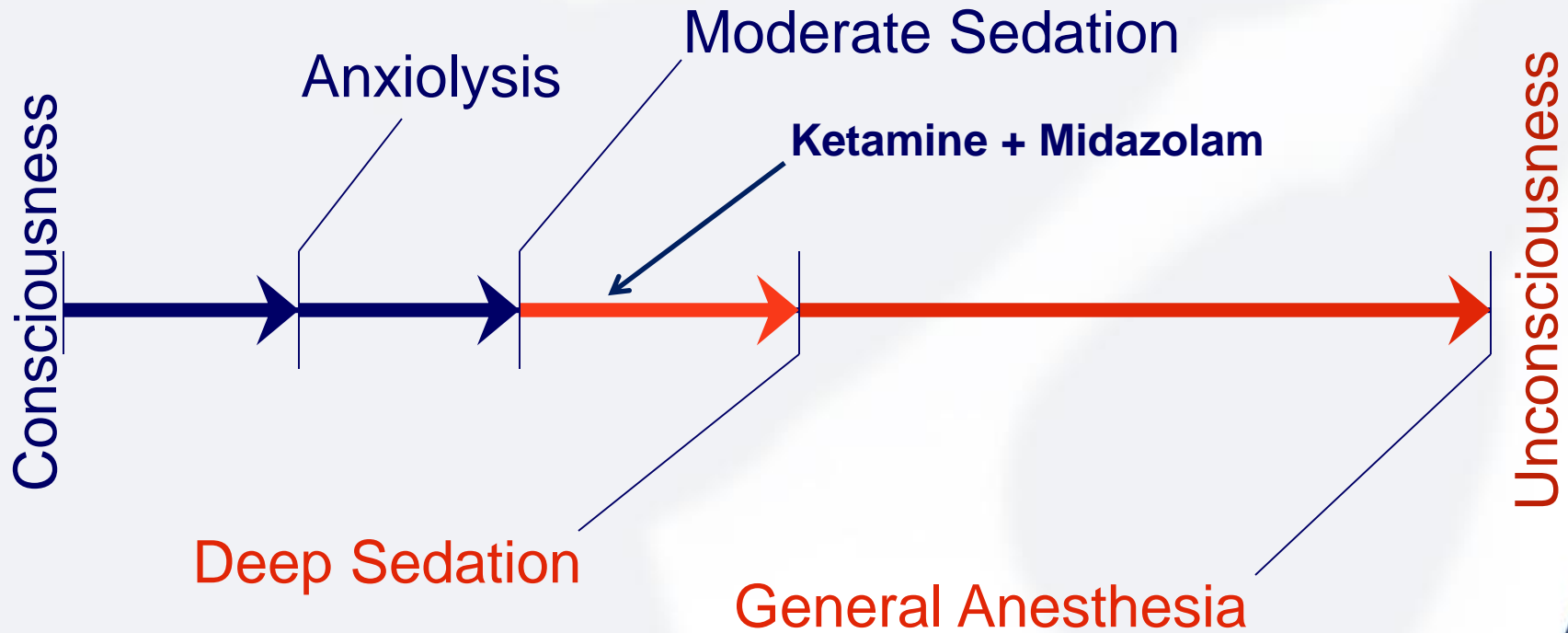


Ketamine



- a parenteral anesthetic agent with amnestic & analgesic properties
- rapid onset & intermed. recovery (esp. IV)
- useful for short, painful procedures
- “dissociative” anesthesia may not produce reliable immobility
- airway secretions as well as emergence delirium & N/V limit this agent's use
- co-administer w/ BZD & anti-sialogogue
 - Midazolam and Glycopyrrolate

Sedation occurs as a Continuum



Ketamine



- Current application @ UMMC
 - Short imaging studies (CT, U/S)
 - Painful procedures (ex: PICC, LP, needle bx's, kidney bx's, laceration repair, joint aspiration, etc.)
 - Midazolam and Glycopyrrolate given prior
 - Initial Bolus: 2 mg/kg IV
 - Supplement 1 mg/ kg for longer cases
 - Maximum dose: 5 – 7 mg/kg/hour
 - Expected onset: 2 to 5 min
 - Expected duration: 15 min (Short)

Ketamine



Advantages:

- Quick onset and rapid offset
- Works well for painful procedures
- Produces a more deeper sedation

Disadvantages:

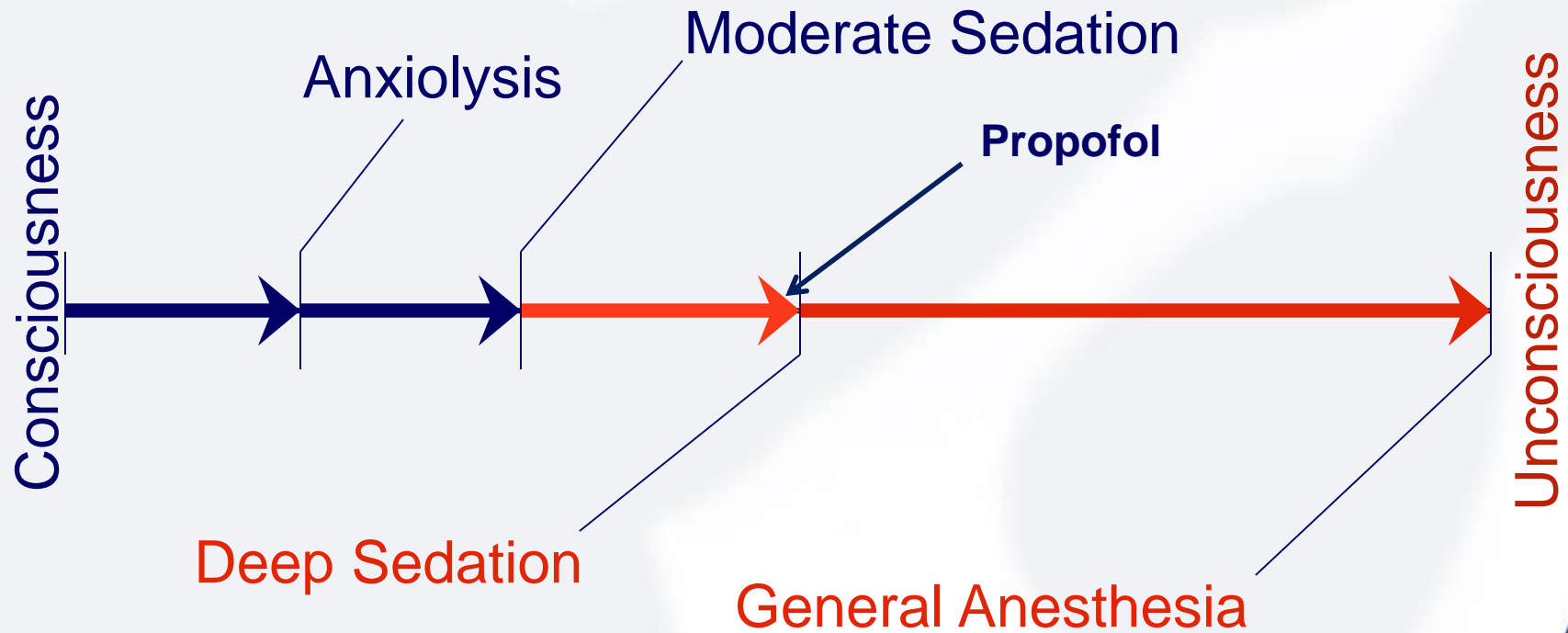
- May produce transient Hypertension and increased HR
- Contraindicated with head trauma, increased ICP or HTN
- Emergence delirium with N/V
- Emergence nystagmus
- No reversal agent

Propofol



- total IV anesthesia (TIVA) / deep sedation
- lacks analgesia & amnesia
- rapid onset & smooth recovery
- utility unaffected by procedure length
- minimal “hangover” & ↓ N/V
- useful for patients tolerant to the effects of opioids, benzodiazepines, & barbiturates
- no reversal agent

Sedation occurs as a Continuum



Propofol

- Current application @ UMMC
 - Only given by Pediatric Anesthesiologist



Propofol

- “slippery slope” to general anesthesia
- sudden or abrupt loss of the airway, hypoventilation, & apnea may occur
- diminishes both airway caliber & reflexes even in hypnotic-sedative dose ranges
- hypotension occasionally limits its use
- in MD nurses cannot administer propofol for procedural sedation to non-intubated patients



Assessing and Managing Risk



What have we learned in pediatrics?

- All classes of agents may cause complications wherever they are used in all age-groups of healthy children!
- Most adverse events occur in ASA I and II (*healthy*) children aged 0 to 5 years

Assessing and Managing Risk



- Decreased respiratory drive
- Inability to maintain patent airway
- Inability to maintain protective reflexes (gag, cough)
- Hemodynamic compromise

YES:



NO:



Serious adverse events



Contributory factors

- Age < 5 years
- “poly-pharmacy”
- *poor* patient assessment
- *poor* patient selection
- presence / severity of co-existing disease
- drug error
- overdose
- **practitioner error**
- inadequate monitoring
- **Failure to recognize instability**
- premature discharge

Negative outcomes



Due to ineffective pediatric sedation

- stress / psychological injury
- pain / distress
- uncontrolled movement
- poor image quality
- sub-optimal operative conditions
- delayed emergence / “hangover”
- failure to complete the procedure

Questions?

