APP PHARMACOLOGY CONFERENCE

OCT 12, 2022

Pediatric Sedation

- Patient Assessment
- Medication Selection

Akron Children's Hospital

OBJECTIVES

1. Recognize some of the acute and chronic medical conditions which might increase risk for adverse events during pediatric sedation
2. Describe the relationship between procedural pain and degree of immobility, and appreciate how these influence your sedation plan
3. Develop an understanding about sedation medications, based on the various factors that impact pediatric sedation

Goals of Sedation

- Guard the patient's safety and welfare
- Minimize physical discomfort and pain
- Control anxiety, minimize psychological trauma, and maximize the potential for amnesia
- Control behavior and/or movement to allow the safe completion of the procedure
- Return the patient to a state in which safe discharge from medical supervision is possible

Sedation Essentials

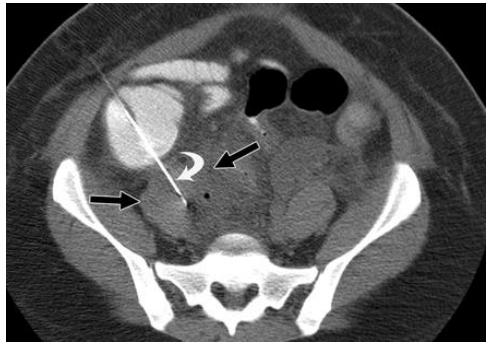
- Medical supervision
- Pre-sedation screening evaluation
- Appropriate NPO status
- System focused pre-sedation examination
- Training / skills in airway management
- Appropriate medications
- Sufficient support and rescue personnel
- Appropriate monitoring
- Adequate recovery prior to discharge

Non-invasive Studies

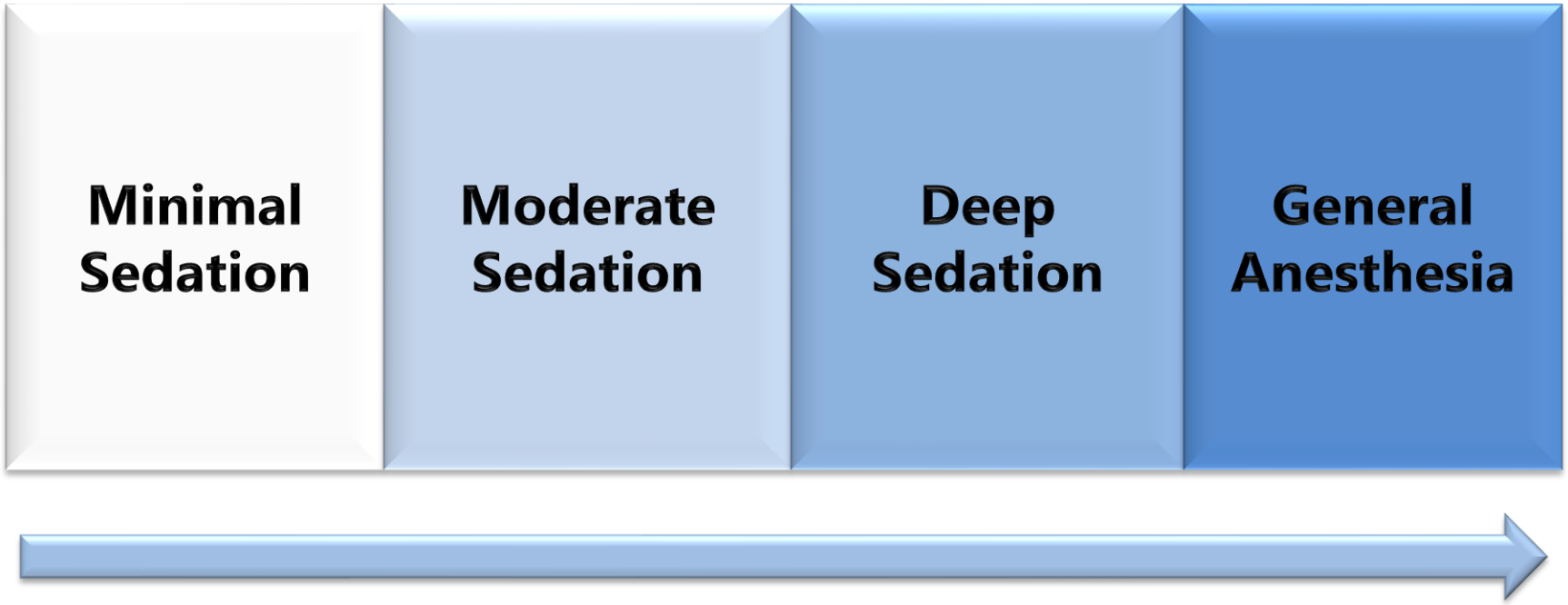
- MRI
- CT
- BSER
- Bone Scan
- DMSA
- Lasix Renal Scan
- MIBG
- Radiation Oncology (AGMC)

Invasive Procedures

- Lumbar Puncture
- Bone Marrow Biopsy / Aspiration
- Botox Injections / Nerve Blocks
- CT Guided Abscess Drainage
- Renal Biopsy
- Skin Biopsy
- Fracture Reduction
- G-tube to J-tube Conversion
- Joint Injection / Aspiration
- PICC Line



Levels of Sedation



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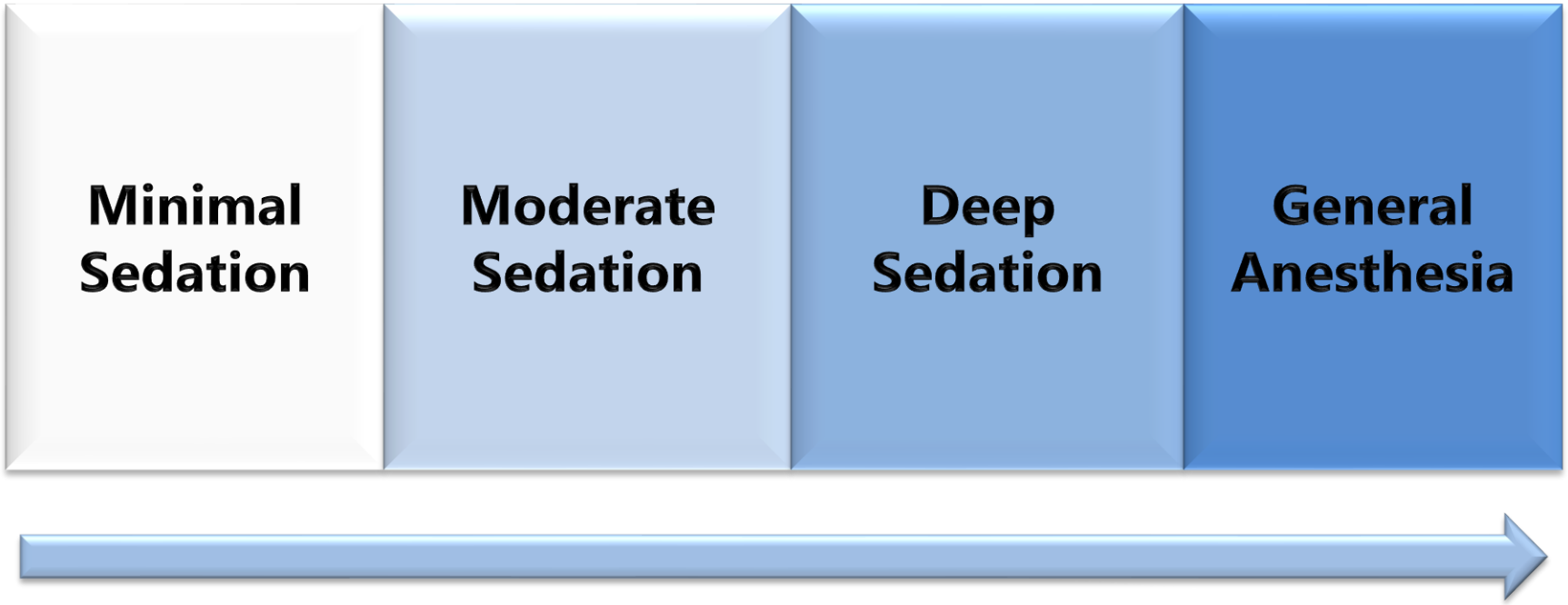
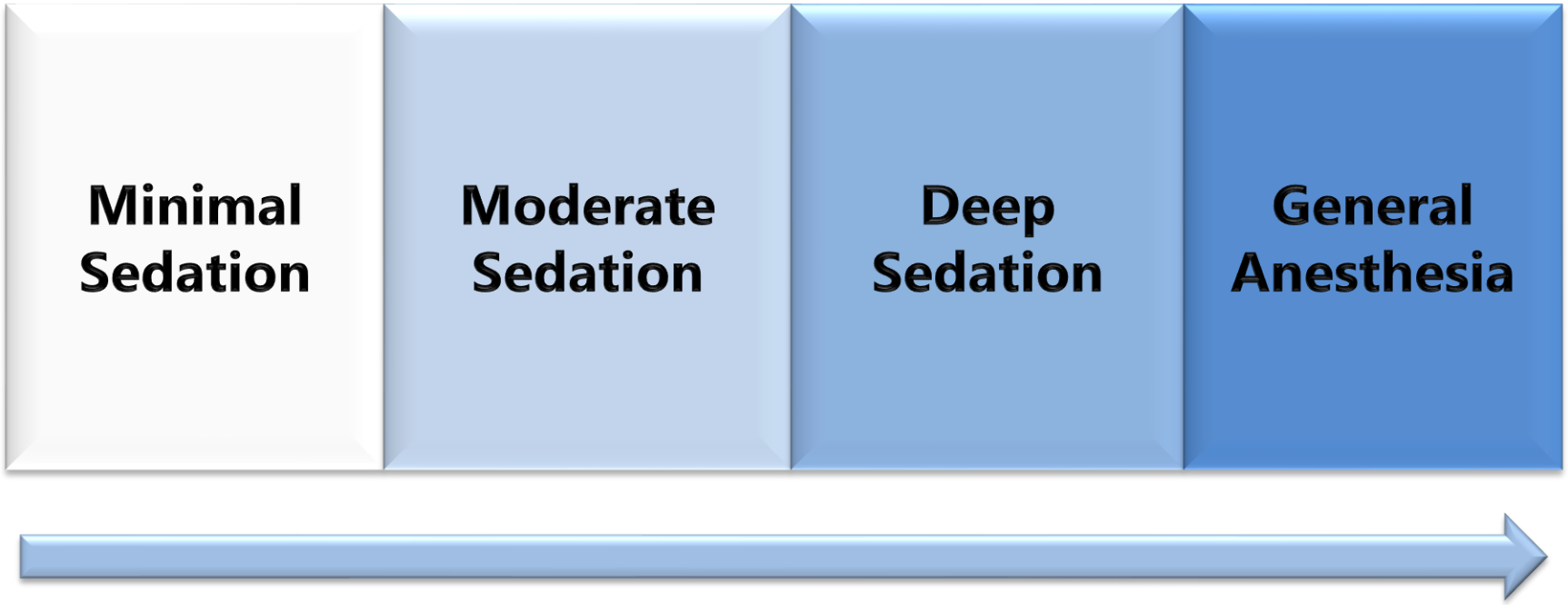


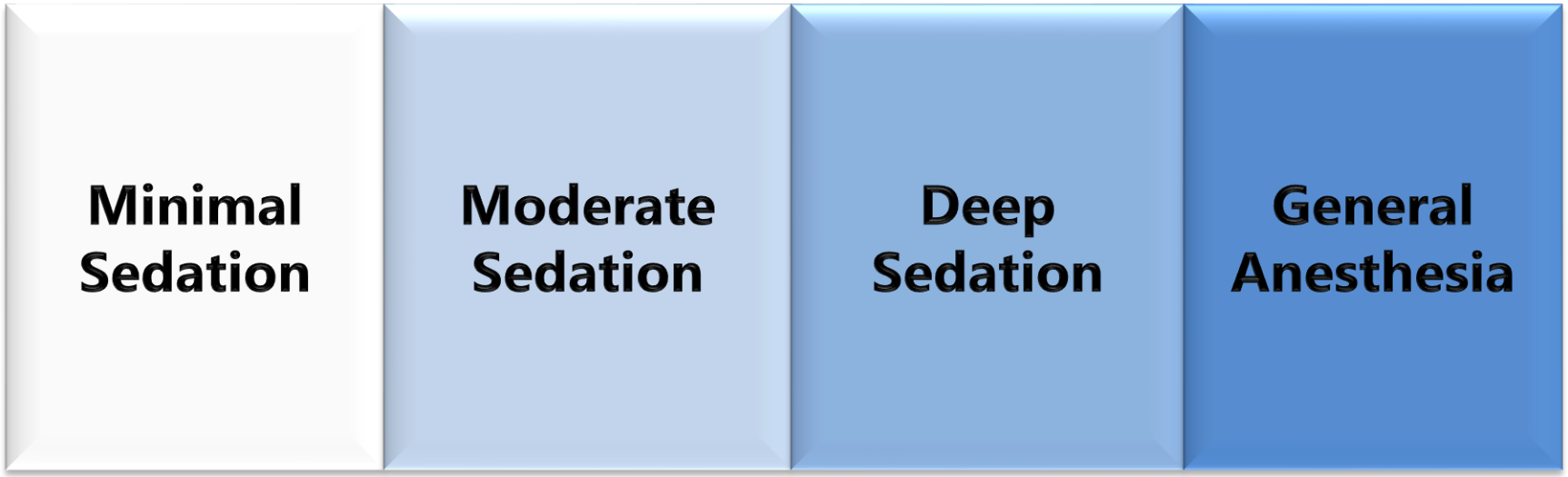
"It is common for children to pass from the intended level of sedation to a deeper, unintended level of sedation." - AAP

Levels of Sedation



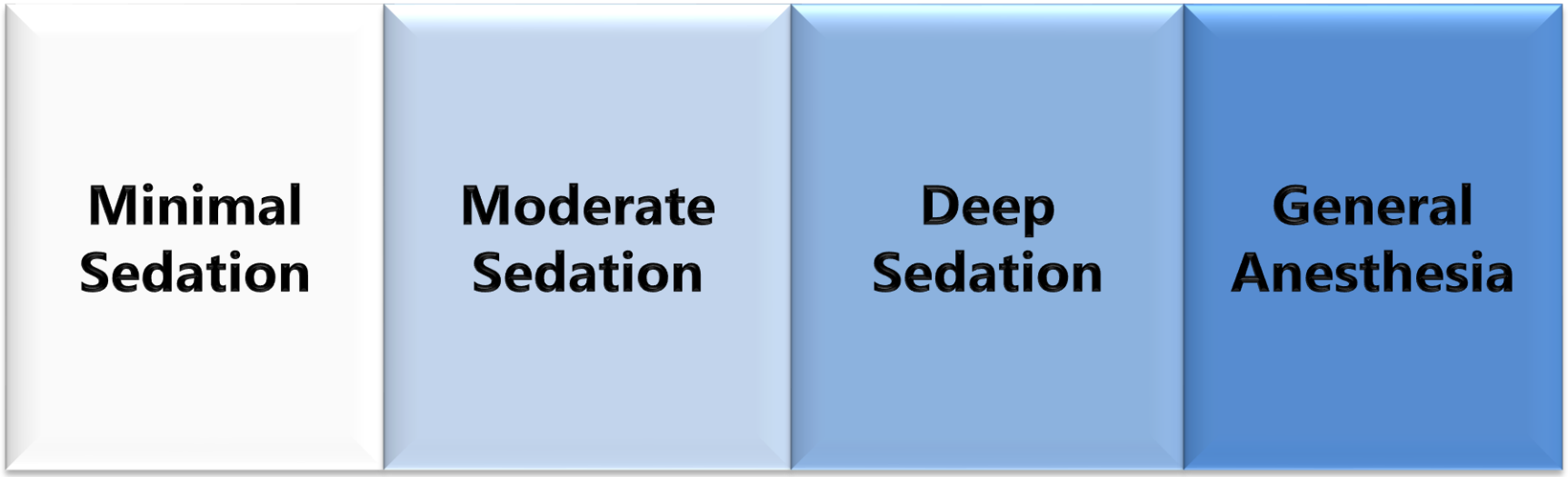
"Practitioners of sedation must have the skills to rescue the patient from a deeper level than that intended . . . " - AAP

Levels of Sedation



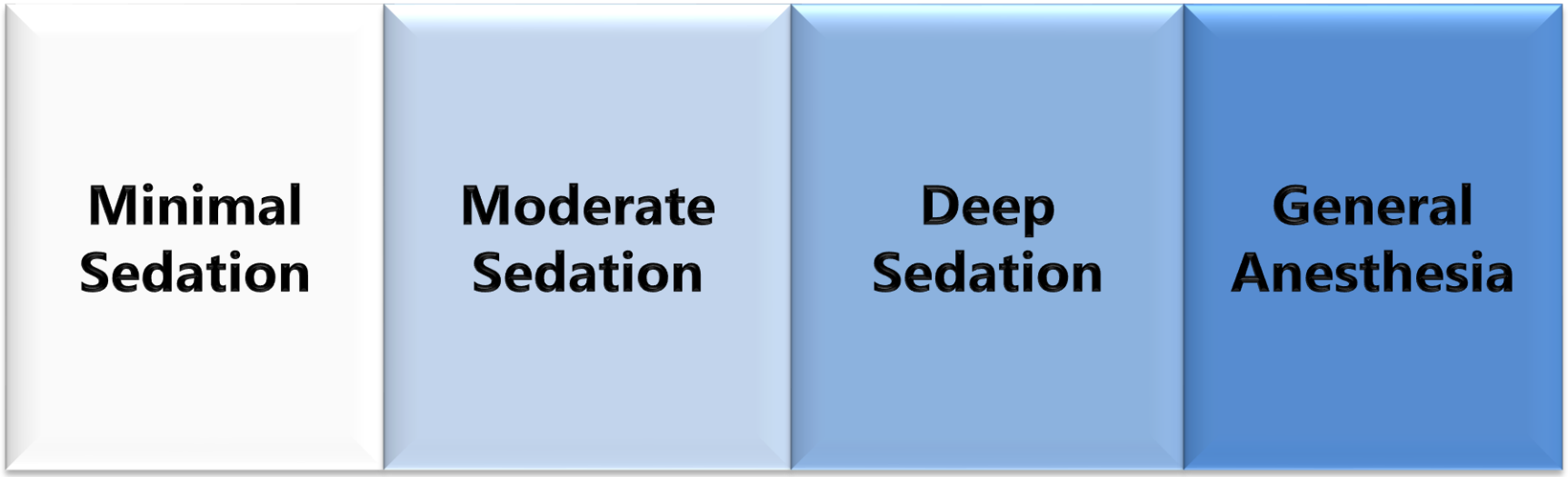
- ✓ Respond normally
- ✓ Cognition/coordination may be impaired
- ✓ + Conscious

Levels of Sedation



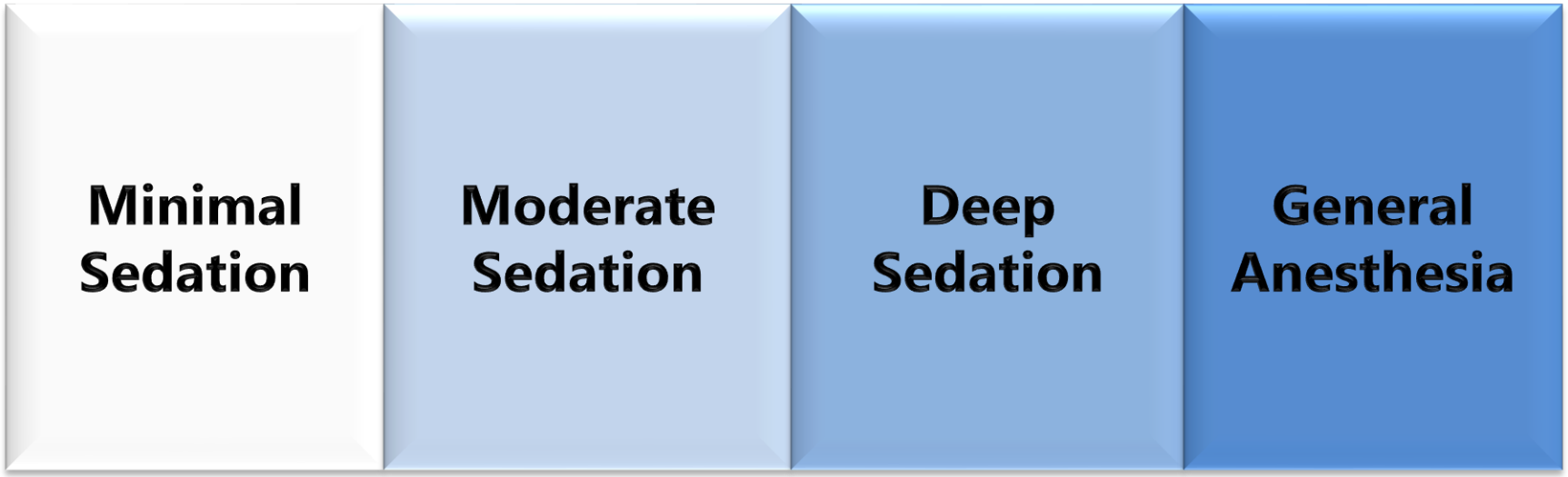
- ✓ Purposeful response to verbal commands
- ✓ Cardiorespiratory function usually maintained
- ✓ + / - Consciousness

Levels of Sedation



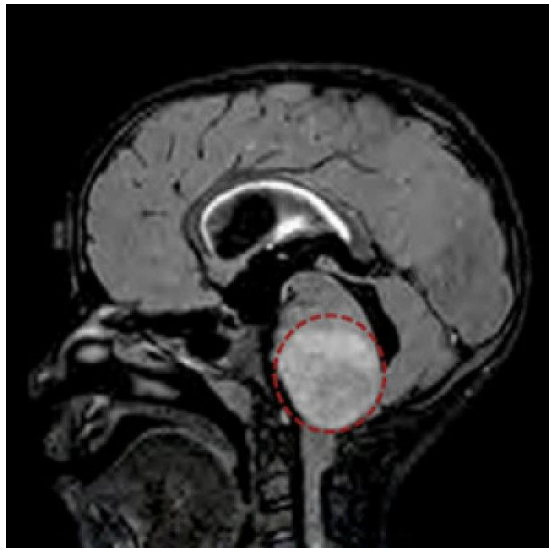
- ✓ Purposeful response to painful stimulus
- ✓ Ventilatory function may be impaired
- ✓ Unconscious

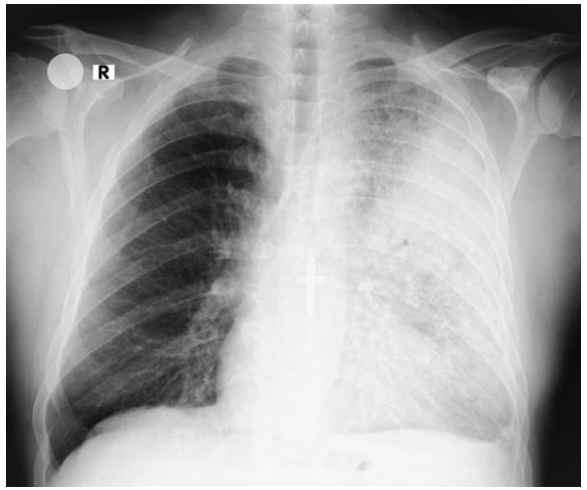
Levels of Sedation



- ✓ Unarousable to painful stimulus
- ✓ Ventilatory often impaired
- ✓ Unconscious

PATIENT ASSESSMENT





NON-PATIENT CONSIDERATIONS

- Location: ED, PICU, ISC, radiology, IR, dental clinic, burn unit
- Level of Sedation: minimal ↔ moderate ↔ deep
- Procedure: quick non-invasive imaging (CT) vs. deep loculated IR abscess drainage
- Sedation Personnel: PICU, ED, Hospitalists, Dentists, APP, sedation RNs + how many
- Emergency resources
  - Personnel: code team, anesthesia stat
  - Immediate access to: resuscitation medications, airway supplies, defibrillator, Xray, lab, PICU

PATIENT #1

15 year old male admitted to the hospital last night with ALL relapse:

- WBC = 29,000 μL (58% peripheral blasts)
- Hgb = 7.1 g/dL
- Platelets = 67,000 μL

Medical history: Down syndrome, leukemia at 4 yr, ECHO report 6 months ago is normal

Weight=90kg BMI=29.4 kg/m^2 (> 95%ile)

Vitals: T=37.4 P=84 R=18 BP=118/79

Exam: II/VI SEM at LLSB, (+) hepatosplenomegaly

† Oncology is requesting sedation for bone marrow aspiration and biopsy

ASA CLASSIFICATION

Cravero J, et al. The Incidence and Nature of Adverse Events During Pediatric Sedation/Anesthesia with Propofol for Procedures Outside the Operating Room: A Report From the Pediatric Sedation Research Consortium. *Anesth Analg*. 2009;108(3):795-804.

- Nearly 50,000 patients, 37 sedation centers, 2004-2007:

	PATIENTS	AE	% AE
ASA I or II	41,191	2,178	5.3%
ASA III	7,727	714	9.5%

- OR = 1.75, 95% CI = 1.61 - 1.89, $p < 0.001$

ASA CLASSIFICATION

Caperell K, et al. Is Higher ASA Class Associated With an Increased Incidence of Adverse Events During Procedural Sedation in a Pediatric Emergency Department? *Pediatr Emer Care*.2009;25: 661-664.

- 1202 pediatric sedations in an ED setting
- Fracture reduction (53%), laceration repair (34%), lumbar puncture (3%)
- Opioid + Midazolam (60%), Ketamine + Midazolam (30%)

EVENT	ASA I (n=988)	ASA II (n=200)	ASA III (n=14)
Hypoxia	14.5%	18.5%	35.7%
Any Adverse Event	18.1%	23.5%	42.8%

ASA CLASSIFICATION

- AAP Guidelines for Monitoring and Management of Pediatric Patients Before, During, and After Sedation for Diagnostic and Therapeutic Procedures: Update 2016

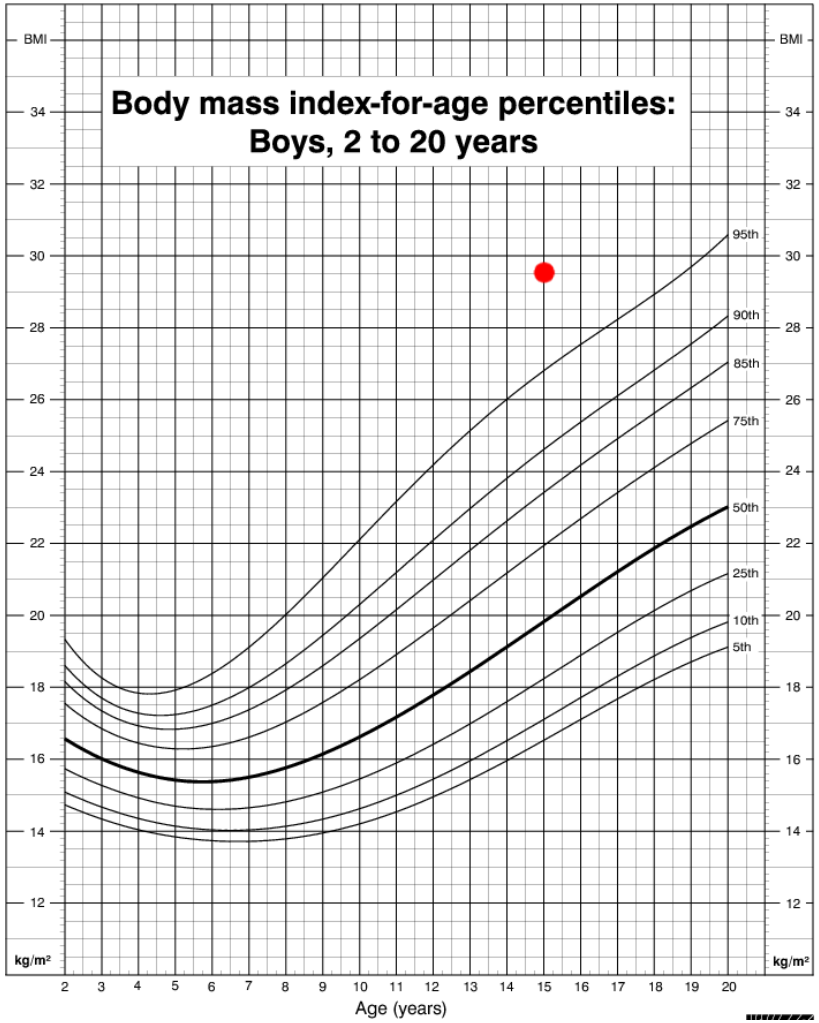
  "Patients who are in ASA classes I and II are frequently considered appropriate candidates for minimal, moderate, or deep sedation"

- ASA Practice Guidelines for Moderate Procedural Sedation and Analgesia 2018

  "For severely compromised or medically unstable patients (e.g., ASA status IV) . . . consult with a physician anesthesiologist"

OBESITY

- CDC definition: BMI ≥ 95th percentile
- BMI 30 – 42



OBESITY

Scherrer T, et al. The Impact of Obesity on Pediatric Procedural Sedation Related Outcomes: Results from the Pediatric Sedation Research Consortium. *Paediatr Anaesth*. 2015;25(2014):689-697.

- Obesity: BMI ≥ 95th percentile for age and gender
- 28,689 patients, 32 sedation centers, 2008-2011

EVENT	NON-OBESE (n=23,693)	OBESE (n=5,153)	OR
Any Adverse Events	4.16%	6.07%	1.49
Airway Obstruction	1.07%	2.06%	1.94
Unexpected BVM	0.80%	1.40%	1.77
Laryngospasm	0.15%	0.35%	2.30
Unable to Complete	0.20%	0.39%	1.96

OBSTRUCTIVE SLEEP APNEA

- Prevalence in the pediatric population is 2-4%
- Peak incidence is 2-6 years of age
- OSA syndrome: sleep fragmentation, episodic apnea, recurrent hypoxemia and hypercarbia
- Chronic exposure to intermittent hypoxia affects opioid system, and sensitivity to exogenous opioids
- Predisposers: craniofacial syndromes, airway anomalies, enlarged tonsils / adenoids

PATIENT #2

12 year old male, right forearm injury following a skateboarding accident 45 min ago:

- Previously healthy
- Vitals: T=37.0 P=92 R=20 BP=124/78
- Angulated right forearm with intact distal pulses / sensation, otherwise PE is normal
- Patient had a snack 2 hours ago

† Sedation: fracture reduction and casting

PRE-INJURY "SNACK"

NPO STATUS

Green S, et al. Fasting and Emergency Department Procedural Sedation and Analgesia: A Consensus-Based Clinical Practice Advisory. *Ann Emerg Med.* 2007;49(4):454-61.

Standard-risk patient[a]

Oral intake in the prior 3 hours	Procedural Urgency[b]			
	Emergent Procedure	*Urgent Procedure*	*Semi-Urgent*	*Non-Urgent*
Nothing	All levels of sedation	All levels of sedation	All levels of sedation	All levels of sedation
Clear liquids only	All levels of sedation	All levels of sedation	Up to and including brief deep sedation	Up to and including extended moderate sedation
Light snack	All levels of sedation	Up to and including brief deep sedation	Up to and including dissociative sedation; non-extended moderate sedation	Minimal sedation only
Heavier snack or meal	All levels of sedation	Up to and including extended moderate sedation	Minimal sedation only	Minimal sedation only

Higher-risk patient[a]

Oral intake in the prior 3 hours	Procedural Urgency[b]			
	Emergent Procedure	*Urgent Procedure*	*Semi-Urgent*	*Non-Urgent*
Nothing	All levels of sedation	All levels of sedation	All levels of sedation	All levels of sedation
Clear liquids only	All levels of sedation	Up to and including brief deep sedation	Up to and including extended moderate sedation	Minimal sedation only
Light snack	All levels of sedation	Up to and including dissociative sedation; non-extended moderate sedation	Minimal sedation only	Minimal sedation only
Heavier snack or meal	All levels of sedation	Up to and including dissociative sedation; non-extended moderate sedation	Minimal sedation only	Minimal sedation only

NPO STATUS

Chumpitazi CE, et al. Shortened preprocedural fasting in the pediatric emergency department, American Journal of Emergency Medicine(2018), https://doi.org/10.1016/j.ajem.2018.01.033

- 2,188 ED patients
  - 1,472 fasted > 6 hours for solids
  - 716 fasted < 6 hours for solids
  - Ketamine = 95%
- No aspiration events were observed in either group
- Vomiting (4.5% of patients), was not significantly associated with shorter fasting
  - OR = 1.18
  - p = 0.44

NPO STATUS

Bhatt M, et al. Association of Preprocedural Fasting With Outcomes of Emergency Department Sedation in Children. JAMAPediatr.doi:10.1001/jamapediatrics.2018.0830

- Children aged 0-18 years
- Procedural sedation for painful procedures (fracture reduction=65.9%, laceration=16.3%)
- 6 Canadian Emergency Departments
- July 2010 – February 2015
- 6,183 patients
- Ketamine alone (62.2%), Ketamine + Propofol (13.7%), Propofol + Fentanyl (11.6%)

NPO STATUS

Bhatt M, et al. Association of Preprocedural Fasting With Outcomes of Emergency Department Sedation in Children. JAMA Pediatr. doi:10.1001/jamapediatrics.2018.0830

- No cases of clinically apparent aspiration were observed
- No discernable association between pre-procedural fasting and any type of sedation adverse event

NPO SOLIDS	Any Event	Serious Event	Vomiting
< 2 hours	10.3%	0.9%	3.4%
2-4 hours	11.8%	1.1%	5.6%
4-6 hours	11.1%	1.0%	4.7%
> 6 hours	11.9%	1.2%	5.3%

NPO LIQUIDS	Any Event	Serious Event	Vomiting
< 2 hours	10.3%	0.6%	5.0%
2-4 hours	12.4%	1.0%	5.6%
4-6 hours	10.8%	1.2%	4.3%
> 6 hours	11.9%	1.2%	5.5%

NPO STATUS

Beach M, et al. Major Adverse Events and Relationship to Nil per Os Status in Pediatric Sedation/Anesthesia Outside the Operating Room. *Anesthesiology*. 2016; 124(1):80-8.

- 107,947 sedation patients over ~4 years
- Propofol (75%), Midazolam (22%), Ketamine (7%)

	NPO (n=82,546)	Not NPO (n=25,401)
Major complication rate per 10,000	5.57	5.91
Aspiration rate per 10,000	0.97	0.79

- " . . . we do not believe our data should be interpreted as an indictment of the ASA NPO criteria. Rather we would point out that the specific relationship between NPO status and patient injury is uncertain."

NPO

- Fasting intervals prior to sedation remains an area of practice difference among sedation providers
- Recent ED Literature:
  - Varying recommendations from the AAP, ASA, ACEP
  - Risk vs. benefit assessment
  - Consider decreasing the targeted depth of sedation
  - Consider GA for airway protection
  - Multiple studies showing no reduced risk for emesis / aspiration, regardless of pre-procedural fasting duration

PATIENT #3

20 month old female, former 31 week preterm infant:

- Gross motor delays: pulls to stand, crawls, not yet walking. Followed by neurology
- Mild gastroesophageal reflux, FTT (weight ~ 3rd%ile). Followed by gastroenterology

Medical history: 6 week NICU hospitalization: RDS. Grade I IVH

Vitals: T=37.2 P=122 R=30 BP=98/62

Exam: weight at 3rd percentile, diffuse mild hypotonia of extremities, sits alone with good head control. Heart and lungs normal.

† Sedation: brain MRI

PRETERM PATIENTS

Havidich JE, Beach M, Dierdorf SF, et al. Preterm Versus Term Children: Analysis of Sedation/Anesthesia Adverse Events and Longitudinal Risk. *Pediatrics*. 2016;137(3):e20150463

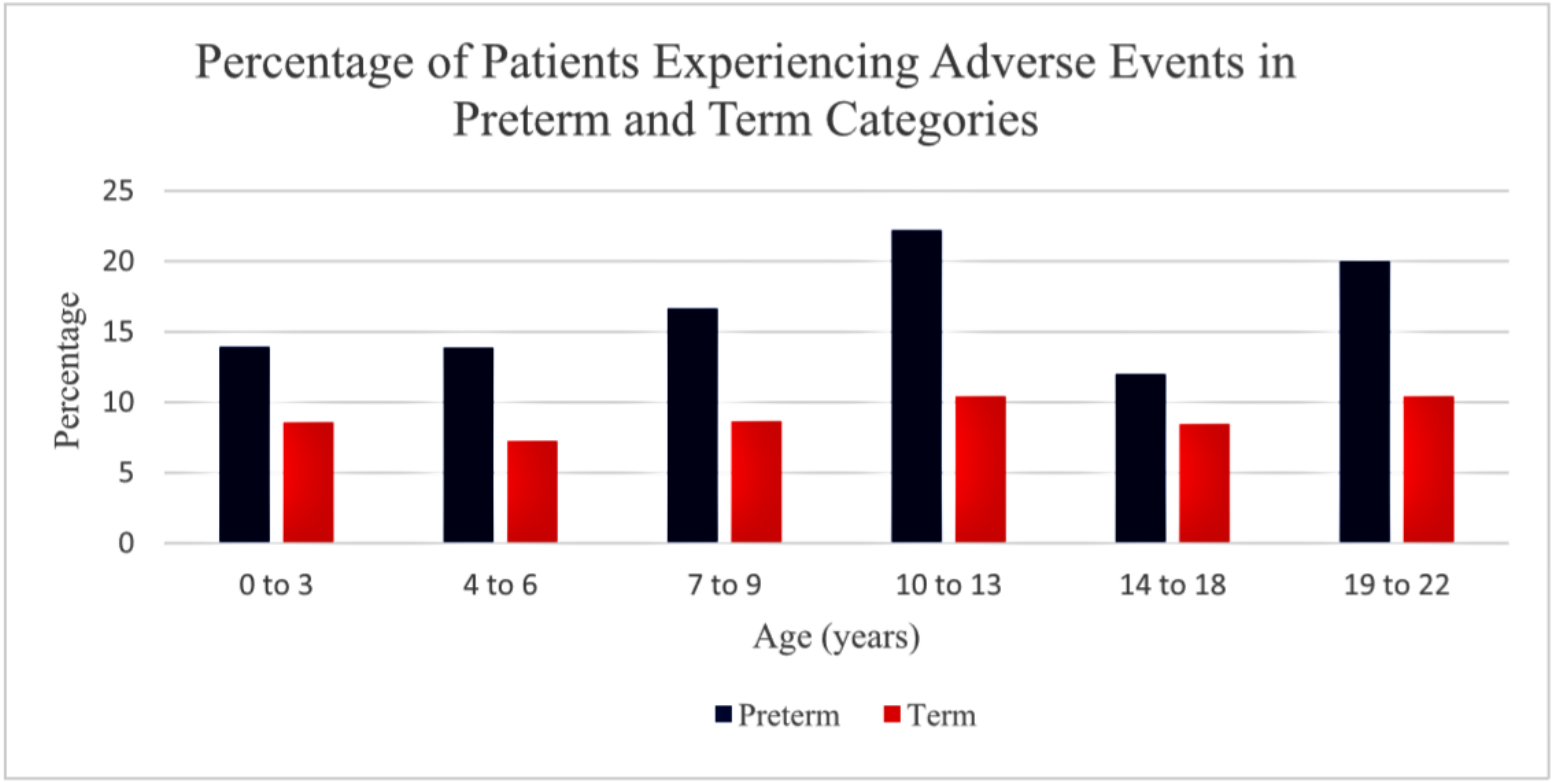
- 57,227 patients, Nov 2012 – April 2014
- Preterm: < 37 weeks gestation
- MRI, hearing test, LP, endoscopy. Propofol +/- midazolam majority of patients

EVENT	TERM (n=56,542)	PRETERM (n=685)	P
Any Complication	8.5%	14.7%	< .001
Oxygen desaturation	1.8%	4.5%	< .001
Secretions	1.0%	2.6%	< .001
Apnea	0.8%	2.0%	.001

- Increased risk for adverse events persists, even through the age of 23 years

PRETERM PATIENTS

Havidich JE, Beach M, Dierdorf SF, et al. Preterm Versus Term Children: Analysis of Sedation/Anesthesia Adverse Events and Longitudinal Risk. *Pediatrics*. 2016;137(3):e20150463



DEVELOPMENTAL DELAYS

Kannikeswaran N, et al. Sedation Medication Received and Adverse Events Related to Sedation for Brain MRI in Children with and without Developmental Disabilities. *Paediatr Anaesth*. 2009; 19(3):250-6.

- 260 developmentally delayed patients (DD) vs. 226 developmentally normal (DN) patients
- MRI sedation, with similar sedative doses in both groups
- Risk for hypoxia: 11.9% in DD vs. 4.9% in DN.

NEUROLOGICAL CONSIDERATIONS

- Hypotonia (esp. truncal, dysphagia)
- Progressive neuromuscular diseases
- Altered mental status
- Increased ICP
- Brain Tumor (esp. large tumors, midbrain, posterior fossa, midline shift, obstruct flow)
- Uncontrolled seizures
- Mitochondrial diseases

PATIENT #4

5 year old female, repaired Tetralogy of Fallot. Echocardiogram 2 weeks ago reports:

- Moderate pulmonic regurgitation
- No pulmonic or peripheral pulmonary artery stenosis
- Moderately dilated right ventricle

EKG: normal sinus rhythm w/ right bundle branch block

Mother reports 8 days of nasal congestion + cough. Low grade fevers for the past 3 days.

Vitals: T=37.2 P=81 R=21 BP=102/67

Exam: clear rhinorrhea. Lungs CTA. II/VI systolic / diastolic murmurs

† Sedation: cardiac MRI

URI

Tait R, et al. Risk Factors for Perioperative Adverse Respiratory Events in Children with Upper Respiratory Tract Infections. *Anesthesiology*. 2001;95(2):299–306.

- 1,078 patients receiving general anesthesia for elective surgical procedures

	No URI (n=407)	Recent URI (n=335)	Current URI (n=336)
Severe cough	4.2%	5.7%	9.8%
SpO_2 < 90%	7.8%	14.7%	15.7%
Laryngospasm	3.9%	4.2%	4.2%
Any Airway Adverse Events	17.9%	24.2%	30.0%

URI

Mallory M, et al. Upper Respiratory Infections and Airway Adverse Events in Pediatric Procedural Sedation. *Pediatrics*. 2017;140(1):e20170009.

- 83,491 sedation patients, 45 centers, 2012 – 2015
- Propofol (87.0%), Fentanyl (22.8%), Ketamine (6.7%), Dexmedetomidine (4.0%)

	No URI	Recent URI (2 weeks)	Current URI (clear)	Current URI (thick)	P value
Required suctioning	0.7%	1.4%	4.1%	9.0%	<0.001
Cough	1.5%	3.4%	5.9%	8.7%	<0.001
Stridor	0.1%	0.3%	0.4%	0.3%	<0.001
Desaturation	1.7%	2.2%	3.8%	8.1%	<0.001
Laryngospasm	0.3%	0.5%	0.7%	0.9%	<0.001
Any Airway Adverse Event	6.3%	9.1%	14.6%	22.2%	<0.001

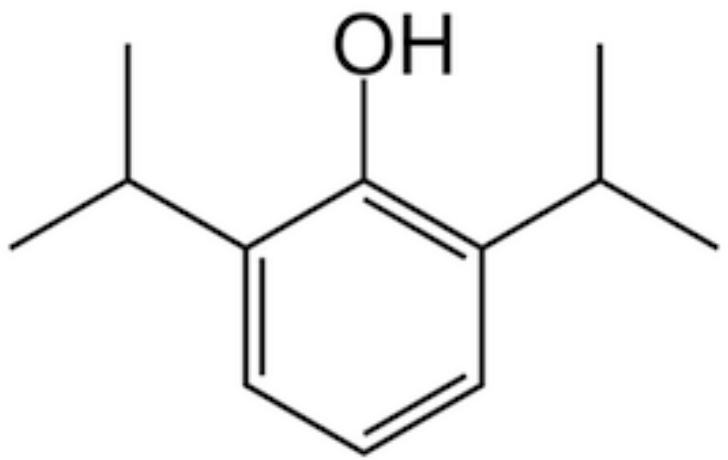
AIRWAY CONSIDERATIONS

- Croup / laryngotracheomalacia
- Extrinsic airway compression (e.g. mediastinal mass)
- Mallampati score
- Craniofacial syndromes (micrognathia, midface hypoplasia, etc.)
- Recent airway reconstruction
- Choanal atresia
- Macroglossia
- Asthma
- CF
- Current / recent pneumonia

CARDIAC CONSIDERATIONS

- Cyanotic heart disease
- Single ventricle physiology
- Obstruction to aortic or pulmonic outflow
- Complex arrhythmias
- Reduced left ventricular function
- Vascular rings
- Pulmonary hypertension
- Cardiac tumors

MEDICATION SELECTION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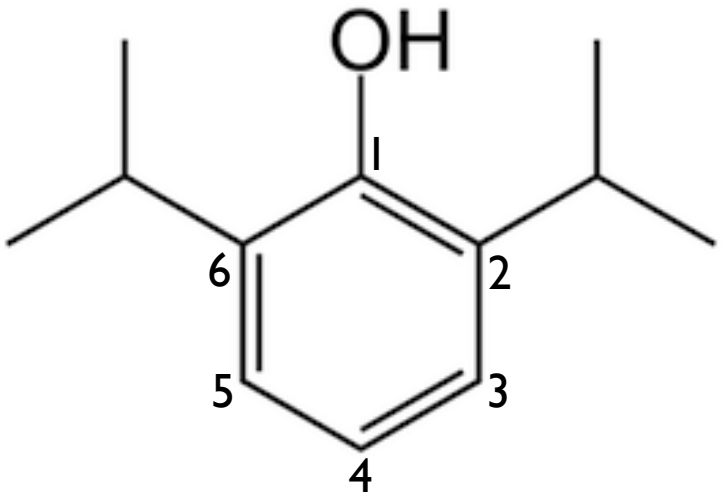
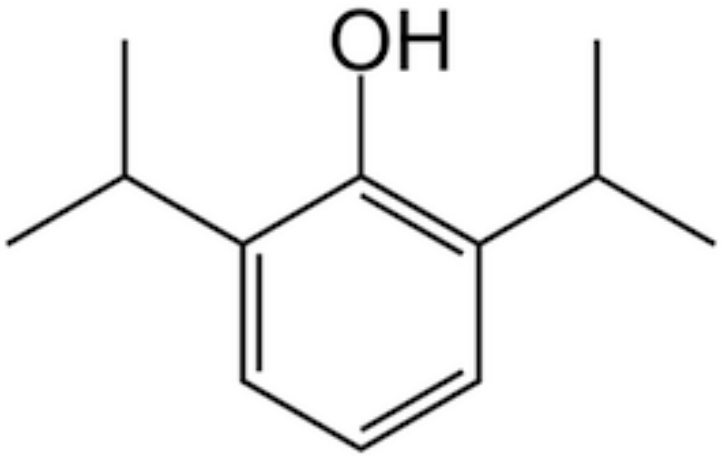


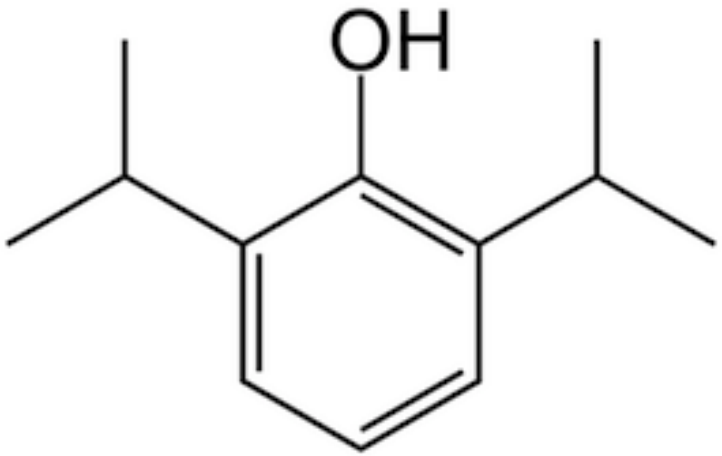
2,6-diisopropylphenol

Propofol



2,6-diisopropylphenol

Diprivan?



2,6-diisopropylphenol

Diprivan = Diisopropyl IV anesthetic

PROPOFOL – TRUE OR FALSE

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Versed

- Midazolam
- Benzodiazepine
- $GABA_A$ receptors
- Anxiolysis, sedation, amnesia
- No analgesia

Versed

- Calm patient / anxiolysis
- Relax skeletal muscle
- Slows HR and RR
- Decreases BP
- Paradoxical excitement

Fentanyl

- Synthetic opiod
- Mu(μ) opiod receptors
- Analgesia, sedation
- ~100x more potent than morphine
- Quick onset
- Short acting

Fentanyl

- Potent CNS and respiratory depressant
- Hypoventilation, desaturation, apnea
- Slows HR
- Decreases BP
- Rapid administration → rigid chest
- Slow IV push over 2-3 minutes
- Reversal → naloxone

Nitrous Oxide

- N_2O
- Dinitrogen Monoxide
- Odorless, colorless gas
- Rapid onset: 30 seconds to 3 minutes
- Eliminated unchanged from the lungs
- No significant hepatic or renal metabolism
- Not stored in tissues
- Rapid and complete recovery in 3 to 5 minutes

Nitrous Oxide

- Anxiolysis – $GABA_A$
- Analgesia – mu, $alpha_2$
- Amnesia
- Euphoria
- Hallucinations
- Dysphoria (rare)
- Initial increase in HR and RR
- Subsequent decrease in HR and RR
- Airway reflexes mostly maintained

Nitrous Oxide

- Nausea / vomiting
- Trapped gas expansion
- Diffusion hypoxia → 100% O2 for 3-5 minutes
- Vitamin B12 inactivation
- Impaired fetal development

Ketamine

- KETALAR
- Dissociative anesthetic
- NMDA receptor antagonist (primary)
- Opioid, serotonin, dopamine agonist and ACh antagonist (secondary)
- Dissociation, analgesia, amnesia
- Airway reflexes and respiration are typically maintained

Ketamine

- Increase in BP (20-30%)
- Tachycardia
- Increased ICP
- Horizontal nystagmus
- Nausea / vomiting → Zofran
- Emergence hallucinations → Versed
- Sialorrhea → Robinul

Ketamine

- Contraindications:
  - age < 3 months
  - elevated ICP
  - brain injury
  - psychosis

Propofol

- 2,6 diisopropylphenol
- DIPRIVAN = DIisoPROpyl IV ANesthetic
- $GABA_A$ receptors
- Quick onset / offset
- Sedation + amnesia
- NO analgesia

Propofol

- Bradycardia
- Hypotension
- Decrease ICP / CPP
- Airway compromise
- Respiratory depression / apnea

Propofol

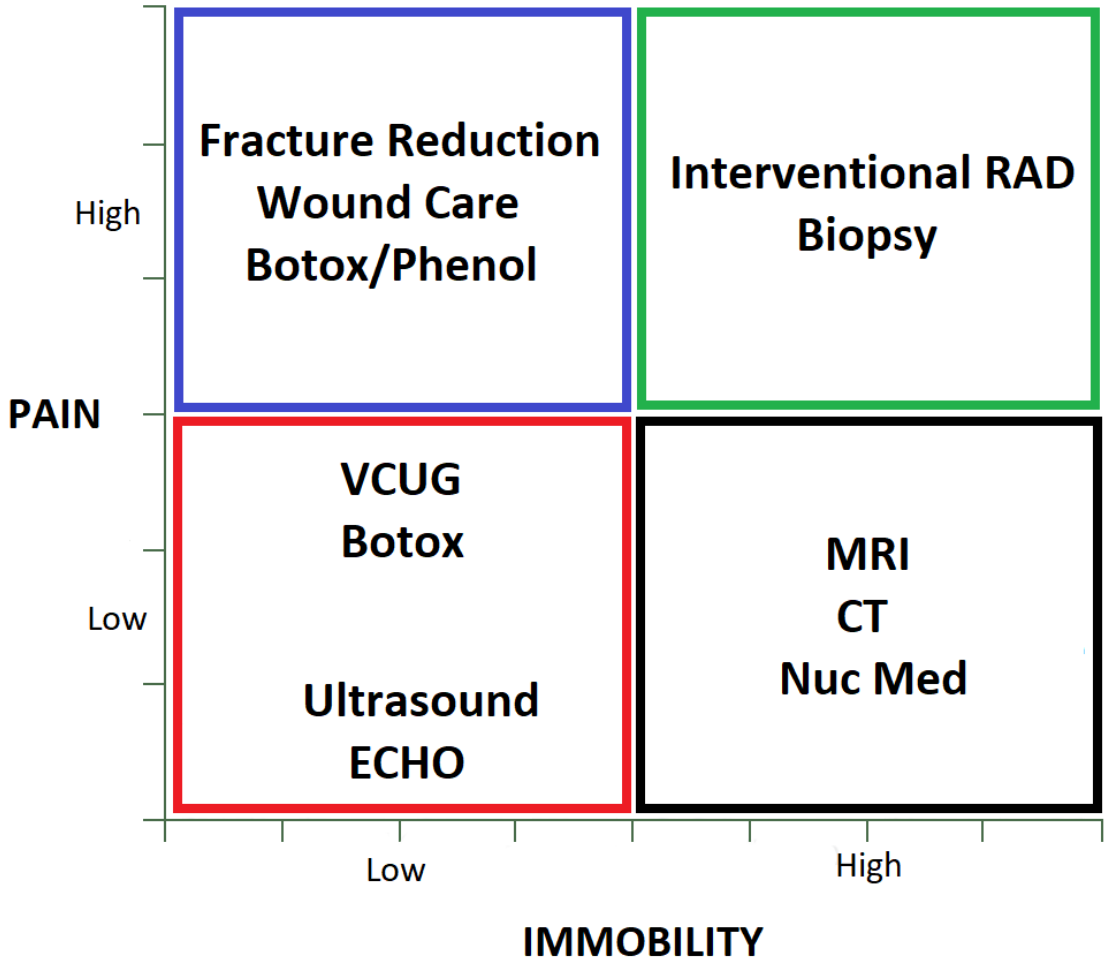
- Contraindications
  - Egg
  - Peanut
  - Soy
- Alternatives
  - Dexmedetomidine (longer/painless procedures)
  - Ketamine (short/painful procedures)
  - Moderate sedation

Propofol

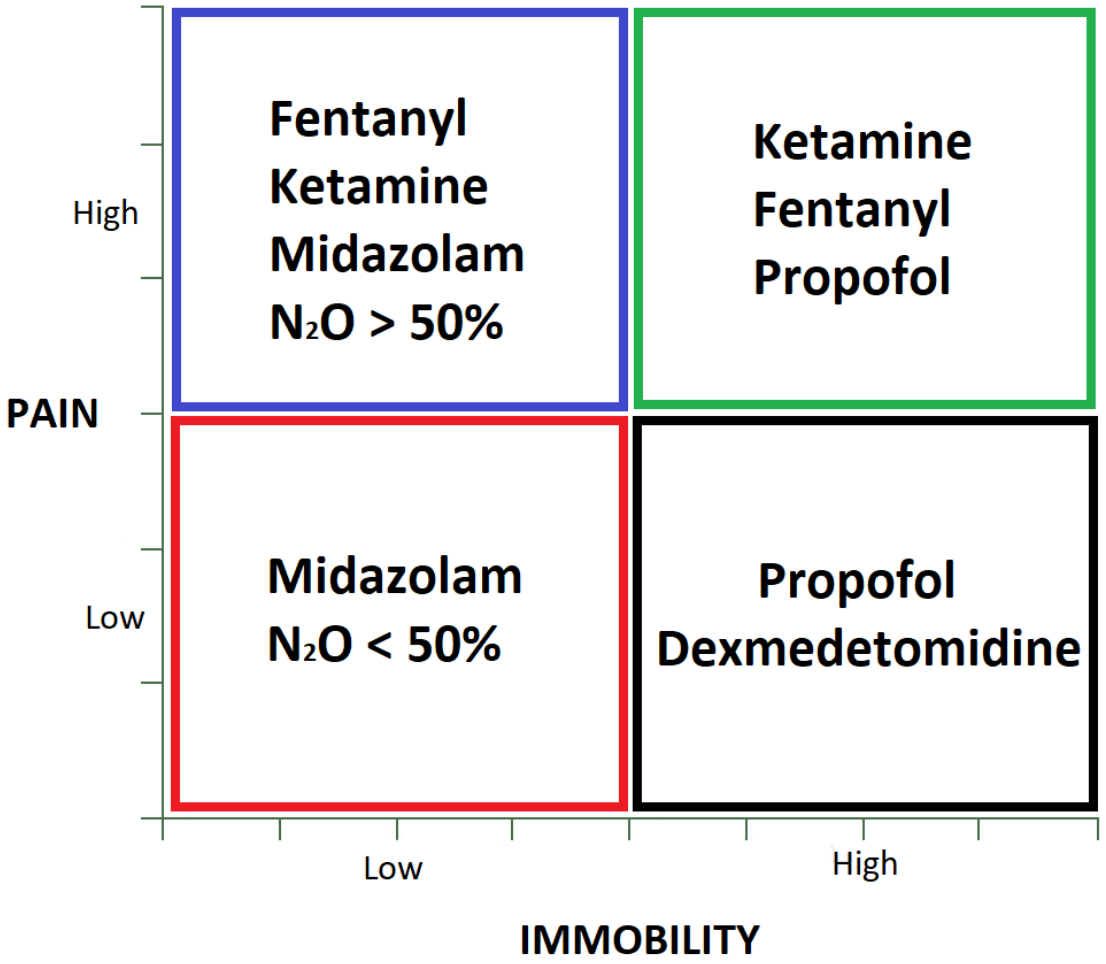
- Must be administered by IV infusion pump (i.e. no hand push)
- Induction bolus 2-3 mg/kg over 3 minutes*
- Continuous infusion 3-6 mg/kg/hr
- Bolus does 1 mg/kg as needed
- Younger patients → faster metabolism → higher mg/kg dosing

* Induction bolus can be stopped early if adequate sedation is achieved

SEDATION CONCEPTS : PROCEDURE



SEDATION CONCEPTS : MEDICATION



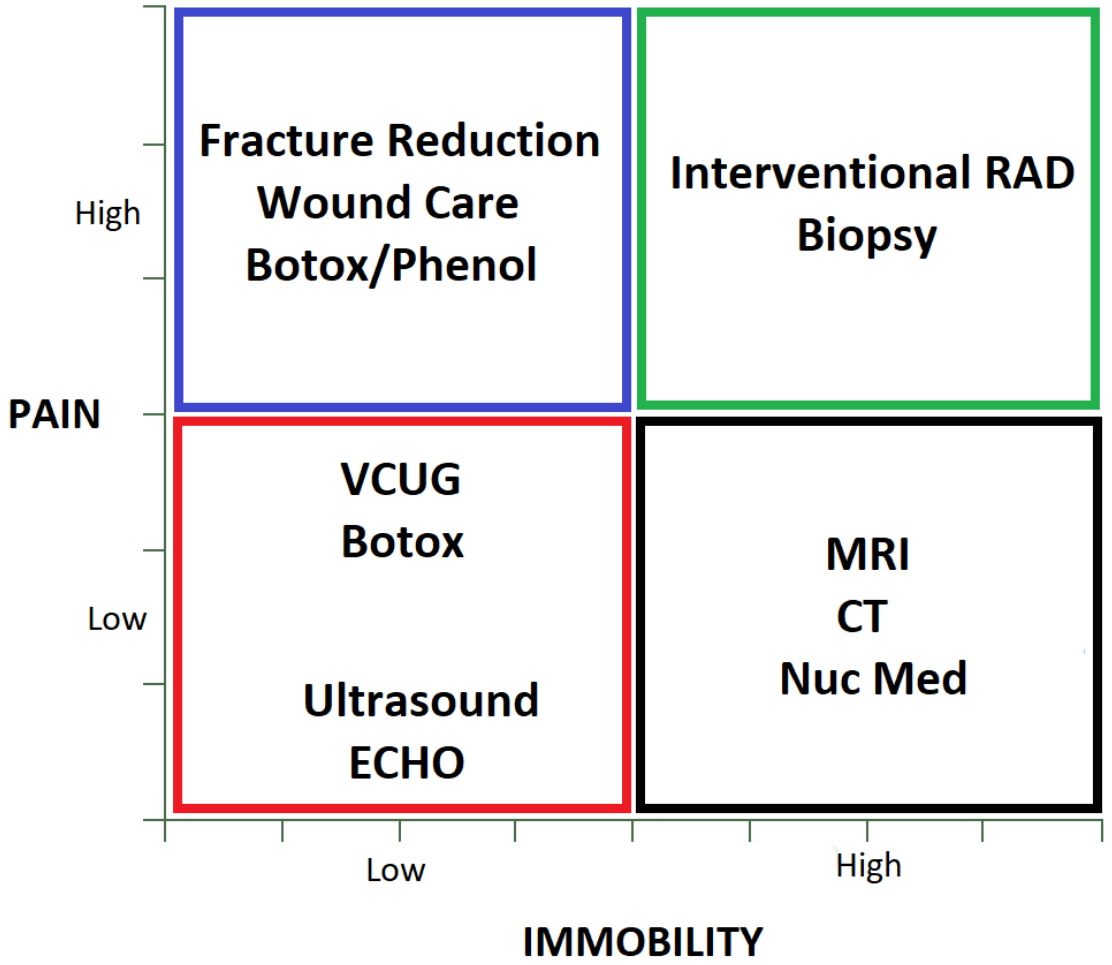
PATIENT #1

6 year old female, admitted to the hospital early Saturday morning with 1-2 days of N/V, RLQ abdominal pain and fever to 103˚. Patient had an appendectomy 8 days ago at an outside facility. Ultrasound obtained in the ED demonstrates a 3cm x 4cm enhancing fluid collection anteriorly.

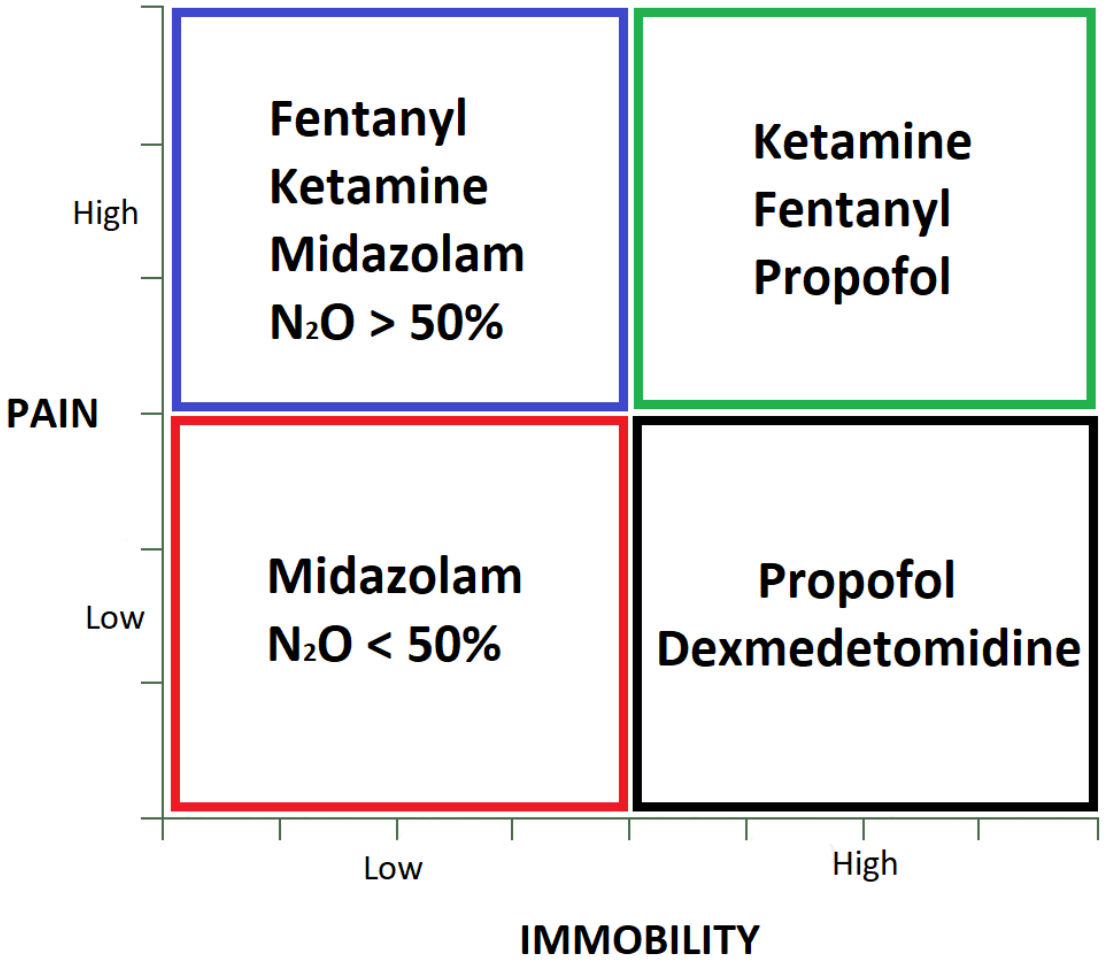
- Previously healthy
- Vitals: T=38.7 P=118 R=22 BP=119/72
- Exam: Heart + lungs normal, tenderness/guarding RLQ

† Interventional radiology is requesting sedation for percutaneous aspiration, cultures, and drain placement

SEDATION CONCEPTS : PROCEDURE



SEDATION CONCEPTS : MEDICATION



PATIENT #1

- 6 year old female
- Anterior abdominal abscess, 8 days post-op s/p appendectomy
- Percutaneous aspiration and drain placement

What is your sedation approach ?

COMBINING MEDICATIONS: ADVANTAGES

- Targeting of different neuroreceptors
- Synergistic effects (1+1=3)
- Decreased dosage of individual medications
- Improved efficacy
- Increased parent, patient, and staff satisfaction

COMBINING MEDICATIONS: DISADVANTAGES

- Increased risk for adverse events

  Cote CJ, et al. Adverse Sedation Events in Pediatrics: Analysis of medications used for sedation. *Pediatrics*. 2000; 106(4):633-44.

  "Adverse sedation events were frequently associated with . . . drug interactions, particularly when 3 or more drugs were used"

- Potential for longer recovery
- Challenges to monitoring the dose-response relationship

PROPOFOL + FENTANYL

Godambe SA, et al. Comparison of Propofol/Fentanyl Versus Ketamine/Midazolam for Brief Orthopedic Procedural Sedation in a Pediatric Emergency Department. *Pediatrics*. 2003;112(1):116-23.

- Propofol + Fentanyl: Fentanyl 1-2 mcg/kg, followed by Propofol 1mg/kg, then smaller aliquots
- Ketamine + Midazolam: Midazolam 0.05 mg/kg (2mg max), Ketamine 1-2mg/kg, then smaller aliquots

	PF (59)	KM (54)
Desaturation	18	4
Agitation	0	3
Emesis	0	2
Recovery Time	20.8	54.2
Total Sedation Time	38.9	62.1

PROPOFOL + KETAMINE (KETOFOL)

Shah A, et al. A Blinded, Randomized Controlled Trial to Evaluate Ketamine/Propofol Versus Ketamine Alone for Procedural Sedation in Children. *Ann Emerg Med*. 2011;57(5):425-33.

Children 2-17 years with isolated orthopedic injury. 140 total patients: 70 Ketamine + 70 PK

	K	PK
Sedation Time (min)	16	13
Recovery Time (min)	12	10
Adverse Events	34%	17%
Patient extremely satisfied	70%	85%
Physician extremely satisfied	57%	87%

PROPOFOL + KETAMINE (KETOFOL)

Alletag M. et al. Ketamine, Propofol, and Ketofol Use for Pediatric Sedation. Pediatr Emerg Care. 2012;28(12):1391-5.

Review of 7 published studies re: Ketofol use in pediatric patients

Resp Events	CV Events	Emesis	Agitation	Doses needed	Recovery Time
		PK < K	PK < K		PK < K
PK < P	PK ↑ HR, BP			PK < P	No difference
PK < P				PK < P	
No difference	PK ↓ hypo, brady	No difference	PK > PF	PK < P	No difference
PK > P	No difference	No difference			No difference
No difference	PK ↓ hypo	No difference	None	PK < P	
	PK ↑ HR, BP				No difference

PROPOFOL + KETAMINE (KETOFOL)

- Greater hemodynamic stability + fewer respiratory AE compared to Propofol alone
- Less vomiting and emergence dysphoria compared to Ketamine alone
- Decreased dosing of individual medications
- Excellent option for short, invasive / painful procedures

PATIENT #2

12 year old male, right forearm injury following a skateboarding accident 45 min ago:

- Previously healthy
- Vitals: T=37.0 P=92 R=20 BP=124/78
- Angulated right forearm with intact distal pulses / sensation, otherwise PE is normal
- Patient had a snack 2 hours ago

† Sedation: Orthopedics for fracture reduction and casting

PRE-INJURY "SNACK"

NPO STATUS

Green S, et al. Fasting and Emergency Department Procedural Sedation and Analgesia: A Consensus-Based Clinical Practice Advisory. *Ann Emerg Med.* 2007;49(4):454-61.

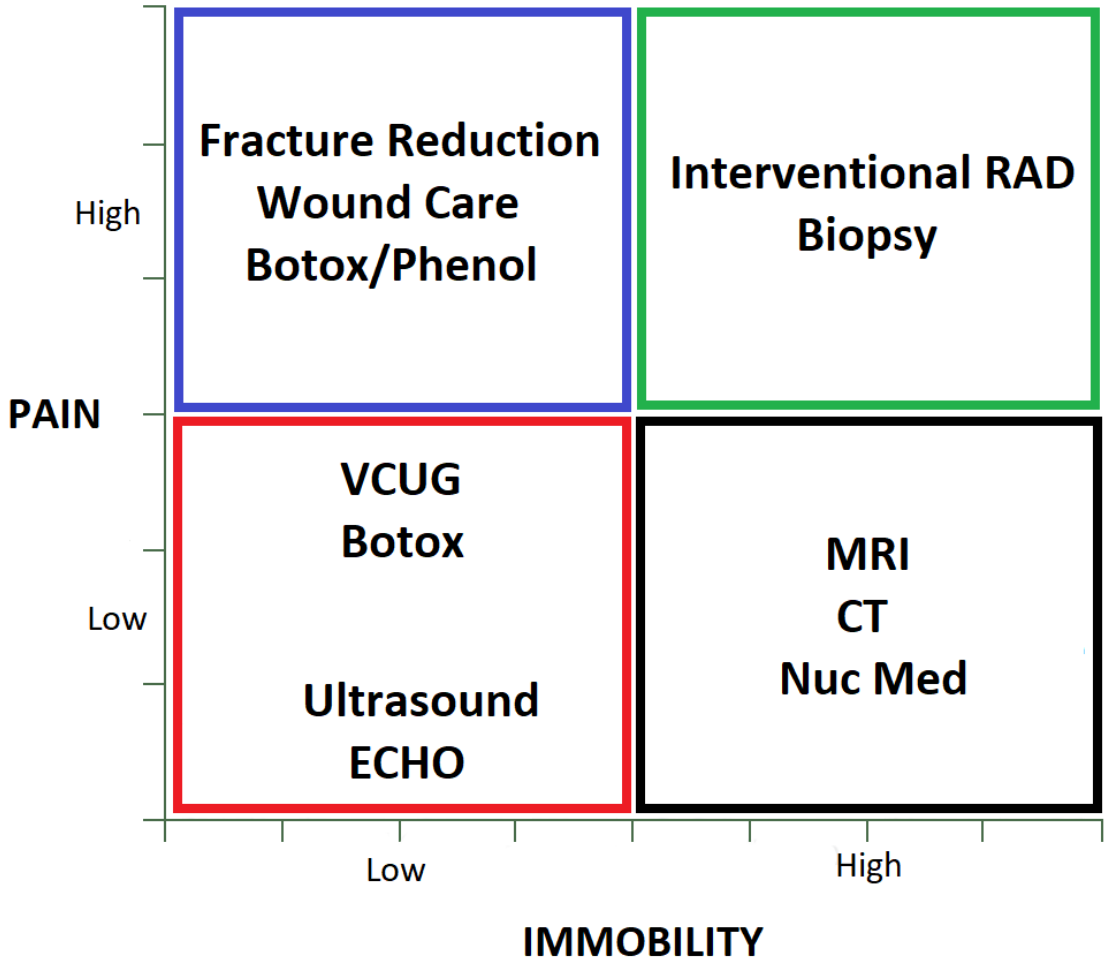
Standard-risk patient[a]

Oral intake in the prior 3 hours	Procedural Urgency[b]			
	Emergent Procedure	*Urgent Procedure*	*Semi-Urgent*	*Non-Urgent*
Nothing	All levels of sedation	All levels of sedation	All levels of sedation	All levels of sedation
Clear liquids only	All levels of sedation	All levels of sedation	Up to and including brief deep sedation	Up to and including extended moderate sedation
Light snack	All levels of sedation	Up to and including brief deep sedation	Up to and including dissociative sedation; non-extended moderate sedation	Minimal sedation only
Heavier snack or meal	All levels of sedation	Up to and including extended moderate sedation	Minimal sedation only	Minimal sedation only

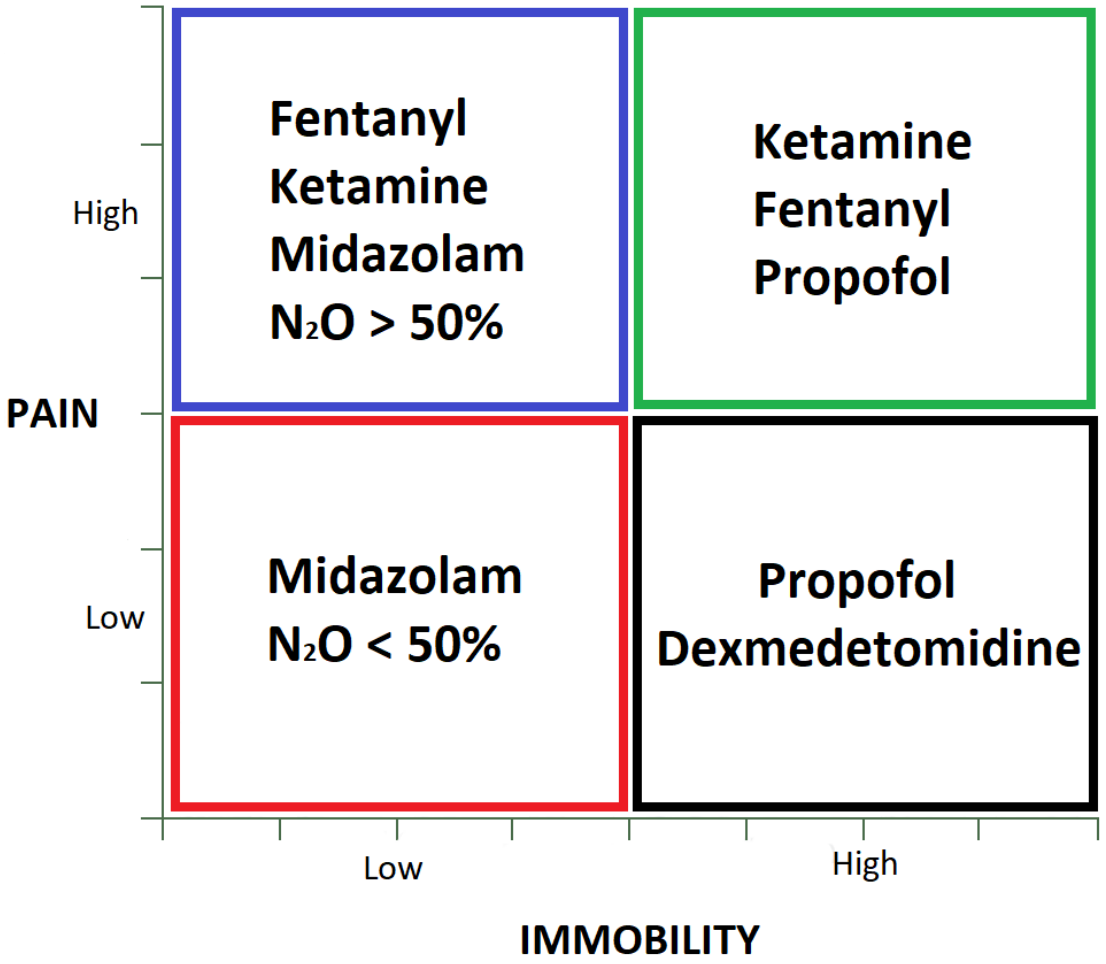
Higher-risk patient[a]

Oral intake in the prior 3 hours	Procedural Urgency[b]			
	Emergent Procedure	*Urgent Procedure*	*Semi-Urgent*	*Non-Urgent*
Nothing	All levels of sedation	All levels of sedation	All levels of sedation	All levels of sedation
Clear liquids only	All levels of sedation	Up to and including brief deep sedation	Up to and including extended moderate sedation	Minimal sedation only
Light snack	All levels of sedation	Up to and including dissociative sedation; non-extended moderate sedation	Minimal sedation only	Minimal sedation only
Heavier snack or meal	All levels of sedation	Up to and including dissociative sedation; non-extended moderate sedation	Minimal sedation only	Minimal sedation only

SEDATION CONCEPTS : PROCEDURE



SEDATION CONCEPTS : MEDICATION



PATIENT #2

- 12 year old male
- Right forearm fracture
- Full meal 2 hours ago
- Fracture reduction + cast

Sedation approach ?

IN FENTANYL + NITROUS OXIDE

Hoeffe J, et al. Intranasal Fentanyl and Inhaled Nitrous Oxide for Fracture Reduction: The FAN Observational Study. *Am J Emerg Med*. 2017; 35:710-15.

- 90 patients with mild/moderately displaced fractures or dislocations
  - IN Fentanyl dosed at 1.5 mcg/kg (additional PRN doses at 0.5 mcg/kg)
  - Either 50% N_2O or 70% N_2O
  - High satisfaction: 89% patients, 96% providers, 97% parents would want same sedation again
  - No serious adverse events
  - Vomiting ~ 12%

PATIENT #3

9 year old girl with dental caries, presenting to the dental office for extraction of 3 teeth. Patient is extremely nervous and crying hysterically in the waiting room. She has had a cough and runny nose for 6-7 days.

- Patient's mother states, "you have to knock her out completely for this, or I'm going to take her to see another dentist"
- PMHx: mild persistent asthma, well controlled on Flovent BID
- PE: T=38.1 P=110 R=22 BP=109/63
- Exam: thick yellow rhinorrhea, nasal congestion, lungs CTA (no wheezing)

† Sedation: Pediatric dentist requesting sedation for extractions

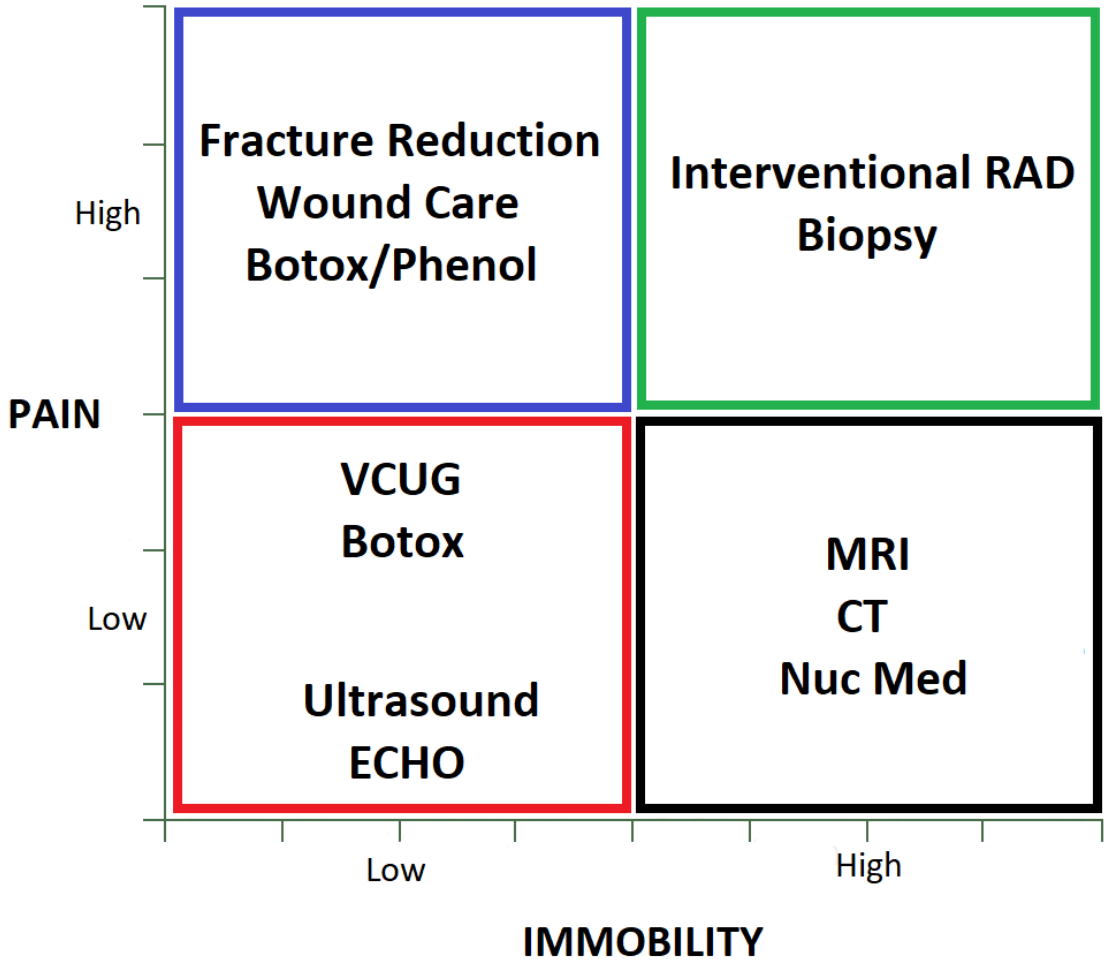
URI

Mallory M, et al. Upper Respiratory Infections and Airway Adverse Events in Pediatric Procedural Sedation. *Pediatrics*. 2017;140(1):e20170009.

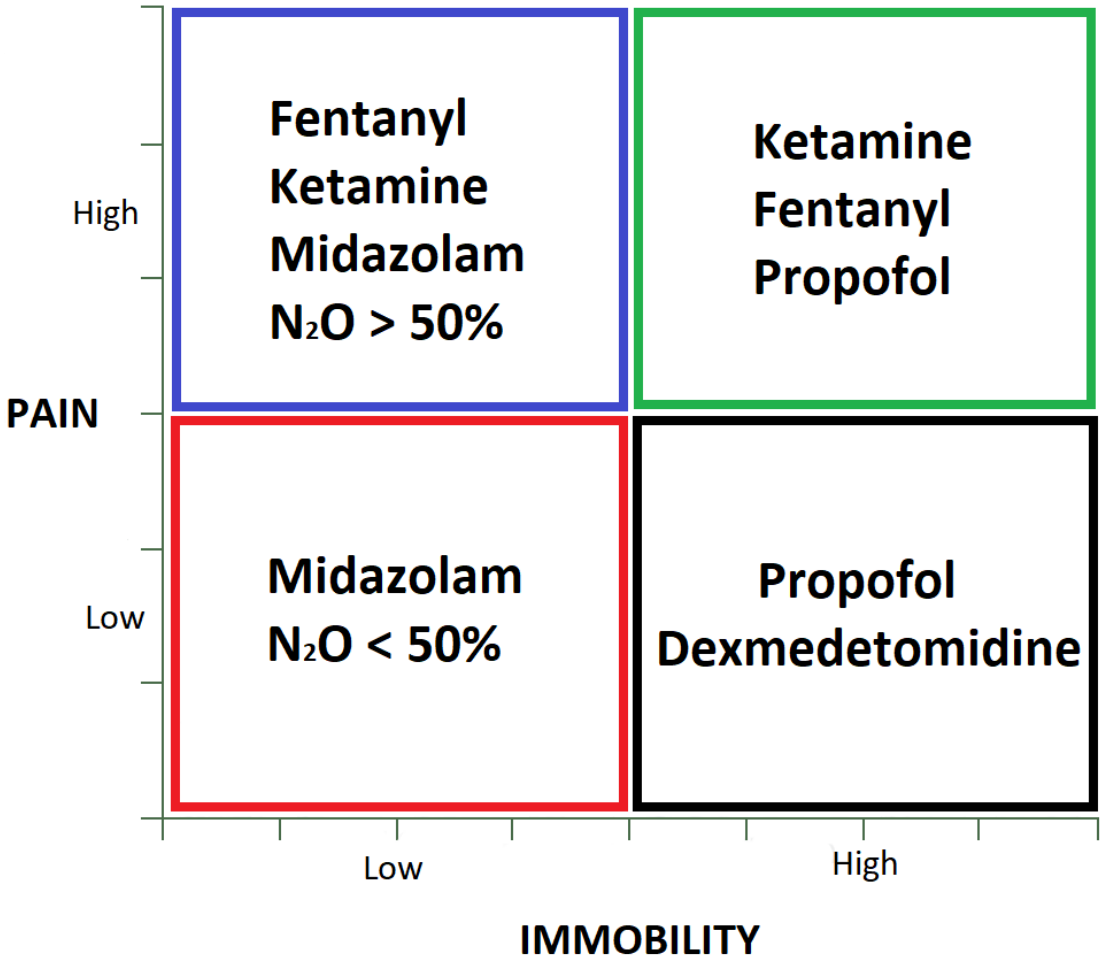
- 83,491 sedation patients

	No URI	Recent URI (2 weeks)	Current URI (clear)	Current URI (thick)	P value
Required suctioning	0.7%	1.4%	4.1%	9.0%	<0.001
Cough	1.5%	3.4%	5.9%	8.7%	<0.001
Stridor	0.1%	0.3%	0.4%	0.3%	<0.001
Desaturation	1.7%	2.2%	3.8%	8.1%	<0.001
Laryngospasm	0.3%	0.5%	0.7%	0.9%	<0.001
Any Airway Adverse Event	6.3%	9.1%	14.6%	22.2%	<0.001

SEDATION CONCEPTS : PROCEDURE



SEDATION CONCEPTS : MEDICATION



PATIENT #3

- 9 year old girl
- Dental caries
- Difficult patient + mother
- URI with thick, purulent rhinorrhea
- Dental extractions

Sedation approach ?

PATIENT #4

5 year old female, repaired Tetralogy of Fallot. Echocardiogram 2 weeks ago reports:

- Moderate pulmonic regurgitation
- No pulmonic or peripheral pulmonary artery stenosis
- Moderately dilated right ventricle

EKG: normal sinus rhythm w/ right bundle branch block

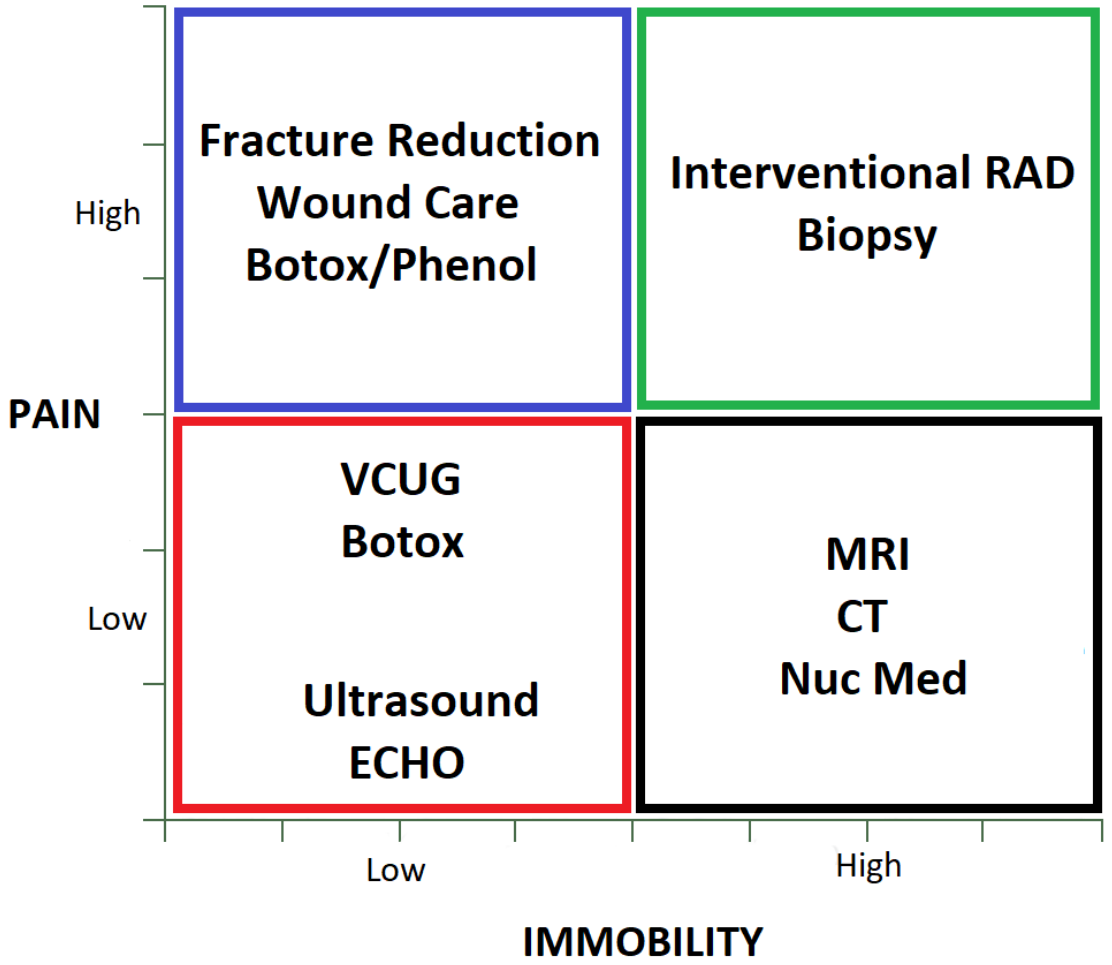
Vitals: T=37.2 P=81 R=21 BP=102/67

Exam: clear rhinorrhea. Lungs CTA. II/VI systolic / diastolic murmurs

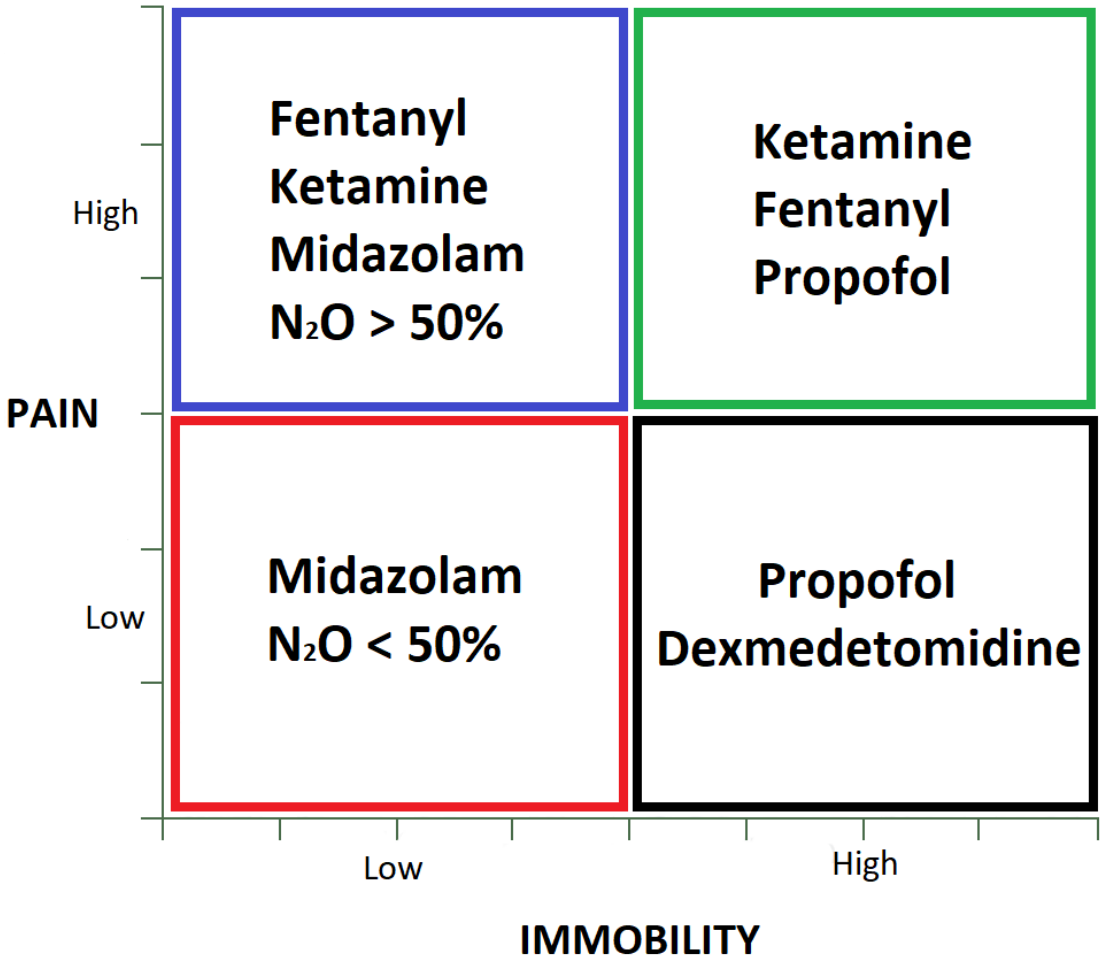
Previous sedation required large doses of Propofol. PMHx snoring.

† Sedation: cardiac MRI

SEDATION CONCEPTS : PROCEDURE



SEDATION CONCEPTS : MEDICATION



PATIENT #4

- 5 year old girl
- Repaired TOF with moderate pulmonic regurgitation + moderately dilated RV
- EKG: normal sinus rhythm w/ right bundle branch block
- II/VI systolic / diastolic murmurs
- Required large propofol doses in the past
- Snores

Sedation approach ?

PROPOFOL + DEXMEDETOMIDINE

Nagoshi M, et al. Low-dose Dexmedetomidine as an Adjuvant to Propofol Infusion for Children in MRI: A Double-cohort Study. *Pediatr Anaesth*. 2018; 28(7):639-46.

	PROPOFOL (n=172)	**PROPOFOL + DEX (n=129)**
Induction	Propofol 2-3 mg/kg	Dex 0.5 mcg/kg + Propofol 2-3 mg/kg
Total propofol given (mg/kg)	19.1	13.2
Recovery time (min)	28	27
Airway support	8.7%	2.3%

PROPOFOL + DEXMEDETOMIDINE: INDUCTION DOSING OPTIONS

	DEX	PROPOFOL
Option # 1	0.5 mcg/kg over 5 minutes	2-3 mg/kg
Option # 2	1 mcg/kg over 5 minutes	1-2 mg/kg
Option # 3	2 mcg/kg over 10 minutes	none

† A standard propofol infusion should immediately following each of these induction options

QUESTIONS

THANK YOU!!