

# PEDIATRIC AMBULATORY ANESTHESIA

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# DISCLAIMER

- I have no actual or potential conflict of interest in relation to this program/presentation.

# PEDIATRIC CLASSIFICATIONS

- Neonate: 0-4 weeks old
- Infant: 4 weeks-1 year
- Toddler: 1 year-3year
- Preschool: 4-6 years
- School Age: 6-13 years
- Adolescent: 13-18 year

T/F Pediatric Patients should be treated as small adults. *Answer is F*

# PEDIATRICS ARE NOT “SMALL ADULTS”

- Large Head
- Shorter Trachea
- Larynx is a C2-C4
- Prominent Occiput
- Cricoid is narrowest part of airway



# PEDIATRIC DIFFERENCES

- Low Percentage of Type I Muscle Fibers leads to Respiratory Fatigue
- Patent Ductus Normal until 4 weeks of age
- Large Surface Area with minimal Fat, leading to difficulty with temperature regulation.



# PEDIATRIC PHYSIOLOGY

- Blood Volume
  - 80ml/kg at birth
  - Stroke Volume Limited
  - Cardiac Output is limited due to limited Stroke Volume
    - CO strictly dependant on HR
- Contractile Element is only 30%.
  - Fluid Overload is detrimental.
- Parasympathetic Nervous System is Dominant
  - “Vagal Monsters”
  - Hypoxia, Hypothermia, stimulation such as laryngoscopy
  - Bradycardia is detrimental due to CO is strictly dependent on HR with limited SV
    - Bradycardia is commonly caused by Hypoxia



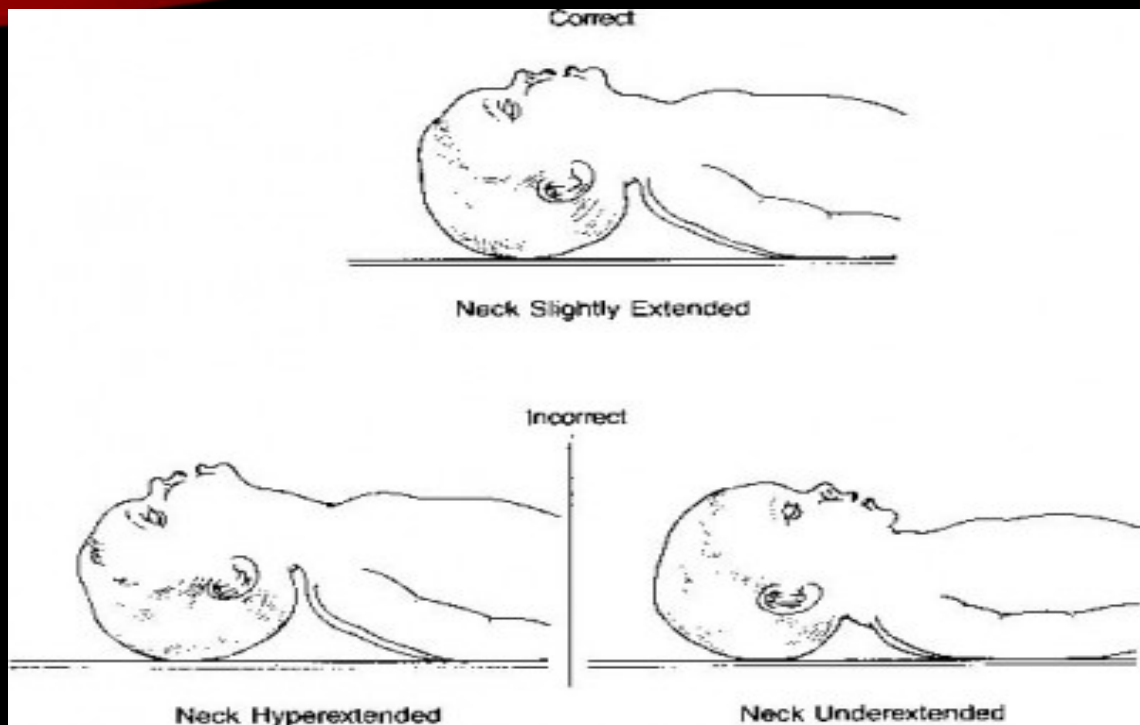
# RESPIRATORY PHYSIOLOGY

- Diaphragm Dependent
  - Limited Lateral Expansion
  - Undeveloped Accessory Muscles
- Lung Compliance is limited:
  - Only 5ml/cmH<sub>2</sub>O (Adult: 100ml/cmH<sub>2</sub>O)
  - Although Chest Compliance is High
  - Rib Cage is largely cartilaginous thus easily collapsible
  - Beware when using PCV

# RESPIRATORY PHYSIOLOGY (CONT.)

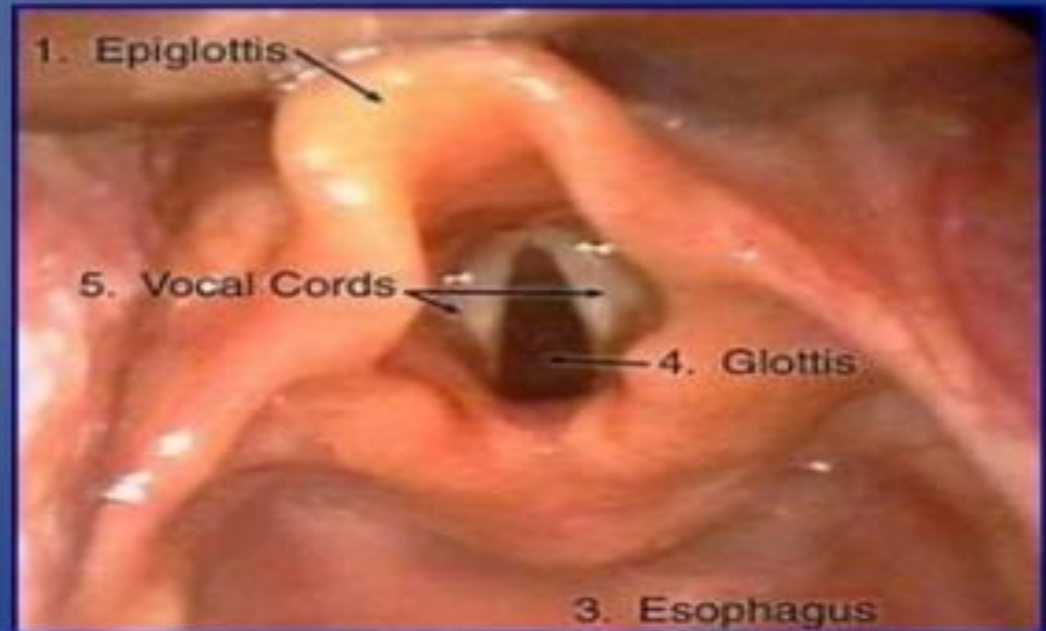
- FRC is low
  - 35%-45% decrease under GA in pediatrics 6-18 compared with adults
- Minute Ventilation is Rate Dependant
- Hypoxic and Hypercapnic drive is not developed
- O<sub>2</sub> Consumption considerably higher in Pediatric Patient (6-7ml/kg vs 3-4ml/kg)





# Airway

- Larynx
  - Anterior
  - Cephalad
  - C 4 level
- Epiglottis long & U shaped
- Trachea short
  - Neonates → 2 cm cords to carina
- Cricoid → Narrowest point until 10 yo



# RENAL PHYSIOLOGY


- Decreased Glomerular Filtration Rate (GFR)
  - Decreased Sodium Excretion
  - Decreased Glucose Excretion
  - Decreased Bicarbonate resorption
- Neonates do not have have well developed renal system

# TEMPERATURE REGULATION

- Infants unable to maintain Body Heat
  - Relatively large surface area
  - 75% of TBW is Water
  - Lower percentage of Muscle and Fat
- Neonates unable to Shiver until 1 y/o
- Thin Skin and Low Fat Content lead to increased Heat loss in the Operating Room
- Cover Head as this is a major loss of Body Heat

# PHARMACODYNAMICS

- **Volume of Distribution** significantly **HIGHER**
  - TBW is 75% water in the infant
  - Protein Binding is Decreased
  - Is increased for Hydrophilic Drugs
  - Is decreased for Lipophilic Drugs
- Hepatic Blood Flow is decreased in newborns and increased in pediatric patients
- **Immature Blood:Brain Barrier**
- Circulation Time is Shorter
- Drug Elimination half-time is increased secondary to reduced enzyme activity in the Pediatric Population



**THE CHALLENGES  
OF AMBULATORY  
ANESTHESIA**



# PRE-OPERATIVE EVALUATION: KEY TO SUCCESS

- Parents Engagement is Key
- Recent URI
- Eating Habits
  - Especially for Neonates and Infants
- Observe Pediatric Patient behavior
  - Is it Age Appropriate
  - How does the child respond to your physical assessment
- PreMature Birth
- Cardiac History

# PSYCHOLOGIC ASSESSMENT

- 0-6 months: Separation Anxiety
- 6months-2 years: Separation Anxiety
- 2-5 years: Fear of Mutilation and Pain
- 6-11 years: Loss of Control, Fear of the Unknown
- 12-18 years: Fear of Death, Pain, Loss of Identity
- Separation Anxiety is present at 9months
  - Parental Presence
  - Midazalam .5mg/kg PO

T/F Parents are key to the pre-operative evaluation. **Answer is T**

# PREMEDICATION

- Midazolam
  - PO .5mg-1mg/kg with a max of 20mg
    - Minimal Brady cardia, hypotension, O2 Desaturation
    - Only 1 in 25 were unarousable
- Dexmedetomidine
  - Intranasal Dexmedetomidine .5mg/kg
- Research shows
  - no difference in parental separation anxiety
  - Dexmedetomidine .5 mcg/kg intranasal produce more sedation than PO Midazolam .5mg/kg
- Parental Presence
  - Similar anxiety scores between Parental Presence only and Parental Presence and Pharmacologic Agent
- Recall occurs in .4% of Pediatric Patients 12-18.

# GLUCOSE

- High Glucose Utilization
  - Neonate-Infant 3-4mg/kg/min
- Low Glycogen Stores
- Predisposed to Hypoglycemia
- Fluids < 2 yr old
  - D5LR
  - D51/2NS
- Fluids > 2 yr old
  - LR
  - Plasmalyte

# SCENARIO #1

- 6 month old M for Bilateral Ear Tubes/Tonsillectomy and Adnoidectomy
- Hx of Chronic Ear Infections
- Hx of GERD
- Obese
- URI within last week

How do you plan your anesthetic and why?

# RECENT URI: TO PROCEED OR NOT

- Recent URI with symptoms
  - Fever (>38 C)
  - Thick and colored Mucous
  - Dyspnea
  - Hx of Asthma
- Type of Procedure
- Hx of Obstructive Sleep Apnea
- Research states to wait 2 weeks unless this surgery will alleviate the recurrent URI's.



# SCENARIO #2

- 3 yr old F Patient for Bilateral Inguinal Hernia
  - Recurrent URI
  - Premature at 34.5 weeks
  - Parents Smoke in the Home
  - Mild Developmental Issues noted
- 
- Anesthetic Plan and Why?

# AIRWAY ANATOMY

- Large Head
- Narrowest Point: The Cricoid Cartilage is the narrowest spot in the pediatric airway
- Tongue is larger in the pediatric population
- Mask Induction

# MASK VENTILATION

- Inhalation Induction is Ideal for Pediatric patients
  - Less Traumatic
  - Sevoflurane is ideal agent
- Select appropriate size of FM for Mask Induction
- After Patient is asleep maintain open airway
- Allow patient to spontaneously breath until ready for placement of secured airway.

# MUSCLE RELAXANTS

ED 95 for muscle relaxants  
(Rapid intubating dose is 1.5-2 x ED 95)

Agents	Infants mg/kg	Children mg/kg
Succinylcholine	0.7	0.4
Rocuronium	0.25	0.4
Cisatracurium	0.05	0.06
Vecuronium	0.05	0.08

# GERD AND PONV

- Pediatric Patients are at a significant higher risk for GERD
  - Shorter Esophagus
  - Excessive Air Swallowing in infants secondary to crying
- Neonate and Infant Patients can not voice complaint of GERD
- Incidence of PONV in Pediatrics (> 2 yr old) is 40% (2x that of adults)
  - Strabismus Surgery
  - Tonsillectomy
  - Inguinal Hernia

# FLUIDS AND NPO

- NPO
  - Solids and Formula: 6h
  - Breast Milk: 4h
  - Clear Fluids: 2h
- Do not infuse deficit or replace EBL with glucose containing fluids
- Gastric pH
  - Neonate- lower for first 8 days after birth
- Use a measured Buretrol in Patients <1.
  
- **In the Ambulatory Setting encourage Clear Liquids until 2 hr. before**



# EMERGENCY DELIRIUM

- Pediatric patients commonly experience symptoms of delirium on emergence
  - Non-purposeful restlessness
  - Crying
  - Incoherent verbalization
  - Disorientation
- No Single Factor has been identified
  - Biologic
  - Pharmacologic
  - Physiologic
  - Social
- Symptoms can last up to 45 minutes

# PITFALL

ATARI



COMPLETE GAMEPLAY



OF PEDIATRIC  
ANESTHESIA

# KEY QUESTIONS

Which of the following is a challenge related to Pediatric Ambulatory Anesthesia?

- a. URI
- b. Obesity
- c. Airway Anatomy
- d. Emergence Delirium
- e. All the Above

The Answer is E

# PITFALLS OF PEDIATRIC ANESTHESIA

- Succinylcholine
  - Infants are at a significant higher risk for cardiac arrhythmias, hyperkalemia, myoglobinemia, profound bradycardia following first dose of succinylcholine
  - Should cardiac arrhythmias develop look at hyperkalemia as the cause
- Obstructive Sleep Apnea
  - Tonsillectomy and Adnoidectomy
  - Sedation Procedures
  - Retrospective Closed Claim Study showed early detection and post operative awareness as well as management of OSA would prevent 16% of cases ending in death or permanent brain damage.
  - Cases of OSA associated with obesity should be done in a facility where patient can be monitored for overnight.

# PITFALLS (CONT.)

- Parental Separation
- PACU
  - Staff that is comfortable with Pediatric Patients
- Adequate Pain Control
  - Regional and Local
  - Acetaminophen Suppository
  - Opioids

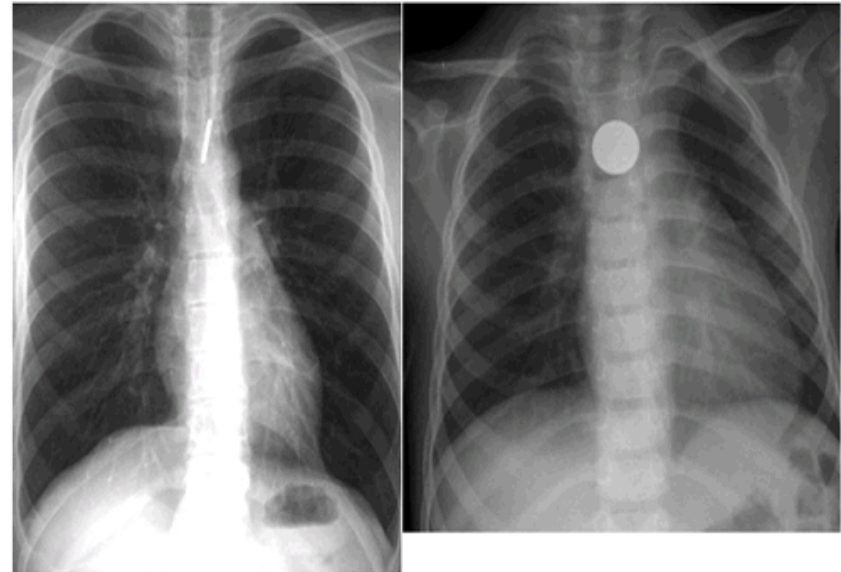


**DIFFICULT OUTPATIENT  
PEDIATRIC CASES**

# FOREIGN BODY ASPIRATION

- Esophageal or Tracheal
- Acute Onset of symptoms
  - Stridor-Supraglottic
  - Wheezing- Subglottic
- Induction
  - RSI-Subglottic
  - Inhalation induction-Supraglottic
- Be Cautious if the object is Supraglottic

**Figure 4.** Sagittally Oriented Coin



A rare view of sagittally oriented coin in the esophagus (left), a more classic radiograph of an esophageal coin seen en face (right).

Reprinted with permission from the *American Journal of Roentgenology*. Schlesinger A, Crowe JE. Sagittal orientation of ingested coins in the esophagus in children. *AJR* 2011;196:670-672.





# KEYS TO SUCCESS

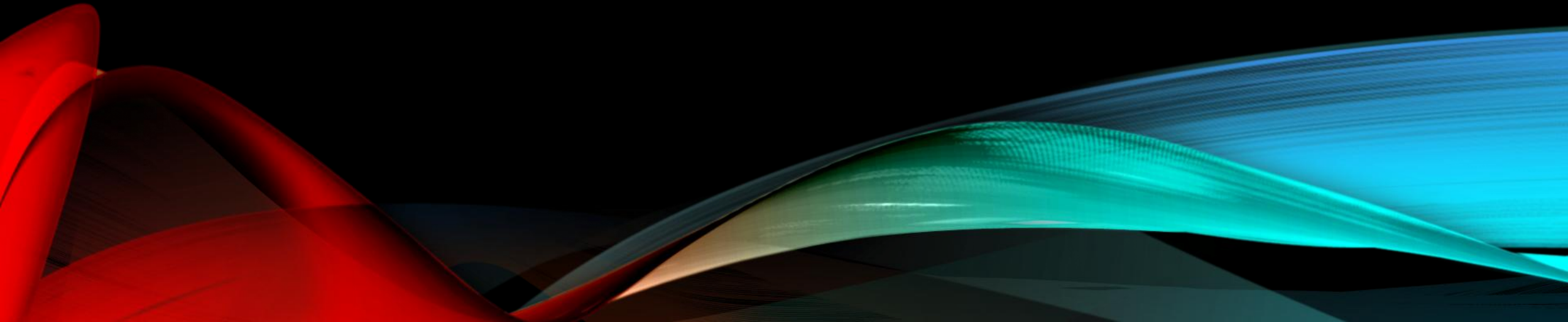
# REGIONAL ANESTHESIA

- Absolutely can use Peripheral Nerve Blocks
- In Pediatric Patients >1 year
  - Faster Onset
  - Shorter Duration
- New research showing that neuraxial blocks on pediatrics significantly lowers opioid use.
  - Data does not show increased risk in pediatric patients
- Consider using CPNB due to shorter duration of Single Shot
- Place under GA with UltraSound

# SUMMARY

- Pre-Assessment
  - Physical
  - History
- Important to address Parents in the Process
  - Remember Parent Satisfaction is key to a positive HCAPS Score
- Premedication
  - Be alert in the Ambulatory Setting
- Use Regional and Local if applicable
  - Decrease Opioid Use
- **Remember that patient will be discharged to home.**

# QUESTIONS AND COMMENTS



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