PEDIATRIC AMBULATORY ANESTHESIA

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• 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-3 years
- Preschool: 4-6 years
- School Age: 6-13 years
- Adolescent: 13-18 years

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.

Special Perioperative Considerations: Paediatric Patient
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/cmH2O (Adult: 100ml/cmH2O)
  • 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
- O2 Consumption considerably higher in Pediatric Patient (6-7ml/kg vs 3-4ml/kg)
Correct
- Neck Slightly Extended

Incorrect
- Neck Hyperextended
- Neck Underextended

Simple Extension is sometimes all that is required to bring an infant into optimal "shifting position".
Airway

- Larynx
  - Anterior
  - Cephalad
  - C 4 level
- Epiglottis long & U shaped
- Trachea short
  - Neonates $\rightarrow$ 2 cm cords to carina
- Cricoid $\rightarrow$ 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 a 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
• 6 months-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 9 months
  • 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)

<table>
<thead>
<tr>
<th>Agents</th>
<th>Infants mg/kg</th>
<th>Children mg/kg</th>
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</thead>
<tbody>
<tr>
<td>Succinylcholine</td>
<td>0.7</td>
<td>0.4</td>
</tr>
<tr>
<td>Rocuronium</td>
<td>0.25</td>
<td>0.4</td>
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<tr>
<td>Cisatricurium</td>
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<td>0.06</td>
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<tr>
<td>Vecuronium</td>
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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
EMERGENCE 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
OF PEDIATRIC ANESTHESIA
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
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
REFERENCES

• Bannister, C. “Pediatric Anxiety, Premedication, and Awareness. Where Are We Now?” PedsAnesthesia.org/meetings/2004winter


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