Special Populations: Pediatric, Geriatric and Pregnant Patients

Objective

- Identify special anatomical and physiologic considerations unique to pediatric, geriatric, and pregnant patients to consider throughout the phases of perianesthesia care

Special Populations

Pediatrics

- Premature Neonate – born prior to 40 weeks gestation
- Newborn - < 72 hours old
- Infant - < 1 month old or 1 to 12 months old
- Toddler – 1 to 3 years old
- Preschool – 3 to 6 years old
- School age – 6 to 12 years old
- Adolescent – 12 to 18 years old
Respiratory Differences

- Small mandible
- Short neck
  - compromises airway
  - difficult intubation

Respiratory Differences

- Small nares
  - obligate nose breathers
  - flare with distress particularly in preemies and neonates
- Large tongue
  - obstructs airway

Facial Differences

Pierre Robin

www.chw.org/.../Groups/CSG/Cranio_Pix_1.jpg
www.dentaldiseases.info/images/pierre_robin_s...
**Respiratory Differences**

- Large amount of upper airway lymphoid tissue – pressure on airway structures
- Tonsillar tissue enlarged until school age

**Physiological Differences**

- Glottis normally is high, narrower and stiffer than adult, u-shaped
- Intubation is more difficult
- Increases chances for airway obstruction and edema

**Subglottic Stenosis**

- Represents narrowing and stiffening of the pediatric airway – increases potential for difficult intubation
- Suspect in patients with hx of: croup, Down syndrome and any other ‘syndromes’
Respiratory Differences

- **Trachea**
  - Child: 22 – 29 cm
  - Adult: 74 - 76 cm

- **Larynx location**
  - Infant: C3 – C4
  - Adult: C4 – C5 (by age 6)

- **Diameter**
  - Child: 4mm
  - Adult: 8mm

1 mm edema in pediatric airway = 75% obstruction

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Respiratory Differences

- **Cricoid Cartilage**
  - Adults
    - Complete ring that prevents upper airway compression
  - Infants
    - < 1 year, collapsible, narrowest part of airway, more susceptible to edema

**OPTIMAL AIRWAY POSITION FOR INFANT IS NEUTRAL OR ‘SNiffING’ POSITION**

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The Pediatric Chest Wall

- **Chest wall**
  - 2x as compliant as adult
  - Encloses the lungs and does not open the chest as readily on inspiration

- **Anything that impedes diaphragm movement can lead to respiratory distress**
  - Abd distension, decreased Abd wall compliant
Muscles Used in Work of Breathing

- Are poorly developed; diaphragmatic and intercostal muscles deficient in type I muscle cells
- Type I muscle cells perform repeated exercise associated with respiration
- Increased work of breathing easily fatigues muscles of respiration; Type I cells reach adult levels at age 2

Respiratory Control Center

- Is easily fatigued
- Periods of apnea common
- As oxygen demands increase, center fatigues faster

Respiratory Rate

- Newborn 30 – 50 bpm
- Infants 30 – 60 bpm
- Toddlers 24 – 40 bpm
- Preschool 22 – 34 bpm
- School age 18 – 30 bpm
- Adolescents 12 – 16 bpm
Respiratory Rate

- Higher in younger children to meet demand and compensate for smaller FRC

- Resp rate of 60 bpm is a sign of respiratory distress in a child of ANY age

Hypoxia

- Lethargy to restlessness
- Hypotension to hypertension
- Tachycardia to bradycardia

Signs / Symptoms of Laryngospasm

- Dyspnea
- Crowing sounds
- Hypoventilation
- Hypoxia
- Hypercarbia
- Breath sounds diminished or absent
- Increased work of breathing
**Treatment**

- Elevate HOB
- Positive pressure ventilation with bag to mask
- Meds
  - Oxygen, racemic epinephrine, decadron, lidocaine, atropine, subtherapeutic does of muscle relaxant, reintubate
- May be due to artificial airway irritation
  - Remove airway

**Bronchospasm**

- Lower airway obstruction
- Causes
  - Asthma, allergy/anaphylaxis, histamine release, aspiration, mucous plug, foreign body
- Signs / Symptoms
  - Wheezing, shallow noisy resps, retractions, dyspnea, tachypnea, dec. saturation

**Treatment of Bronchospasm**

- Inc. oxygen
- Remove irritant
- Administer muscle relaxants
- Deepen anesthesia
- Bronchodilators
- Terbutaline
- Epinephrine
- Antihistamine
### Croup

- Barking, hoarse cough
- At risk 1 to 4 years olds
- Causes
  - Traumatic intubation, long duration of intubation, OET too large causing edema of chords, prolonged coughing on OET, surgical trauma

### Croup

- Treatment
  - Humidified oxygen, steroids, aerosolized epinephrine, hydration, observe
- Have patient evaluated by MDA prior to DC

### Other Common Respiratory Issues

- Aspiration
  - Position pt!
- Atelectasis
- Non-Cardiogenic Pulmonary Edema
  - Older children
  - Coughing on closed epiglottis increases intra-thoracic pressure
  - Trauma to alveoli
Non-Cardiogenic Pulmonary Edema

- Bucking, coughing on closed glottis
- Narcan
- Signs / symptoms
  - Low oxygen saturation which can not be explained, confirmed on CXR
- Treatment depends on patient

Signs of Impending Respiratory Failure

- Falling oxygen saturation
- Cyanosis, tachypnea
- ? CV compromise
- Possible hemodynamic instability

Cardiovascular Considerations

- Cardiac Output
  - 30 - 50% higher in infant to meet oxygen demands
  - Depends on heart rate and circulating blood volume
  - Children may remain normotensive until 25% of their blood volume is lost
**Cardiovascular Considerations**

- First sign of dysfunction seen in HR or pulse
- Should monitor apical pulse or heart rate until age of 6

**Bradycardia**

- First sign of decompensation in younger children
- Other possible causes of bradycardia in children: anesthetic agents, atropine, crying, anxiety, parasympathetic stimulation (suction, defecation)

**Cardiovascular Considerations**

- Stroke volume is fixed ~ myocardium is less contractile than adult
- So increasing fluids (preload) will NOT increase cardiac output
- To increase cardiac output, increase heart rate with meds NOT fluids
Pediatric ECG

- T waves are much larger
  - electrodes closer to the heart
- T waves may be the same size as QRS
  - watch double counting
- Snap electrodes to leads before applying to chest to avoid rib fracture

Heart Rates
Beats per Minute

<table>
<thead>
<tr>
<th>Age</th>
<th>Awake</th>
<th>Asleep</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newborn</td>
<td>100–180</td>
<td>80–160</td>
</tr>
<tr>
<td>Infants</td>
<td>100–160</td>
<td>75–160</td>
</tr>
<tr>
<td>Toddlers</td>
<td>80–110</td>
<td>60–90</td>
</tr>
<tr>
<td>Preschool</td>
<td>70–110</td>
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</tr>
<tr>
<td>Adolescents</td>
<td>60–90</td>
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</tr>
</tbody>
</table>

Tachycardia

- Normal response
  - Attempts to increase cardiac output
- Causes
  - Dec. perfusion due to impending shock, inc. temp, pain, early resp distress, full bladder/bowel or stomach
- Treat the cause
Bradycardia

- Classic hallmark sign
  - Usually seen first (or drop in oxygen saturation?)

- Causes
  - Hypoxia, respiratory distress, late sign, vagal response, increased ICP

Emergence Delirium

- Occurs in 18% of all children emerging
- Dissociative state
- No response to verbal commands
- Factors that may cause: pre op anxiety, pain, hypoxia, hypotension, distended bladder

Emergence Agitation

- ‘mild state of restlessness and mental distress’ by D. Moos, JOPAN, (20)1, 2005
- Cause
  - Hypoxia, hypercapnia, airway obstruction, residual muscle relaxation, pain, gastric distention, urinary retention, cerebral embolism, hemorrhage or hypoperfusion, metabolic issues
Postanesthesia Care

- Regression common
  - Expect and Respect it!!!!
- A crying child is a healthy child

Endocrine Issues

- Thermoregulation
  - Larger surface area in relation to body weight = greater environment exposure and increased heat loss
  - Infant core temp 1 degree > than adult
  - 75% body heat can be lost through head
  - Infant temperature regulating mechanism is immature

Thermoregulation

- Relatively small amount of subcutaneous fat to minimize heat loss
- Unable to produce heat through shivering
Hypothermia

- Increases metabolism
- Increases oxygen consumption
- Leads to metabolic acidosis

Hyperthermia

- Suspect infection or MH
- Lower temp gradually; DO NOT uncover completely

Metabolic Considerations

- Normally have increased metabolism which increases oxygen demand
- Result
  - Hypoxemia, hypoglycemia, metabolic acidosis, dysrhythmia and delayed arousal from anesthesia
GI Considerations

- Increased salivation
- Increased peristalsis causes increased gastric secretions
- Immature lower esophageal sphincter more prone to reflux which increases the risk of aspiration

Developmental Stages

- Infant
  - Trust vs. Mistrust
- Toddler
  - Autonomy vs. Shame and Doubt
- Preschool
  - Initiative vs. Guilt
- School age
  - Industry vs. Inferiority
- Adolescence
  - Identity vs. Role Confusion

Infants
Trust vs. Mistrust

- Fears: separation, stranger anxiety
- Are curious
- Do experience pain
**Toddler**

**Autonomy vs. Shame**

- **Fears**
  - separation, injury and pain, loss of control
- **Interventions**
  - parental involvement in care, familiar objects, prepare immediately before procedure, offer choices – returns some control

**Preschool**

**Initiative vs. Guilt**

- Developing initiative
- **Fears:** separation, injury & pain, mutilation, pain as punishment, loss of control
- **Regression**
- **Aggressive behavior with loss of control**

**School Age**

**Industry vs. Inferiority**

- Development of industry
  - increased language, learns rules, cooperation
- **Fears**
  - separation, loss of control, helplessness, anger over dependence, physical disability, pain, death, mutilation, guilt about illness
Adolescent Identity vs. Role Confusion

- Characterized by marked physical changes
- Achieves identity through peer pressure and role experimentation
- Strong privacy needs

Response to Pain According to Developmental Stage

- Infant ~ Trust vs. Mistrust
  - crying, flailing arms & legs
- Toddler ~ Autonomy vs. Shame
  - screaming, clinging, total body resistance, localization by pointing
- Preschool ~ Initiative vs. Guilt
  - crying, hitting, kicking, withdrawing, clinging

Response to Pain According to Developmental Stage

- School age ~ Industry vs. Inferiority
  - passive coping techniques, describe pain with a variety of words and phrases
- Adolescent ~ Identity vs. Role Confusion
  - increased body control, maintain composure, embarrassment, loss of privacy may be as stressful as pain
Postanesthesia Care

- Resp issues: position patent to promote drainage off vocal cords and optimize respiration, at risk for croup
- Bradycardia often first sign of hypoxia
- Have appropriate size equipment available

Case Study

- 5 year old female
- Tympanoplasty
- ? Family history of “anesthetic problem”
- No previous surgery

Case Study

- 11 month old male for hypospadias repair
- Parents very anxious
- 4 year old sister with URI, productive cough, exposure to chicken pox
Case Study
- 26 month old male for burn scar revision L anterior thigh and abdomen
- h/o 4 previous surgeries
- Injury occurred at grandparents house

Case Study
- 17 year old male for left ACL repair
- “star” quarterback of the high school football team

Special Populations
Geriatric Patients
Special Populations
The Geriatric Patient

Cardiovascular Changes
- Arteriosclerosis
- Left ventricular hypertrophy
- Myocardial irritability
- Decreased contractility

CV Changes Can Result In

- Decreased organ perfusion
- Increased systolic BP
- Dysrhythmias
- Valve incompetence
- Decreased cardiac output and reserve

Respiratory Changes in Aging

- Increasing A-P diameter
- Progressive flattening of diaphragm
- Loss of diaphragmatic muscle tone/strength
- Increased chest wall rigidity
- Decreased alveolar surface
- Loss of skeletal muscle mass
Effect of Respiratory Changes

- Progressive decrease in arterial oxygenation
- Diminished responsiveness to hypoxia and hypercapnia
- Reduced pulmonary elasticity
- Decreased chest wall mobility
- Increased air trapping

Effect of Respiratory Changes

- Decrease in TV, FRC, and vital capacity
- Increased airway resistance
- Potential for increased obstruction
- Decreased cough and gag reflexes

Renal Changes

- Progressive decrease in renal function
- Decreased blood flow to kidneys
- Decreased clearance of medications, metabolites
- Fluid overload
- Inability to conserve sodium
- Response time to correct fluid and electrolytes is increased
Other Changes

- Loss of fat
  - thermoregulation problems, pressure to bony prominences
- Visual, auditory and tactile changes
- Changes in cognition
  - associated with atherosclerosis, CVA, dementia, Alzheimers, Parkinson’s, or depression

Signs of Elder Abuse

- Poor hygiene
- Malnourished or dehydrated
- Burns, pressure sores, bruises
- Patient may verbalize fear of caregiver

Signs of Elder Abuse

- Caregiver reluctant to leave patient alone with staff
- Must report per State / facility protocol
Case Study

- 60 year old female for rhytidectomy
- Takes valerian, vitamin E 1200 iu bid, ginkgo
- h/o mild hypertension

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Case Study

- 70 year old male physician for wide excision of facial melanoma
- h/o panic attacks
- Flying home after surgery

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Special Populations
The Pregnant Patient
Special Populations
The Pregnant Patient

Cardiovascular Changes
- Total blood volume ↑~ 30-40% or 1 to 1.5 liters
- RBC volume ↑~20%
- Plasma volume ↑45-50%
- Total body water ↑~ 6-8 liters

Cardiac Output in the Pregnant Patient
- Cardiac output
  - volume of blood ejected from the heart over 1 minute
- Norm 4-8 liters/min
- Pregnant Body C.O. ↑ 20-50%
  - 6-7 liters/min, at rest 4-6 liters/minute

Heart Rate
- Increases 10 – 15 beats per min during second trimester
- Returns to normal 6 weeks postpartum; many maternal physiologic changes return to prepregnant norm after 6 weeks, not after delivery
**Pulmonary Changes in Pregnancy**

- Oxygen consumption ↑15-25% to accommodate maternal/fetal hyperdynamic function
- Resp rate ↑15%
- Tidal volume ↑40%
- Hyperventilation is normal
- Pregnancy is a state of compensatory resp alkalosis

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**GI Changes in Pregnancy**

- Anatomic and physiologic changes place patient at risk for
  - Silent regurgitation
  - Active vomiting
  - Pulmonary aspiration

- All pregnant women are considered full stomach and at risk for aspiration

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**The Pregnant Patient in the PACU**

- Oxygen!! Helps meet demand for Mom and baby
- BP NOT reliable indicator of hypovolemia or shock
  - Blood loss may reach 35% before hypovolemic shock occurs
  - Earliest sign – mild tachycardia without changes in BP
Case Study

- 37 year old G3P0 female for diagnostic laparoscopy and hysteroscopy
- h/o infertility

Case Study

A 33 year old female, 31 weeks pregnant, to OR for ORIF of fractured right ankle under general anesthesia. Admitted to PACU post procedure.

Case Study

While in Preop, a 16 year old is being prepared for an appendectomy. Her pregnancy test comes back positive.
Case Study

- 24 year old female is admitted to PACU after a cholecystectomy with general anesthesia. Last week, she delivered a healthy baby by c-section.

Bibliography


Thank you!