Anatomy and Assessment of the Pediatric Airway
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Topics
- Airway anatomy
- Differences between children and adults
- Respiratory Assessment
- Cardio respiratory monitoring

Anatomy and Function of the Respiratory System
- Respiration is the act of breathing.
  - Inhaling (inspiration) is taking in of air to supply oxygen to body tissues.
  - Exhaling (expiration) is the giving off of the waste product carbon dioxide
- The respiratory system is divided into the upper and lower airway.
Pediatric Upper Airway

Trachea below vocal cords

Size of trach tube dependent on diameter of airway and distance to carina

Pediatric Lower Airway

Bronchi branch out
Gas exchange in alveoli

What is a Tracheostomy?

A surgical opening in the trachea which bypasses the nose and mouth

Vertical or horizontal incision in the trachea
Stay sutures placed near the end of the incised tracheal ring

Differences Between Children & Adults

- Airway diameter smaller & airways shorter
- Larynx higher & more anterior
- More prone to severe obstruction of airways

Differences of Airways

- Mucus or swelling = increased resistance to airflow
- One mm of edema increases resistance a factor of 16 versus a factor of 2.4 for and adult

Differences of Lungs
- Airway muscles & cartilage not completely developed
- Easier for airways to collapse
- Less surface area for gas exchange

Differences of Chest Wall
- Higher ratio of cartilage to bone
- Chest wall rounder in infant
- Becomes more oval with growth

Differences of Respiratory Muscles
- Diaphragm higher & less curved in a child
- Intercostal muscles not as effective

Retrieved from:
http://www.hawaii.edu/medicine/pediatrics/pemxray/v4c03.html
http://www.answers.com/topic/anatomy
http://www.buteyko.co.nz/asthma/facts/mechanics.cfm
Assessment Look

Color
- Best seen inside mouth, lips, eyes, face, or fingers
- Sufficient
  - pink = adequate oxygen
- Insufficient
  - Pale, white, gray, blue, purple (cyanosis)

Assessment Look

Respiratory Effort
- Sufficient
  - Alert, content, playful
- Insufficient
  - Lethargic or too sleepy, anxious, restless, agitated, irritable

Assessment Look

Respiratory Rate
- Count rate for one minute when child is quiet
- Insufficient
  - Significantly increased respiratory rate = respiratory distress
  - Significantly decreased respiratory rate = fatigue or hypothermia

### Assessment Look: Respiratory Rate

<table>
<thead>
<tr>
<th>Age</th>
<th>Infant (0-1 year)</th>
<th>Toddler (1-3 years)</th>
<th>Preschooler (3-5 years)</th>
<th>School-age (6-12 years)</th>
<th>Adolescent (12-18 years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiratory Rate</td>
<td>30-60</td>
<td>24-40</td>
<td>22-34</td>
<td>18-30</td>
<td>12-16</td>
</tr>
<tr>
<td>Breath Rate (breaths per minute)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Assessment Look: Mucus

- Note amount, color, consistency, child’s ability to clear secretions
- **Sufficient**
  - None or minimal amount, thin, clear or white from nose, mouth, or trach
- **Insufficient**
  - Increased amount
  - Yellow or green
  - Indicates infection
  - Signs of food
  - May indicate reflux or aspiration
  - Bloody

### Assessment Look: Feeding Behavior

- **Feeding**
  - Appetite
  - Feeding tolerance
  - Fatigue
  - Coughing (aspiration)
Assessment Listen
Audible Sounds

- **Sufficient**
  - Occasional cough to clear throat or trach
  - Quiet breaths
- **Insufficient**
  - Cough - frequency,
  - character of cough - dry or loose - clearing trach
  - Wheeze - musical sounding usually on expiration. Sign of airway obstruction

Assessment Listen
Auscultation Sounds

- **Sufficient**
  - Clear
  - Symmetry
  - May hear transmitted sounds from top to bottom or side to side

Assessment Listen
Auscultation Sounds

- **Insufficient**
  - Wheeze - where heard?
  - Caused by airway obstruction
    - 1. something obstructing the airway
    - 2. bronchoconstriction
    - 3. edema or inflammation of airway
    - 4. malacia of the airway

Retrieved from: http://www.med.emory.edu/GENETICS/patients/

Retrieved from: http://learn.gwumc.edu/hscidist/LearningObjects/PediatricAsthma/whatis_asthma.htm
**Assessment Listen**

**Auscultation Sounds**

- **Insufficient**
  - Crackles – fine or coarse
  - Sign of fluid in lungs
  - Coarse or rhonchi – sign of mucus in larger airways

- **Decreased** – less loud in one area
  - = less air movement

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**Websites for Breath Sounds**

- [http://www.emory.edu/WHSCL/grady/inetgrp/hplung.html](http://www.emory.edu/WHSCL/grady/inetgrp/hplung.html)
- [http://rnceus.com/resp/respabn.html](http://rnceus.com/resp/respabn.html)
- [http://www.umshp.org/rt/sounds/sounds.html](http://www.umshp.org/rt/sounds/sounds.html)

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**Assessment Feel**

**Chest Expansion**

- **Sufficient**
  - Movement in & out equal on both sides

- **Insufficient**
  - Shallow rapid movement of chest
  - Unequal movement of chest
Assessment Feel
Mucus in Lungs

- Sufficient
  - No evidence of mucus
- Insufficient
  - Feel mucus moving in the lungs

Tools for assessment
You

- You are the best tool
- Knowledge of child’s baseline if child has chronic illness

Tools for Assessment
Stethoscope

Use correct size stethoscope
Tools for Assessment
Cardio/Respiratory Monitors

Purpose:
Detect and inform of potential life threatening event

Topics:
- Attaching the cardio/respiratory monitor to the child
- Safely using the monitor
- Responding to cardio/respiratory alarms

Tools for Assessment
Monitors

- Best monitor is vigilant, trained caregiver
- No commercial monitor is ideal
- Consider monitoring for children at high risk
- Know how to use the equipment

When To Use Monitor

- During sleep
- Traveling
- When not closely observed
**Parts of Monitor**

- Two electrodes
- Lead wires
- Patient cable
- Monitor

- Measures
  - heart rate
  - breathing rate

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**Monitor Alarm Limits**

- Alarms and limits appropriate for age
- Apnea delay 20 seconds
- High heart rate (tachycardia)
  - greater than the upper range for the child
  - (200–225)
- Low heart rate (bradycardia)
  - dependent on age and
  - individual child
  - (50–80)

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**Parts of Monitor**

- Electrodes
- Lead wires
- Monitor & Patient Cable

Sources:

Monitor Parts
Electrodes
• Disposable – stick directly on skin
  - paper
  - cloth
  - foam

Monitor Parts
Electrodes
• Reusable – black carbon secured with belt
  - less irritating
  - move out of position more easily

Electrodes
• Use 2 electrodes
  - White electrode on child’s right side
  - Black one on child’s left

• Place directly under armpit
  - At greatest amount of chest wall movement


procedure/web037975.asp
Safety Considerations

- Never put in water
- Disconnect monitor from child before bathing
- Don’t use water with electrodes

Safety Considerations

- Siblings should not play with monitor
- Need to be within 10 seconds of reaching child
- Place on high, hard, flat surface
- Have light source available

Safety Considerations

- Avoid electrical interference caused by
  - Placement too close to electrical appliances
  - Woolen blankets or sweaters
  - Intercom too close to monitor
- Have phone available for call for help
- Keep lead wires out of reach of all children
- Misuse of monitor can cause a shock or electrical burn for caregiver or child
Monitor Power Source

- Electrical
  - plugged into AC source
  - internal battery lasts 8 hours
  - recharge every night

Monitor Alarms

- Equipment
  - steady tone
  - loss of power
  - lead alarm
- Human
  - beep once per second
  - High Heart Rate
  - Low Heart Rate
  - Apnea

Response
- count beeps
- look at and assess the child
- push reset button to clear the alarm light

False alarms caused by something other than child's condition

Apnea alarm when child is breathing can happen with shallow breathing (deep sleep)

If all else fails call the equipment provider

Check for tight connections

Move leads to area of greatest chest movement

Check tightness of belt

Change leads, electrodes, patient cable
Monitor Flow sheets

Key Points: Anatomy & Assessment

Children respond differently than adults to changes in their respiratory status.

Correct use of a cardio-respiratory monitor may save a child’s life.

Assessment and documentation of the assessment are key components of caring for a child with a tracheostomy.