Evaluating The Child With Respiratory Distress
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Oh no.....
3 am: Stat page from 9 Special Med-
14 year old patient with severe CF related lung
disease (FEV1 29%) admitted with pulmonary
exacerbation. Sudden worsening of
respiratory status, RR 40, sats 82% on RA—
LOOKS BAD!

WHAT DO YOU DO?

What is normal respiration?
• The physiologic act through which oxygen is
moved into the body and delivered to the
tissues and carbon dioxide is removed from
the body
• Inspiration/Expansion of the chest
  — Active motion of respiratory muscles
  — Opposed by elastic/restrictive forces of lung
• Expiration
  — Elastic recoil force from energy stored
during inspiration

Airflow is governed by
• Resistive forces of gas flow> resistive forces of
  lung tissue
• Resistance during turbulent flow
• Resistance during laminar flow
  — R=8ηl/πr4 (Poiseuille’s Law)
• R_n=R_{aw}+R_{LT}+R_{CW}
• Minute Ventilation=Tidal Volume x RR

Oxygenation

What is respiratory distress?
• Clinical state of altered/inadequate
  respiratory effort that may result in
abnormalities of oxygenation and/or
ventilation
• Common presenting symptoms
  — Abnormal Respiratory Rate
  — Increased Work of Breathing
  — Abnormal Breath Sounds
  — Altered Sensorium
Causes of Respiratory Distress

- Central/Neurologic
- Biochemical
- Anatomic
- Infectious
- Cardiac/Vascular

Central and Neuromuscular Defects

- Immature central control
- Altered brainstem position/compression
  - Arnold Chiari Malformation
  - Hydrocephalus
  - Tumor
  - Trauma
- Neuromuscular
  - Duchenne’s Muscular Dystrophy
  - Spinal Muscular Atrophy
- Congenital Central Hypoventilation
- Sedation, anxiety, pain, fever

Biochemical

↑ Respiratory Rate
- Metabolic Acidosis
- Hyperammonemia
- Salicylate intoxication
- Hyperthyroidism
- Mitochondrial disease

↓ Respiratory Rate
- Opioid overdose
- Ethanol

Biochemical

- Allergic reaction
- Thermal injury
- Aspiration
- Pulmonary Hemorrhage
- Hypocalcemia
- Hypomagnesemia

Anatomic

- Functional
  - Choanal stenosis
  - Laryngomalacia/Tracheomalacia
  - Bronchomalacia
  - Subglottic stenosis
  - Tracheal rings
  - Abnormal vocal cord movement
- Obstructive
  - Foreign body/tumor/external compression
  - Asthma

Extrathoracic Obstruction

Inspiration
Intrathoracic Obstruction

**Exhilation**

### Anatomic

- Pneumothorax
- Rib cage abnormalities-flail chest/asphyxiating dystrophies
- Intra-abdominal process

### Anatomic-The Insufficient Chest

- Hypoplastic Chest-Jeunes’s Syndrome
  - Pulmonary hypoplasia
  - Decreased compliance of chest wall
  - Decreased tidal volume
- Scoliosis
  - Decreased compliance of chest wall
  - Decreased tidal volume
- Flail Chest/Missing Ribs-Paradoxical chest wall movement results in decreased inspiratory capacity and total lung capacity

### Infectious

- Retropharyngeal/Peritonsillar abscess
- Epiglottitis
- Croup
- Tracheitis
- Pneumonia (pleural effusions)
- Bronchiolitis
- Meningitis/Encephalitis
### Cardiac/Vascular

- Heart failure
- Cardiac tamponade
- Pulmonary embolism
- Acute chest syndrome

### Urgent Intervention For......

- Tension pneumothorax
- Airway obstruction
- Impending respiratory failure
- Cardiac tamponade

### Back To The Basics

- **History***
- **Physical***
- **Laboratory/Radiographic Studies***

*Rapid assessment within minutes of seeing the child!*

### History

- **Birth History**
  - Gestational age
  - Need for mechanical ventilation/oxygen
  - Meconium aspiration
  - Apnea
  - Feeding difficulties
- **Family History**
- **Medications**
- **Allergies**

### Physical Examination

- Begins when you walk in the room
  - How distressed is the child?
    - Is the child interacting with their surroundings or is he concentrating on breathing?
    - Can the child communicate/interact with you?
    - Does your child always breath like this?
  - How distressed is the parent?
  - How distressed is the nurse?
  - How distressed are you?
Vital Signs

- Hyper and Hypothermia both adversely affect respiratory rate.
  - Low and slow vs high and fast
- Know age appropriate norms
- Respiratory rate should never equal heart rate
  - HR 120, RR 120
  - HR 0, RR 0
- Very few people have a RR=20 all the time and infants should never have a RR=20!

Respiratory Rates and Patterns

- Tachypnea/Bradypnea
- Apnea/Periodic Breathing
- Paradoxical Breathing
- Hyperpnea-Deep respiration-metabolic acidosis
- Hypopnea-Shallow respiration-metabolic alkalosis
- Kussmaul-Deep, sighing and regular with prolonged exhalation-DKA
- Cheyne-Stokes-↑ then ↓ depth with periods of apnea-↑ICP, CNS trauma, CHF
- Biot's- Irregular depth and irregular apnea-severe brain trauma

HR and BP

- Know age appropriate norms!
- ↑ sympathetic tone→↑HR
- ↓ HR-BAD
- ↓BP-BAD
- Pulsus Paradoxus

Cyanosis

- Occurs when concentration of reduced hemoglobin content in arterial blood is ≥ 3g/100 ml or 4-6 g/100ml in capillary blood
- Peripheral vs Central
- Central Cyanosis
  - Alveolar hypventilation
  - V/Q mismatch
  - Barrier to Diffusion
  - Cardiac disease with right to left shunt

Cyanosis

- Cardiac diseases associated with a right to left shunt
  - Tetralogy of Fallot
  - Transposition of the great arteries
  - Tricuspid atresia
  - Total anomalous venous return

Physical Exam-Stop, Look and Listen

- Listen before you put your stethoscope on the chest
  - Speech Pattern
  - Muffled or Hoarse Cry
  - Accessory muscle use
  - Cough
  - Stridor
  - Wheeze
**Cough**
- Multiple cough receptors throughout the respiratory tract.
  - Highest concentrations in larynx, trachea, mainstem bronchi
- Opening of glottis, short inspiration
- Glottic closure, chest wall/ abdominal/ perineal muscle contraction
- Sudden opening of glottis, decompression of airway, movement of airway contents

**Recurrent Cough**
- Asthma
- Foreign body (Aspiration)
- Congenital anomalies of the esophagus and tracheobronchial tree
- Infectious-Viral, pertussis, chlamydia, sinusitis
  - Bronchiectasis/ Cystic Fibrosis
  - Ciliary Agenesis or Dyskinesia
  - Immunodeficiency/Immunocompromised
- Psychogenic Cough

**Wheeze**
- Classically heard on exhalation
- Produces by static or dynamic intrathoracic airway compression/obstruction
- Important Historical Points
  - Age at onset
  - Associated symptoms
  - Precipitating / Alleviating Factors
  - Family History
- Important Physical Exam Points
  - Monophonic vs Polyphonic
  - Degree of distress
  - Quality of airflow

**Cough**
- Dry or productive
- Quality (Croup, paroxysmal, staccato)
- Timing (Daytime, Nocturnal, Frequency, Association with Feeding)
- Triggers and alleviating factors

**Stridor**
- Classically heard on inspiration
- Due to extrathoracic dynamic compression/obstruction of the airway
- Important historical points
  - Age at onset: Neonate vs Older Child
  - Precipitating events/environmental triggers
  - Skin exam
  - Past intubation
- Important to physical exam points
  - Degree of distress
  - Quality of air flow
  - Quality of voice

**Other often heard noises**
- Decreased breath sounds
- Tubular breath sounds
- Rhonchi
- Crackles
- No breath sounds—VERY VERY BAD!
Laboratory Examination

• CBC
• Chemistry
• Tox Screen
• Blood gas
• Lateral neck film
• CXR
• Chest CT
• Echo

Back to our case

• Patient reports sudden onset of left sided chest pain following a coughing spasm. She is scared. RR=35, HR= 120, BP 132/84, sats=84%

Chest exam reveals diffuse crackles on the right side, and decreased breath sounds on the left

<table>
<thead>
<tr>
<th>Blood Gases</th>
<th>pH</th>
<th>pO2</th>
<th>pCO2</th>
<th>HCO3</th>
<th>Saturation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arterial</td>
<td>7.35-7.45</td>
<td>80-100 mmHg</td>
<td>35-45 mmHg</td>
<td>22-26 mEq/L</td>
<td>95-100%</td>
</tr>
<tr>
<td>Venous</td>
<td>7.32-7.42</td>
<td>30-50 mmHg</td>
<td>40-52 mmHg</td>
<td>22-28 mEq/L</td>
<td>80-85%</td>
</tr>
<tr>
<td>Capillary</td>
<td>7.35-7.40</td>
<td>45-60 mmHg</td>
<td>40-45 mmHg</td>
<td>22-26 mEq/L</td>
<td>&gt;70%</td>
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As you are seeing the patient and obtaining the pertinent labs/film.....

- Quick history and physical to assess the severity of the distress and urgency for intervention
- Flash back to basic pulmonary physiology when considering the differential diagnosis
- Assess the need for immediate intervention
  - Supplemental oxygen
  - Bronchodilators
  - BVM/Intubation
- ASK FOR HELP!
- REMAIN CALM!