SHORTNESS OF BREATH (SOB)

Background: Shortness of breath can be described by patients in several ways. Often, they will indicate “I can’t catch my breath”, or “I feel smothered”, or simply “I am short of breath”. However people choose to describe this sensation, the medical community defines it as Dyspnea.

Dyspnea is defined as an abnormal or uncomfortable awareness of breathing. More specifically, it is a perception of the brain when the ventilatory effort does not adequately meet the metabolic demands of the body. This mechanism is not thoroughly understood, however there are known various factors which do contribute to this phenomenon. Although dyspnea can be a complaint primarily attributed to the respiratory system, other causes can be blood pH levels, anxiety levels, CHF, COPD, cardiac related events among others. The variation in the description of this complaint makes dyspnea difficult to characterize and also diagnose. When confronted with a complaint of dyspnea, the health care provider must take immediate measures to support respirations and ventilation. Then the provider must conduct a thorough assessment aimed at discovering clues to the underlying cause of the patient’s respiratory difficulty and provide appropriate treatment.

It is important to remember, however, that there is not a direct relationship between the level of hypoxia and the sensation of dyspnea; many hypoxic patients will not complain of being short of breath (COPD, etc.) while other patients with normal pO2 levels may complain of dyspnea (i.e., patients with a pulmonary embolism).

Also, it is important to realize that respiratory failure or arrest may be imminent. It is typically indicated by bradycardia, bradypnea, agonal respirations, however, these signs may only occur for a very brief period of time prior to arrest.

Other helpful indicators of respiratory issues are home oxygen devices or nebulizing equipment. History of smoking or evidence of another smoker in their home (2nd hand smoke), their medications (particularly nitrates, diuretics, digitalis, inhalers, steroids, antibiotics, or blood thinners).

Pathophysiology: The respiratory system performs the function of facilitating the life-sustaining process of oxygen transport, respiration, ventilation and gas
exchange. Blood enters the systemic veins (where it is called venous blood) and travels to the pulmonary circulation. The oxygen concentration in the blood within the capillaries of the lungs is lower than in the lungs’ air sacs (alveoli). Because of this concentration gradient, oxygen diffuses from the alveoli to the blood. Carbon dioxide, which has a higher concentration in the blood than in the alveoli, diffuses from the blood into the alveoli. Movement of air in and out of the airways (ventilation) continually replenishes the oxygen and removes the carbon dioxide from the airways in the lung. This whole process of gas exchange between the atmospheric air and the blood and between the blood cells of the body is called respiration.

During inspiration, air flows from the environment into the trachea, bronchi, bronchioles and alveoli. During expiration, alveolar gas travels the same route in reverse.

Resting respiration is the result of cyclical excitation of the respiratory muscles by the phrenic nerve. The rhythm of breathing is controlled by respiratory centers in the brain. The inspiratory and expiratory centers in the medulla oblongata and pons control the rate and depth of ventilation to meet the body’s metabolic demands.

Several groups of receptor sites assist in the brain’s control of respiratory function. The central chemo receptors are located in the medulla and respond to chemical changes in the cerebrospinal fluid, which result from chemical changes in the blood. These receptors respond to an increase or decrease in the pH and convey a message to the lungs to change the depth and then the rate of ventilation to correct the imbalance. The peripheral chemo receptors are located in the aortic arch and the carotid arteries and respond first to changes in PaO2, then to PaCO2 and pH. The Hering-Breuer reflex is activated by stretch receptors in the alveoli. When the lungs are distended, inspiration is inhibited; as a result, the lungs do not become over distended. In addition, proprioceptors in the muscles and joints respond to body movements, such as exercise, causing an increase in ventilation. Thus, range of motion exercises in an immobile patient stimulates breathing. Baroreceptors, also located in the aortic and carotid bodies, respond to an increase or decrease in arterial blood pressure and cause reflex hypoventilation or hyperventilation.

Lung compliance to expand and retract is normally easily stretched and distended when pressure is applied. High or increased compliance occurs when the lungs have lost their elasticity and the thorax is over distended (i.e., emphysema). When the lungs and thorax are “stiff”, there is low or decreased compliance. Conditions associated with this include pneumothorax, hemothorax,
pleural effusion, pulmonary edema, atelectasis, pulmonary fibrosis, and Acute Respiratory Distress Syndrome (ARDS). Lungs with decreased compliance require greater than normal energy expenditure to achieve normal levels of ventilation.

Air flows from a region of higher pressure to a region of lower pressure. During inspiration, movement of the diaphragm and other muscles of respiration enlarge the thoracic cavity and thereby lower the pressure inside the thorax to a level below that of atmospheric pressure. Therefore, air is drawn through the trachea and bronchi to the alveoli. During normal expiration, the diaphragm relaxes and the lungs recoil, resulting in a decrease in the size of the thoracic cavity. The alveolar pressure then exceeds atmospheric pressure, and air flows from the lungs into the atmosphere.

**Frequency:**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asthma</td>
<td>30.8 million people</td>
</tr>
<tr>
<td>Bronchitis</td>
<td>12 million cases per year</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>3 million cases annually</td>
</tr>
<tr>
<td>Emphysema</td>
<td>2 million people</td>
</tr>
<tr>
<td>Respiratory Acidosis</td>
<td>Undetermined</td>
</tr>
<tr>
<td>Tracheal Trauma</td>
<td>Undetermined</td>
</tr>
<tr>
<td>Airway Obstruction</td>
<td>Undetermined</td>
</tr>
<tr>
<td>CHF/Pulmonary Edema</td>
<td>3 million people have CHF, and more than 400,000 new patients present yearly</td>
</tr>
<tr>
<td>Cardiac Complications</td>
<td>Cardiovascular disease is the leading cause of death for both men and women in the U.S.</td>
</tr>
<tr>
<td>Anxiety</td>
<td>Undetermined</td>
</tr>
<tr>
<td>Acute Respiratory Distress Syndrome</td>
<td>75 cases per 100,000 population.</td>
</tr>
<tr>
<td>Pulmonary Embolism</td>
<td>650,000 cases occurring annually</td>
</tr>
</tbody>
</table>
### Mortality/Morbidity:
- Depending on the cause, dyspnea can lead to high rates of morbidity. Conditions such as pulmonary embolism can have a very poor prognosis (up to 1/3 of undiagnosed PE patients die), unless properly diagnosed and treated.
- Lung cancer is the leading cause of death in the US.
- COPD is the fourth leading cause of death in the US.

### Sex:
- Sex may offer some diagnostic clues because of certain predisposing risk factors:
  - **Females:**
    - Birth control pills – consider possible pulmonary embolism
    - Pregnancy – consider possible pulmonary embolism

  - **Males:**
    - Tall, thin, young males – consider possible spontaneous pneumothorax

### Chest Trauma
- 12 persons per million population per day

### Pneumothorax
- Undetermined

### Hemothorax
- Undetermined

### Diaphragmatic Rupture
- Undetermined

### Inhalation injury
- Undetermined

### Anaphylaxis
- Up to 15% of the US population is "at risk" for anaphylaxis

### Lung Cancer
- 174,470 new cases of lung cancer in the United States annually
Age:
- The age of the patient can be an indicator of what may be causing the signs of symptoms of respiratory distress.
- Pediatrics typically have small but healthy lungs and a greater likeliness to suffer from inherited or infectious ailments due to underdeveloped lung tissues and immune systems. Some of the more common childhood respiratory disorders are: common colds, influenza, asthma, croup, bronchiolitis, and infrequently, epiglottitis.
- Adults are also susceptible to some of the same respiratory disorders that pediatrics suffer from, such as asthma and bronchitis; however, adults are more likely to have cardiac caused dyspnea. Adults have also, over time, exposed their lungs to numerous toxins, creating a larger number of potential respiratory complications. Exposure to cigarettes, marijuana, asbestos, insulation materials, smog, and other inhaled substances can damage lung tissue leading to diseases such as emphysema and lung cancer. As humans age, they inevitably are susceptible to potentially more respiratory complaints due to our environment and the elements within it.
- Older adults have had adequate time to deteriorate the functionality of their respiratory system. COPD and CHF are prime examples of common disorders in the older adult population.

History:
- Onset may be rapid or slow. Rapid onsets may be indicative of acute asthma, anaphylaxis, pulmonary edema, pulmonary embolism, etc. Slow onsets are typical in exacerbation of COPD, pneumonia, infections, etc.
- Associated symptoms may give important clues to cause of symptoms. i.e., Fever may indicate pneumonia, or other infection, hives could indicate anaphylaxis, etc.
- Recent use of inhalers or oxygen should give clues to history
- Anxiety may be present in all causes of dyspnea. Rapid respiration in conjunction with recent stress, numbness in hands, feet, and face, and carpal pedal spasms may be hyperventilation syndrome.
- Lightheadedness and syncope
- Cough may present. Look for sputum that may be clear, purulent, yellow, pink frothy, or bloody.
- Diaphoresis may indicate cardiac cause
- Wheezing, stridor, rales, and rhonchi are good clues as to origin of dyspnea
Physical:

The normal adult patient breathes between 8 and 18 times per minute with a tidal volume of 400 to 800 ml. A patient who is breathing outside of this range may be experiencing respiratory difficulty. If a patient is breathing greater than 18 times a minute their breathing may be too fast to effectively allow for adequate oxygen intake and carbon dioxide release. This may produce signs and symptoms of hypoxia, or possibly hyperventilation syndrome if the patient is over-ventilating.

The mental status of a patient with shortness of breath will eventually become affected if treatment is not provided quickly. Patients may feel fearful and/or agitated (due to the sensation of difficulty breathing); if hypoxia is not corrected, this may progress to lethargy, confusion, and eventually to unconsciousness. Signs and symptoms for some patients in respiratory distress may not be immediately obvious. Careful assessment may reveal covert signs of distress such as neck or thoracic accessory muscle use, pursed lips, or cyanosis. If signs of distress are immediately apparent, the patient is probably suffering from hypoxia and immediate treatment to correct the cause is indicated. This is especially true in the pediatric patient.

Patients utilize gravity to assist with lung expansion. This gravitational assist is termed “tripoding”. Tripoding patients typically will sit upright with their hands on their knees and their torso leaning slightly forward. This allows them to be in the “sniffing” position, which in turn, opens their airway to its fullest potential, allowing less resistance.

Airway obstructions may be clearly audible. Remember that normal respiration is a quiet process. Upon approaching a patient with respiratory complaints, listen for any upper airway sounds such as grunting, snoring, or stridor that suggest upper airway obstruction. If there is an obstruction, make an immediate determination as to whether the obstruction is complete or incomplete. Additionally, you must quickly determine if the obstruction has resulted from foreign body aspiration or another cause. In the case of complete obstruction, you will note that the patient will have an ineffective cough, stridor, poor air movement, and decreased mental status or unconsciousness.

Consider all respiratory distress patients as potentially critical until proven otherwise. The human body will exert significant effort to survive respiratory compromise; however it will ultimately fail due to exhaustion. The timing of respiratory failure however, is impossible to predict as everyone responds differently. If a patient does appear tired from breathing difficulty, be prepared to assist with respirations, and treat these patients as true emergencies.
Causes:

There are a number of conditions that can cause Shortness of Breath:

- Asthma: narrowing of bronchioles, fluid production
- Bronchitis: inflammation of bronchioles, fluid production
- Pneumonia: inflammation of bronchioles, fluid production, consolidation, hemorrhage
- Emphysema: collapse or destruction of alveoli preventing effective exhalation
- Respiratory Acidosis: metabolic condition in which the body fails to rid itself of excessive acids
- Tracheal Trauma: damage and/or swelling of upper airway tissues
- Airway Obstruction: complete or partial blockage by foreign body, mucus, fluids, tissue, or edema.
- CHF/Pulmonary Edema: fluid build-up due to plasma entering alveoli
- Cardiac Complications: CHF/pulmonary edema
- Anxiety: hyperventilation
- Adult Respiratory Distress Syndrome (ARDS): acute lung inflammation and diffuse alveolar-capillary injury
- Pulmonary Embolism: blocked pulmonary artery
- Chest Trauma: pulmonary contusion or tear
- Pneumothorax: partial to complete collapse of lung from either spontaneous or traumatic cause
- Hemothorax: bleeding from lung parenchyma or damaged vessels
- Diaphragmatic Rupture: intraabdominal organs put pressure on thoracic cavity, thus inhibiting respiration
- Inhalation Injury: burns and toxic substance inhalation can damage lung tissue, cause edema, and produce pulmonary edema
- Anaphylaxis: bronchospasm, mucus production, and laryngeal or epiglottic edema
SHORTNESS OF BREATH

All patients presenting with signs and/or symptoms of shortness of breath should be assessed and treated according to accepted medical standards.

Assessment:

- ABC’s
- Description of SOB to include:
  - Provocation/precipitating factors (What were you doing when it started? Did it start suddenly or gradually? Is it worse lying down? Is there any pain with breathing?)
  - Quality (SOB with inspiration vs. expiration, or both? Is it constant or intermittent? Description of any pain)
  - Recurrence/region/relieving factors (Have you had it before? Was it the same? Have you taken anything for it? Did anything relieve it such as rest, positioning, or nebulizers/medications?)
  - Severity (On a scale from 1 to 10 where does this episode rate? Is this the worst SOB you have had? Have you ever been intubated?)
  - Time (What time did it start?)
- Past medical history
- Medication allergies
- Current medications
- Risk factors (smoking, cardiac history, chronic infection, etc.)
- History of medication use related to chief complaint
- Focused secondary exam to include:
  - Palpation of chest
  - Pain with respiration?
  - Positional relief?
  - JVD/pedal edema
  - Accessory muscle use/retractions
  - Skin signs/ cyanosis
- Vital signs:
  - ECG rhythm (note ST changes/ectopy)
  - Pulse oximetry
  - Breath sounds (4 point, preferably on bare skin)
  - Pulse
  - Respirations
  - Blood pressure (auscultated)
Differential diagnosis CHF vs. COPD:

CHF and COPD can be difficult to differentiate, however there are specific clues that EMS personnel can look for that will help when making treatment decisions. Normally patients with either of these diseases can tell you what type of respiratory problem they have. Medications can also be a good source when seeking a differential diagnoses. Certain signs and symptoms can also lead you to the correct treatment regimen, the table below shows what to look for:

<table>
<thead>
<tr>
<th></th>
<th>CHF</th>
<th>COPD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood pressure</td>
<td>normal to elevated</td>
<td>normal</td>
</tr>
<tr>
<td>Breath sounds</td>
<td>crackles/wheezes/rales</td>
<td>wheezes/distant</td>
</tr>
<tr>
<td>Cough</td>
<td>frothy/pink</td>
<td>thick mucous</td>
</tr>
<tr>
<td>JVD</td>
<td>present</td>
<td>absent</td>
</tr>
<tr>
<td>Patient’s weight</td>
<td>normal to heavy</td>
<td>normal to light</td>
</tr>
<tr>
<td>Chest diameter</td>
<td>normal</td>
<td>increased</td>
</tr>
<tr>
<td>Pursed lip breathing</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>Orthopnea</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Nocturnal dyspnea</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Nocturia</td>
<td>yes</td>
<td>no</td>
</tr>
</tbody>
</table>

Treatment:
- Treatment should be performed as soon as possible
- Progress of treatment algorithms assume the patient’s condition is continuing despite continued therapy
- Target on-scene times should be less than ten (10) minutes in critical patients
- Do not allow patient to walk due to increased O2 demand
- Use of bronchodilators to “open-up” a suspected pulmonary edema patient is not acceptable. Proper assessment should provide adequate information for correct treatment regimen
- CPAP may be indicated if the patient exhibits: increased respiratory effort, low oxygen saturation, inability to speak, and/or signs of decreased level of consciousness.
County protocols shall be followed. Specific time frames for treatment regimens are as follows (whenever possible):

<table>
<thead>
<tr>
<th>Specific Therapy</th>
<th>Time Frame</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxygen</td>
<td>1-2 minutes</td>
</tr>
<tr>
<td>CPAP (if indicated)</td>
<td>ASAP</td>
</tr>
<tr>
<td>Intravenous Access</td>
<td>3-5 minutes</td>
</tr>
<tr>
<td>Medication Administration</td>
<td>ASAP (May precede IV if applicable)</td>
</tr>
<tr>
<td>Transport</td>
<td>Within ten (10) minutes, if critical</td>
</tr>
</tbody>
</table>