Dyspnea is the subjective sensation of breathing discomfort. It is a normal manifestation of heavy exertion, but also may be caused by underlying conditions (both pulmonary and extrapulmonary). Management focuses on treating the underlying condition. Wheezes are high-pitched, continuous loud sounds that are often louder than breath sounds. They can be heard on inspiration or expiration. They are caused by a narrowing of the airways, resulting in the oscillation of opposing airway walls. The most common causes of wheezing are asthma and COPD exacerbations (often from viral respiratory infections).

Dyspnea – Introduction and Pathophysiology

**Definition**

Dyspnea is the subjective sensation of breathing discomfort (chest tightness or shortness of breath).

**Pathophysiology**

Dyspnea occurs due to an imbalance between the required gas exchange and the acid-base status of an individual. This sensation is often due to a combination of factors including
- Changes in lung physiology:
  - Increased airway resistance
  - Increased dead space
  - Ventilation-perfusion mismatch
- Decrease in lung/chest wall compliance
  - Stimulates chest wall and pulmonary mechanoreceptors
    - Vagus nerve
    - Muscle spindles and tendons of the chest wall
- Acute hypercapnia, hypoxemia, or metabolic acidosis
  - Stimulation of chemoreceptors (by $\text{PaO}_2$, pH, and $\text{PaCO}_2$)
    - Peripheral: aortic arch and carotid bodies
    - Central: medulla
- Impaired oxygen delivery/utilization
  - May be due to reduced oxygen-carrying capacity of the blood
  - May be due to deconditioning

**Dyspnea - Etiology**

- Can be broken down into
  - Pulmonary or extrapulmonary causes
- 5 most common causes of chronic dyspnea:
  - Asthma
  - COPD
  - Interstitial lung disease
  - Myocardial dysfunction
  - Obesity/deconditioning
- See chart below for a summary of the conditions in each category.

<table>
<thead>
<tr>
<th>Pulmonary Causes of Dyspnea</th>
<th>Clinical presentation</th>
<th>Associated conditions</th>
</tr>
</thead>
</table>

Layout presenting the pathophysiology of dyspnea. Image by Lecturio.
### Obstructive lung disease
- Characterized by air trapping in the lungs
  - ↑ FRC and TLC
  - ↓↓ FEV₁
  - ↓ FVC
  - ↓ FVC/FEV
  - Findings
  - Wheezing
  - Dyspnea is not worsened by change in body position.

### Restrictive lung disease
- Characterized by decreased lung compliance:
  - ↓ FVC and TLC
  - FEV₁/FVC ≥ 80%
  - Findings
  - Short, shallow breaths

### Upper airway obstruction
- Often caused by infection or foreign body obstruction
  - Findings
  - Usually acute onset dyspnea
  - Associated with stridor

### Others
- Characterization and findings vary.

### Extrapulmonary Causes of Dyspnea

<table>
<thead>
<tr>
<th>Clinical presentation</th>
<th>Associated conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cardiac dyspnea</strong></td>
<td>Often a complication of left-sided heart failure</td>
</tr>
<tr>
<td></td>
<td>Findings</td>
</tr>
<tr>
<td></td>
<td>Dyspnea varies with body position</td>
</tr>
<tr>
<td></td>
<td>Orthopnea</td>
</tr>
<tr>
<td></td>
<td>Paroxysmal nocturnal dyspnea</td>
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<td></td>
<td>Bilateral basal rales</td>
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<tr>
<td><strong>Anemia</strong></td>
<td>Impaired tissue oxygenation</td>
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<tr>
<td></td>
<td>Findings</td>
</tr>
<tr>
<td></td>
<td>Dyspnea and dyspnea on exertion</td>
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<tr>
<td></td>
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<tr>
<td><strong>Psychogenic dyspnea</strong></td>
<td>Hyperventilation associated with anxiety may lead to acute respiratory alkalosis manifested as</td>
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<tr>
<td></td>
<td>Paresthesia at the fingertips and around the mouth</td>
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<td>Tetanic cramps in severe cases</td>
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<tr>
<td><strong>Endocrine dyspnea</strong></td>
<td>Changes in pH and PaCO₂ stimulate the brain stem</td>
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<td></td>
<td>Alveolar hyperventilation</td>
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<tr>
<td></td>
<td>Deep breathing</td>
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<tr>
<td></td>
<td>Compensates acidosis by washing out the CO₂</td>
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<tr>
<td><strong>Hypertensive or valvular heart disease</strong></td>
<td>Heart failure</td>
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<tr>
<td></td>
<td>Cardiomyopathy</td>
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<tr>
<td></td>
<td>Ischemic heart disease:</td>
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<tr>
<td></td>
<td>Stable and unstable angina</td>
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<td></td>
<td>Acute myocardial infarction</td>
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<tr>
<td></td>
<td>Coronary heart disease</td>
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<tr>
<td></td>
<td>Heart failure with reduced or preserved ejection fraction</td>
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<tr>
<td></td>
<td>Pericarditis</td>
</tr>
<tr>
<td></td>
<td>Arrhythmia</td>
</tr>
<tr>
<td><strong>Hypovolemic shock</strong></td>
<td>Acute hemorrhage</td>
</tr>
<tr>
<td><strong>Psychogenic dyspnea</strong></td>
<td>Panic disorder</td>
</tr>
<tr>
<td></td>
<td>Anxiety</td>
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<tr>
<td></td>
<td>Pain</td>
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<td></td>
<td>Somatization disorder</td>
</tr>
<tr>
<td><strong>Metabolic acidosis:</strong></td>
<td>Ketoacidosis in diabetes</td>
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<td></td>
<td>Acidosis in renal insufficiency</td>
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<td>Medications:</td>
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<td>Salicylate overdose</td>
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</tbody>
</table>
Central dyspnea

Variable causes

Neuromuscular disease
- Myasthenia gravis
- Guillain-Barré

### Important elements in clinical history

- Duration, onset, severity, and progression of dyspnea
  - Sudden acute dyspnea is more concerning than chronic dyspnea.
- Triggers relation to
  - Exertion
  - Body position
  - Cold air
  - Animal dander
  - Stress/anxiety
- Associated symptoms:
  - Cough
  - Sputum production
  - Orthopnea
  - Paroxysmal nocturnal dyspnea
  - Chest pain
  - Peripheral edema
  - Joint swelling
  - Palpitations
- Effects of medications (such as albuterol, beta-blockers)
- Tobacco history
- Thrombosis risk factors

### Important elements in physical exam

Due to the wide array of differential diagnoses, it is important to take different considerations during physical exam.

<table>
<thead>
<tr>
<th>Vital signs</th>
<th>Pulmonary</th>
<th>Cardiovascular</th>
<th>Abdominal</th>
<th>Musculoskeletal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Stable vs. unstable</td>
<td>Stridor</td>
<td>Jugular venous distention</td>
<td>Protruding abdomen</td>
</tr>
<tr>
<td></td>
<td>Increasing respiratory rate</td>
<td>Wheezing</td>
<td>Distant heart sounds</td>
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<td></td>
<td>Increasing work of breathing</td>
<td>Crackles</td>
<td>Tachycardia</td>
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<td>Rales</td>
<td>Arrhythmia</td>
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<td>Murmurs</td>
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<td>Gallops</td>
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<td>Peripheral edema</td>
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<tr>
<td><strong>Red flag vital signs</strong></td>
<td>Heart rate &gt; 120 beats/min</td>
<td>Respiratory rate &gt; 30 breaths/min</td>
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<td></td>
<td>Pulse ox &lt; 90%</td>
<td>Hypotension</td>
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</tr>
<tr>
<td><strong>Red flags exam findings</strong></td>
<td>Stridor or airway obstruction</td>
<td>Periods of apnea</td>
<td>Use of accessory muscles, chest retractions, or tracheal deviation</td>
<td>Cyanosis</td>
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<td></td>
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<td>Altered mental status</td>
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</tbody>
</table>

### Labs

- CBS and BMP, especially in patients who have fever, sputum production, or anemia
- BNP if heart failure is suspected
- D-dimer if pulmonary embolism is suspected
- Arterial blood gas

### Imaging and other tests
Chest X-ray may detect cardiopulmonary disease (e.g., congestive heart failure, COPD, cor pulmonale, pulmonary hypertension)

Lateral neck radiography
  - If suspected upper airway obstruction

ECG
  - May detect ischemia, arrhythmia, or ventricular hypertrophy

CT – pulmonary angiogram or VQ lung scan
  - If pulmonary embolism is suspected

Spirometry
  - Used in outpatient setting to differentiate obstructive vs. restrictive lung disease
  - Used with a bronchodilator to differentiate asthma from COPD

Other tests to consider in specific situations
  - Echocardiography
  - Chest CT
  - Cardiac stress testing

Video Gallery

Dyspnea by Charles Vega, MD

Dyspnea: Diagnosis by Charles Vega, MD

Dyspnea – Management

- Oxygen supplementation if O₂ saturation is < 90%.
- Treatment of the underlying cause
  - Asthma and COPD
    - Bronchodilators or inhaled corticosteroids
  - Dyspnea associated with heart failure
    - Diuretics
  - Pneumonia/infectious causes
    - Antibiotics
    - Supplemental oxygen
  - Pulmonary embolism
    - Thrombolytics

Wheezing

Definition

- High-pitched, continuous loud sounds
- Generally louder than normal breath sounds
  - May be inspiratory or expiratory

Pathophysiology

- Caused by a narrowing of the airways, resulting in the oscillation of opposing airway walls

Etiology

- Viral respiratory tract infections
Most common cause of wheezing in children and adults
Most common cause of asthma exacerbations in children and adults
May also be associated with COPD and airway obstruction

**Differential Diagnosis**

- Symmetric wheezing
  - Asthma
  - COPD
- **Unilateral wheezing:**
  - Foreign body aspiration
  - Airway compression from a tumor or mass

It is important to **differentiate wheezing from stridor**, as acute stridor needs rapid medical intervention.

- Stridor is a specific kind of wheezing that has a constant pitch.
- Most commonly heard in upper respiratory obstruction
  - Inspiratory stridor is usually related to laryngeal obstruction.
  - Expiratory stridor is associated with tracheobronchial obstruction.

**Diagnostics**

- Dependent on history, exam findings, and extrapulmonary findings
- Pulmonary function testing
  - With pre and post-bronchodilator
  - Evaluation of the flow-volume loop
- Chest X-ray

**Video Gallery**

*Wheezing* by Carlo Raj, MD

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