21.5D: Breathing Patterns

Breathing is an autonomic process that moves air in and out of the lungs.

LEARNING OBJECTIVE

Describe the process of breathing in humans

KEY TAKEAWAYS

Key Points

- Breathing patterns consist of tidal volume and respiratory rate in an individual.
- An average breathing pattern is 12 breaths per minute and 500 mL per breath.
- Eupnea is normal breathing at rest.
- There are types of altered breathing patterns that are symptoms of many diseases.
- Altered breathing patterns refer to changes in respiratory rate or amount of air exchanged during breathing, and do not always indicate changes in alveolar ventilation.
• The mechanism of generation of the ventilatory pattern involves the integration of neural signals by respiratory control centers in the medulla and pons.

**Key Terms**

• **altered breathing patterns**: Abnormal breathing patterns that indicate typically indicate either too fast or too slow respiratory rate or too much or too little tidal volume.

• **tidal volume**: The amount of air displaced or exchanged in a single breath.

Breathing patterns refer to the respiratory rate, which is defined as the frequency of breaths over a period of time, as well as the amount of air cycled during breathing (tidal volume). Breathing patterns are an important diagnostic criteria for many diseases, including some which involve more than the respiratory system itself.

**Characteristics of the Breathing Patterns**

The respiratory rate is frequency of breaths over time. The time period is variable, but usually expressed in breaths per minute because that time period allows for estimation of minute ventilation. During normal breathing, the volume of air cycled through inhalation and exhalation is called tidal volume (VT), and is the amount of air exchanged in a single breath. Tidal volume multiplied by the respiratory rate is minute ventilation, which is one of the most important indicators of lung function. In an average human adult, the average respiratory rate is 12 breaths per minute, with a tidal volume of .5 liters and a minute ventilation of 6 liters per minute, though these numbers vary from person to person. Infants and children have considerably higher respiratory rates than adults.

**Spirometry curve**: The normal respiratory rate refers to the cyclical inhalation and exhalation of tidal volume (VT).

The respiratory rate is controlled by involuntary processes of the autonomic nervous system. In particular, the respiratory centers of the medulla and the pons control the overall respiratory rate based on a variety of chemical stimuli from within the body. The hypothalamus can also influence the respiratory rate during emotional and stress responses.
Normal and Altered Breathing Patterns

Eupnea is the term for the normal respiratory rate for an individual at rest. Several other terms describe abnormal breathing patterns that are indicative of symptoms of many diseases, many of which aren’t mainly respiratory diseases. Some of the more common terms for altered breathing patterns include:

- **Dyspnea**: commonly called shortness of breath. It describes dramatically decreased tidal volume and sometimes increased respiratory rate, leading to a sensation of breathlessness. It is a common symptom of anxiety attacks, pulmonary embolisms, heart attacks, and emphysema, among other things.
- **Hyperpnea**: refers to increased volume of air cycled to meet the body’s metabolic needs, which may or may not involve a change in frequency of breathing. It is a symptom of exercise and adjustment to high altitude, which are generally not problematic, but can also be seen in those with anemia or septic shock, which is problematic.
- **Tachypnea**: describes increased respiratory rate. Often a symptom of carbon monoxide poisoning or pneumonia.
- **Bradypnea**: describes decreased respiratory rate. Often a symptom of hypertension, heart arrhythmias, or slow metabolic rate from hypothyroidism.
- **Apnea**: Transient stopped breathing that begins again soon afterwards. It is the main symptom of sleep apnea, in which breathing temporarily stops during sleep.

These terms all describe an altered breathing pattern through increased or decreased (or stopped) tidal volume or respiratory rate. It is important to distinguish these terms from hyperventilation and hypoventilation, which refer to abnormalities in alveolar gas exchange (and thus blood pH) instead of an altered breathing pattern, but they may be associated with an altered breathing pattern. For example dyspnea or tachypnea often occur together with hyperventilation during anxiety attacks, though not always.

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