

1. The following is excerpts from an article in *The Seattle Times*, December 20,1996 entitled: University Of Washington Doctors To Aid In Rating Radical New Lung Surgery. Clearly, this journalist did not take Phyl 422. Identify the errors in the description of the physiological relationships.

*" About 2 million Americans suffer from emphysema, a stiffening and weakening of the lungs resulting primarily from smoking.*

*Lung tissue is normally very elastic, and when it stiffens with emphysema, not enough air can be expelled, pushing the diaphragm down in the abdomen and lessening the muscles' ability to contract.*

*In the lung-reduction operation, severely damaged tissue is removed. That allows the remaining lung to expand more, increasing its elasticity and freeing up space for the diaphragm to return to its normal position."*

2. You are called to the bedside of a patient who appears anxious and short of breath. Her respiratory rate is 24 breaths/min, and she seems to be moving a lot of air with each breath. Is she hyperventilating?
3. A patient is brought to the emergency room after being found comatose in his apartment. His respirations appear shallow, approximately 10 breaths/min, and blood pressure and pulse are stable. He remains comatose. Is he hypoventilating?
4. A well conditioned undergraduate decides to jog around the Copp building. Assuming she has normal resting values for carbon dioxide production of 200 ml/min and normal resting values for alveolar ventilation of 4.3 L/min, what would be her most likely values just before she finishes running?
  - a.  $P_a\text{CO}_2 = 25$  mm Hg; alveolar ventilation = 8.6 L/min;  $\text{CO}_2$  production = 400 ml/min
  - b.  $P_a\text{CO}_2 = 40$  mm Hg; alveolar ventilation = 8.6 L/min;  $\text{CO}_2$  production = 400 ml/min
  - c.  $P_a\text{CO}_2 = 40$  mm Hg; alveolar ventilation = 4.3 L/min;  $\text{CO}_2$  production = 400 ml/min
  - d.  $P_a\text{CO}_2 = 40$  mm Hg; alveolar ventilation = 8.6 L/min;  $\text{CO}_2$  production = 200 ml/min
  - e.  $P_a\text{CO}_2 = 50$  mm Hg; alveolar ventilation = 8.6 L/min;  $\text{CO}_2$  production = 400 ml/min
5. State whether each of the following are true or false:
  - a.  $P_a\text{CO}_2$  is inversely related to alveolar ventilation.
  - b.  $P_a\text{CO}_2$  is directly related to the level of carbon dioxide production.
  - c. Dead-space ventilation can rise solely from a change in the pattern of breathing, i.e. without a change in the lung architecture.
  - d. To calculate the ratio of dead space to tidal volume using the Bohr equation, one need measure only tidal volume and  $P_a\text{CO}_2$ .
  - e. As  $P_a\text{CO}_2$  goes up alveolar  $\text{PO}_2$  goes down.

## Answers

1. The definition of emphysema is incorrect. In emphysema, due to the destruction of the elastic component of lung tissue, there is an increase in lung compliance (distensibility) and this could in lay terms be referred to as lungs weakening but the lung tissue does not stiffen, in fact it loosens! The functional consequence of loss of elasticity of lung tissue is hyperinflation of the lungs.

There is no explanation given as to why the shortened diaphragm (as a result of hyperinflation of the lung) has a lesser ability to contract (generate force). Can you think of an explanation related to basic skeletal muscle physiology?

2. You do not have sufficient information to answer this question. You need to know the patient's  $\text{PaCO}_2$ . A patient can appear anxious and short of breath but not hyperventilating.
3. Again you need to know the patient's  $\text{PaCO}_2$ . If the  $\text{PaCO}_2$  is above the normal range for  $\text{PaCO}_2$  (normal range = 35-45 mmHg) then the patient is hypoventilating. But you are not provided with any information regarding the patient's arterial levels of  $\text{CO}_2$  so you can not answer this question.
4. Refer to the  $\text{PCO}_2$  equation.
5.
  - a. True; Refer to the  $\text{PCO}_2$  equation.
  - b. True; Refer to the  $\text{PCO}_2$  equation.
  - c. True; See table provided in your handouts, lecture 2.
  - d. False; Also need to measure the partial pressure of  $\text{CO}_2$  in the mixed expired air.
  - e. True. See the alveolar air equation.