

## PHYL 422 Review Questions

## Set 4

1. The following relate to pulmonary circulation. Determine whether the statements are true or false.
  - a. The whole of cardiac output passes through the lungs.
  - b. The pressures in the pulmonary arteries are similar to those in the systemic arteries
  - c. The mean pressure in the pulmonary arteries rises as cardiac output increases.
  - d. The resistance of the pulmonary circulation falls as the pulmonary blood flow increases.
  - e. In an upright man, pulmonary blood flow is greatest at the base of the lungs.
  - f. The pattern of pulmonary blood flow is dependent on posture.
  - g. The lungs inactivate all circulating vasoactive materials.
  
2. With respect to diffusion of gases across the alveolar capillary membrane, which of the following statements are correct?
  - a. A decrease in either surface area or and increase in thickness of the alveolar capillary membrane should result in a slower rate of gas transfer across this membrane.
  - b. Increasing the partial pressure of alveolar oxygen should increase diffusion rate across the alveolar capillary membrane.
  - c. At rest, it takes  $\frac{3}{4}$  of a second for equilibration of oxygen tension in the pulmonary capillary blood with partial pressure of oxygen in the alveoli.
  - d. If pulmonary transit time is less than 0.25 seconds, oxygen transfer becomes diffusion limited.
  - e. In general, during exercise, oxygen transfer is diffusion limited.
  - f. The rate of gas transfer is similar for both oxygen and carbon dioxide, because the driving pressure for oxygen is less than that of carbon dioxide but its solubility is substantially higher than the solubility of carbon dioxide.
  
3. List five factors that can affect the diffusing capacity of the lungs. Provide an explanation on why each factor is significant in determining DLCO.
  
4. Specify why the following statements are true?
  - a. An individual can be hypoxic but not hypoxemic
  - b. In an individual with a R-L shunt, increasing inspired oxygen levels can increase the degree of PaO<sub>2</sub>.
  - c. An increase in V/Q mismatch can result in both normocapnia and hypercapnia
  - d. P[A-a] gradient remains normal during hypoventilation and when breathing low inspired partial pressures of oxygen.

5. Equal volumes of blood from hypoventilated and normally ventilated regions of a lung become mixed in a pulmonary vein. If the  $PO_2$  of the blood draining the hypoventilated region is 60 mmHg and that of the normally ventilated region is 100 mmHg, will the  $PO_2$  of the mixed blood be?
- 90 mmHg;
  - 80 mmHg;
  - 70 mmHg

## Answers

1. All of the output of the right ventricle passes through the pulmonary circulation and the output of both right and left heart will be the same over any significant period. The systolic and diastolic pressures in the pulmonary arteries are about 25 and 8 mmHg respectively, compared to 120/80 for the systemic arteries. Although the pressure in the pulmonary arteries rises with increasing cardiac output, the increase is small as the resistance of the pulmonary circulation falls due to recruitment and distention of pulmonary capillaries. Although the gradient of blood flow is greater in an upright person relative to a person lying on their side or on their back, blood flow pattern is maintained such that the gravity dependent portion of the lungs receives the greatest blood flow. While the lungs inactivate many vasoactive materials such as bradykinin, they convert angiotensin I to its active form, angiotensin II.
- b. True; b. False; c. True; d. True; e. True; f. True; g. False
2. a) true, b) true, c) false, d) true, e) false, f) false
3. a) lung volume; a larger lung volume signifies a greater surface area for diffusion.  
 b) age: alveolar size and number change with development. Up to age 20, these changes increase the DLCO. Aging results in loss of alveoli and hence a decrease in the DLCO.  
 c) exercise: during exercise, pulmonary blood volume increases which in turn see below:  
 d) pulmonary blood volume: the greater the pulmonary blood volume, the greater the surface area for gas exchange, the greater the diffusing capacity  
 e) hematocrit : fewer red blood cells result in low hemoglobin levels. The relative low level of hemoglobin results in relatively less binding of CO with Hb. The unbound CO in solution reduces the driving pressure for diffusion of CO and hence decreases DLCO
4. a) Hypoxemia refers to low partial pressure of oxygen in the arterial blood. Tissue oxygen levels can be low (hypoxia) despite the fact that the partial pressure of the blood reaching them is normal. This low tissue oxygen level can be the result of low levels of functional hemoglobin such that oxygen content of the blood perfusing the tissue is low despite its normal  $PO_2$ .
- b) Yes, if the degree of shunting is less than 50%, increasing  $FIO_2$  can elevate the  $PaO_2$ . This increase in  $PaO_2$  however is substantially less than that observed in a similar degree of V/Q mismatch. In elevated V/Q mismatch, supplemental oxygen washes out the nitrogen in the low V/Q units improving the end capillary  $PO_2$ ; whereas, in a shunt the shunted blood never comes into contact with the elevated inspired oxygen.

c) the end capillary blood of low V/Q units has an elevated PCO<sub>2</sub> and a low PO<sub>2</sub>. These in turn elevate the arterial PCO<sub>2</sub> and lower the arterial PO<sub>2</sub> which in turn act as ventilatory stimulants. If this chemoreflex typically results in hyperventilation and the individual will be normocapnic. However, If the individual can not hyperventilate due to a disease process affecting the ventilatory pump, then hypercapnia will prevail.

d) Although hypoventilation and low inspired oxygen decrease the alveolar PO<sub>2</sub>, there will be a similar relative decrease in arterial PO<sub>2</sub>. Since both alveolar and arterial levels decrease proportionally, the normal A-a gradient is maintained.

5. Approximately 70 mmHg as it is the oxygen content of each stream of blood that is averaged, not their partial pressures.