Antomical dead space and frc assignment

Anatomical dead space and functional residual capacity (FRC) play a very important role to ensure the constancy of alveolar gas tensions. Firstly it is important to understand what the anatomical dead space and FRC actually are. The anatomical dead space refers to the gas in the conducting areas of the respiratory system where air does not come into contact with alveoli. Examples of places in the respiratory system where anatomical dead space is present are the mouth and trachea. The functional residual capacity is the amount of air that remains in the lungs after a normal and passive expiration.

It is usually measured at approximately 2. 5 litres of air. Both the FRC and the anatomical dead space are essential in maintaining the constancy of alveolar gas tensions. To highlight there importance, it would be very useful to imagine the situation within the respiratory tract if they were not present. The consequence of these two factors not being present means that the inspired air would be equal to the normal tidal volume and the lungs would completely empty on expiration. This would mean that the air breathed in would equilibrate itself with the blood flowing in the lungs.

Hence the pCO_2 and pO_2 levels in the blood flowing out of the lungs would have equilibrated itself with the gas tensions in the inspired air. Then when expiration takes place, no gas is present in the lungs as it has completely emptied itself. The effects of this are that on inspiration, diffusion would take place in between the inspired air and the blood. Due to this the blood pO_2 levels would become atmospheric. This means the blood would have 20 Kpa of O_2 and 0 Kpa of Co_2 as the atmospheric air has a negligible concentration of CO_2.

As we have such a low concentration of CO_2 in the lungs, there is a shift in the carbonic acid equilibrium. Due to this there is less carbonic acid produced as there is no CO_2 and the blood becomes more alkaline. This is known as alkalosis. On expiration, as there is a high pH in the blood due to alkalosis, there is another shift in the carbonic acid equation. This time however, the body tries to lower the pH of the blood. This is known as acidosis and causes a low pH in the blood. Thus there would be significant changes in the pH while breathing in and out as blood is continuously flowing throughout our body.

Hence this would have a major debilitating effect on the enzyme function within our body as enzymes work under very specific conditions. The loss of enzyme function could lead to some serious problems within our body as enzymes are involved in most of the important metabolic reactions. Another issue that could arise would be that when you breathe out you would only be left with around 5 Kpa of O_2 in the blood and this is not enough to sustain the cells within our body. This could lead to cell starvation which is known as hypoxia. The FRC of the lung is maintained at about 2500ml.

On average, 500ml of air enters with every normal inspiration. Of this 500ml, 150ml does not reach the alveoli and becomes part of the anatomical dead space. The remaining 350ml of air reaches the alveoli to take part in gaseous exchange. Hence according to these calculations, only 350ml of fresh air reaches the lungs. Hence as the FRC is 2. 5 litres, fluctuations of 350ml don’t cause any major changes in the pCO_2 and pO_2 concentrations. They thus stay constant at around 13 Kpa of O_2 and 5 Kpa of Co_2 and hence drastic fluctuations in gas concentrations are avoided. The dead space also prevents infection and warms up incoming air.

Due to the FRC and anatomical dead space being present, constant conditions are provided which allow our body to function optimally. Even though we know the importance of FRC and anatomical dead space, it is essential to measure them. There are two main techniques used for their measurement. Anatomical dead space is measured using the Fowler’s method which is also known as the nitrogen washout method. The FRC is measured using the helium dilution technique. A brief overview of both these methods is given below. In the nitrogen washout method the patient is made to inhale a breath of 100 percent oxygen.

The patient then exhales through a one way valve which measures the nitrogen content and volume in the expired breath. There airways only contain oxygen but the alveoli also contain nitrogen. When the patient expires the nitrogen content is monitored. A nitrogen vs expired volume curve is plotted by increasing nitrogen concentration from zero to the concentration of nitrogen within the alveoli. The concentration of nitrogen increases as the air from the dead space is expired and eventually reaches a plateau once the alveolar air starts to be exhaled.

The concentration is initially zero because the patient is exhaling dead space oxygen that they just breathed in. As we know this oxygen does not take part in gaseous exchange. It then increases as the air in the dead space mixes with that of the alveoli. The anatomical dead space can be obtained from this curve by drawing a vertical line down the curve so that the area to the left of the line is equal to that of the area to right of the line. The graph obtained can be seen below. In the helium dilution technique, a closed system circuit is setup where a spirometer is filled with a mixture of helium and oxygen.

The concentration of helium used in the spirometer is calculated and recorded. Helium is used because it is an inert gas and it has very low solubility in blood. The patient is made to expire normally and is then made to inhale from the spirometer. As the patient inhales the helium mixes with the remaining air present in the lungs. The patient is made to take a few breaths and this causes the concentration of helium in the spirometer to equilibrate with that of the lungs. The final concentration of helium in the spirometer is noted.

The FRC is calculated using the equation: FRC = [(Initial Helium concentration/ final Helium concentration)-1] x volume of spirometer. D? In conclusion it can be seen that both the FRC and the anatomical dead space are essential for the proper functioning of the respiratory system and without them our body would face some very serious health implications.

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