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**Diffusion of gases**

Gas exchange refers to the process in which oxygen and carbon dioxide move between the bloodstream and the lungs (Graham et al., 2018). During inhalation, air enters the body via the mouth or nose through to the pharynx trachea, and lungs. Within the lungs, trachea divides into smaller branches called bronchioles which end in alveoli, tiny air sacs where gaseous exchange take place via diffusion. The movement of the gases is random but the overall direction is dependent on the concentration gradient. Oxygen diffuses from the lungs to the blood and at the same time carbon dioxide diffuse from blood to the lungs. The greater the concentration gradient the faster the rate of diffusion. In addition, the greater the surface area for diffusion the faster the rate.

Pulmonary diffusion capacity is a method used to assess lung function by measuring how well oxygen and carbon dioxide diffuse between the lungs and bloodstream (Saydain et al., 2004). In this test, inhaled carbon monoxide is used because its affinity for hemoglobin is high, about 200 times that of oxygen. In addition to the high affinity, carbon monoxide uptake is less dependent on cardiac output unlike oxygen. The single breath method is used to perform a diffusion capacity test, in which a patient is asked to take regular breaths followed by full exhalation up to residual volume, and then inhale a test gas up to vital capacity. This test gas contains 0.3 percent carbon monoxide, 0.3 percent tracer gas, 21% oxygen, and the rest nitrogen. The patient is then asked to hold their breath for 10 seconds at full lung capacity before completely exhaling. The CO and tracer concentrations are measured in the exhaled gas. CO absorption is measured in cc of CO per second per millimeter of CO driving pressure (cc of CO/sec/mm of Hg).

In this test hemoglobin is significant as it binds to the carbon monoxide whose uptake quantity is being measured. Diffusing capacity is significant clinically in diagnosis of lung disease.

The hemoglobin level is not taken into account while calculating diffusion capacity. As a result, it is lower in anemia patients and higher in polycythemia patients. As a result, hemoglobin levels should be taken into account while interpreting the results. Anemia that is severe or develops during treatment should not be mistaken for pulmonary disease. When pulmonary blood flow and consequently alveolar-capillary volume and surface area rise, diffusing capacity increases as well. Furthermore, diffusing capacity may be increased in response to changes in pulmonary capillary blood volume although alveolar-capillary membrane function is normal. During exercise, it increases by about twofold due to the mobilization of pulmonary capillaries and the resulting increase in the alveolar-capillary membrane surface area. It may also be higher in patients with asthma or obesity, owing to an increase in pulmonary blood volume, but these increases are not clinically significant.

**Krogh model of diffusion in tissue**

The Krogh tissue cylinder model is a simplified illustration of the surrounding tissue of the capillary. It is assumed that each capillary is surrounded by a cylindrical layer of tissue, and that the solute is carried only through that capillary. The capillary should have a consistent radius and be spherical in shape. The model assumes that diffusion takes place from a capillary cylinder into a larger but limited cylinder surrounding it (Popel, 1989). Also, it is assumed that only diffusion takes place and there is no active transport and no turbulence. In addition, diffusion and oxygen consumption in the tissue are homogeneous and independent of the cellular structure or local oxygen partial pressure. Other assumptions of the model are that both utilization and solubility of oxygen is the tissue is constant and uniform. Additionally, longitudinal diffusion of oxygen is not significant. Furthermore, Krogh model assumes that all capillaries receive equal supply of oxygen.

In Krogh model, the condition of zero radial solute flux is imposed at the outer edge of the cylinder. This assumption is based on the fact that the tissue cylinder is surrounded by an array of analogous parallel units, ensuring that solute levels in adjacent units are identical and that no solute exchange occurs. This approach was motivated by the fact that capillaries present in the skeletal muscle form a parallel array which are aligned with the muscle fibers. However, capillaries in skeletal muscle are not evenly spaced, and the points of connection to feeding arterioles and draining venules are not always aligned across numerous adjacent capillaries.

**References**

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