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Got O2? The Relevance of Oxygen to Fluid Shifting

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The significance of oxygen is overlooked when considering how fluid shifts across the intracellular, interstitial, and vascular compartments. When oxygen supply is lacking, there is decreased energy production within the cell. Decreased energy production impedes shifting of fluid into the vascular space where it's removed during hemodialysis.

To remove fluid during hemodialysis, it must shift from the intracellular to the extracellular space. This requires energy. Oxygen is required to produce energy in the form of ATP. The process of producing the maximum amount of ATP molecules (34) is called aerobic cellular respiration. Comparatively, anerobic cellular respiration produces only a net of (2) ATP molecules.

The passive movement of water from a lower solute concentration to a higher solute concentration is called Osmosis. Diffusion is the passive movement of solutes from an area of higher solute concentration to one of lower solute concentration. Active transport is the process of moving solutes against their concentration gradient. Active transport requires energy (ATP).

On its own, sodium (Na) will passively diffuse from the extracellular space into the intracellular space bringing water along with it. In contrast, energy is required to fuel the Na/potassium (K) pump, ensuring that sodium is consistently present in a higher concentration outside of the cell and potassium maintains a higher concentration inside the cell. As the Na/K pump kicks out three Na molecules per cycle, water will follow, thus facilitating the shift of fluid from the intracellular space to the extracellular space.

Aerobic cellular respiration will decrease if oxygen is not present in adequate supply due to low hemoglobin, insufficient oxygen intake, or decreased consumption. If aerobic respiration is limited, there will be a decrease in ATP production. Decreased ATP results in less available energy to fuel the Na/K pump. Without the Na/K pump, sodium will passively diffuse into the intracellular space carrying water along with it. This will inhibit the shifting of fluid into the vascular space where it can be removed by the process of hemodialysis.

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