Critical Events Occuring During a Dive in the Water and During Hyperbaric Oxygen Treatment

This table serves as a reminder of the factors to consider in preparing patients for and managing them during hyperbaric oxygen treatment.

	Air Breathing Diver in the Water	Oxygen Breathing Patient in Monoplace Chamber
Compression	Absolute pressure increases…the volume of gas containing spaces with flexible boundaries decreases (*Boyle's Law*) 1. Middle ear and sinus barotrauma 2. Mask squeeze 3. Decrease in volume of wet suit, and buoyancy compensator 4. Breathing gas density increases, work of breathing increases 5. Number of gas molecules consumed with each breath increases	Absolute pressure increases…the volume of gas containing spaces with flexible boundaries decreases (*Boyle's Law*) 1. Middle ear and sinus barotrauma 2. Volume of gas containing medical implants or within medical devices decreases, can affect equipment function 3. Breathing gas density increases, work of breathing increases 4. Number of gas molecules consumed with each breath increases
	Partial pressure of gases increases leading to increased gas tensions in blood and tissues…inert gas and oxygen (*Dalton's Law*) 1. Inert gas narcosis 2. Oxygen toxicity 3. Carbon dioxide retention in ambient environment	Partial pressure of gases increases leading to increased gas tensions in blood and tissues…oxygen (*Dalton's Law*) 1. Pharmacophysiologic effects of hyperoxygenation of blood and tissue 2. Oxygen toxicity 3. Carbon dioxide retention in ambient environment
		Pharmacophysiologic effects of hyperoxygenation of blood and tissue 1. Improved oxygen dependent cellular metabolism 2. Antimicrobial effects 3. Protection against ischemia reperfusion injury 4. Tissue regenerative effects (angiogenesis, tissue growth) 5. Anti-inflammatory effects 6. Anti-apoptotic effects 7. Activated stem cell mobilization
	Increased inert gas volume in solution (*Henry's Law*) defined by partial pressure of ambient gas, solubility of gas in water and lipid, gas diffusion	Increased oxygen volume in solution (*Henry's Law*) defined by partial pressure of ambient gas, solubility of gas in water and lipid, gas diffusion
		Ambient temperature increases in the chamber (*Gay-Lussac's Law*)
Decompression	Absolute pressure decreases…the volume of gas containing spaces with flexible boundaries increases (*Boyle's Law*) 1. Middle ear and sinus barotrauma 2. Pulmonary barotrauma, pneumothorax 3. Breathing gas density decreases, work of breathing decreases 4. Number of gas molecules consumed with each breath decreases 5. Any inert gas or oxygen bubbles forming during decompression (phase separation) will increase in size as ambient pressure decreases	Absolute pressure decreases…the volume of gas containing spaces with flexible boundaries increases (*Boyle's Law*) 1. Middle ear and sinus barotrauma 2. Pulmonary barotrauma, pneumothorax 3. Breathing gas density decreases, work of breathing decreases 4. Number of gas molecules consumed with each breath decreases 6. Any inert gas or oxygen bubbles forming during decompression (phase separation) will increase in size as ambient pressure decreases
	Partial pressure of gases decreases leading to decreased gas tensions in blood and tissues…inert gas and oxygen (*Dalton's Law*) 1. Recovery from inert gas narcosis 2. Hypoxia	Partial pressure of gases decreases leading to decreased gas tensions in blood and tissues…inert gas and oxygen (*Dalton's Law*) 1. Blood and tissue oxygen gas tensions decrease but hypoxia cannot occur with normal lungs as patient always breathing 100% oxygen even on return to 1 ATA at surface
	Decreased inert gas volume in solution (*Henry's Law*) defined by partial pressure of ambient gas, solubility of gas in water and lipid, gas diffusion 1. Inert gas decompression sickness	Decreased oxygen gas volume in solution (*Henry's Law*) defined by partial pressure of ambient gas, solubility of gas in water and lipid, gas diffusion 1. Oxygen decompression sickness could occur but would be very short lived due to rapid re-absorption of oxygen as it is metabolically consumed
		Ambient temperature decreases in the chamber (*Gay-Lussac's Law*)

Boyle's Law: At a constant temperature, the volume of a given gas is inversely proportional to the surrounding ambient absolute pressure.

To maintain a neutral lung volume as we descend on scuba, we inhale proportionally more gas molecules per breath.

Dalton's Law: The total pressure exerted by a gas mixture is equal to the sum of the partial pressures of each individual gas.

As we breathe more gas molecules per breath on descent, the potential impact of elevated partial pressures becomes important. Nitrogen narcosis is the result of elevated nitrogen partial pressures.

Henry's Law: At a constant temperature, the amount of a given gas that dissolves into a liquid is directly proportional to the partial pressure of that gas above the liquid. In physiological terms, this gas pressure exists within our lungs relative to the gas pressure within our blood.

The greater the gas pressure within our lungs, the more gas will dissolve into our blood and body tissues. This is the basis of decompression sickness.

 Reference: Larson-Lohr V, Norvell H, Josefsen L, Wilcox J et al. Hyperbaric Nursing and Wound Care. Flagstaff, AZ: Best Publishing Company; 2010.