Oxygen
the ultimate nutrient

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ASK Annual Conference Crawley June 2014

Hypoxia is a condition in which the body or a region of the body is deprived of adequate oxygen supply.

Hypoxia may be classified as either generalized, affecting the whole body, or local, affecting a region of the body.

Symptoms
Gradual onset - Light-headedness
Numbness / tingling of extremities, Nausea and anorexia.
Tiredness
Visual deterioration
Memory loss
Feeling the cold
Degenerative changes
Symptoms
Rapid onset - ataxia, confusion / disorientation / hallucinations / behavioral change, severe headaches / reduced level of consciousness, papilloedema, breathlessness, pallor, tachycardia and pulmonary hypertension.

If hypoxia is very severe, a tissue may eventually gangrene. Extreme pain may also be felt at or around the site. Eventually leading to the late signs cyanosis, bradycardia / cor pulmonale and hypotension followed by death.

Because haemoglobin is a darker red when it is not bound to oxygen (deoxyhaemoglobin), as opposed to the rich red colour that it has when bound to oxygen (oxyhaemoglobin), when seen through the skin it has an increased tendency to reflect blue light back to the eye.
Hypoxia can result from a failure at any stage in the delivery of oxygen to cells. This can include decreased partial pressures of oxygen, problems with diffusion of oxygen in the lungs, insufficient available haemoglobin, problems with blood flow to the end tissue, and problems with breathing rhythm.

History and Functional Testing for Hypoxia

1. Bioimpedance actually determines the electrical impedance, or opposition to the flow of an electric current through body tissues which can then be used to calculate an estimate of total body water. TBW can be used to estimate fat-free body mass and, by difference with body weight, body fat.
Electro Interstitial Scanner
The EIS provides an electrical signal corresponding to the status of a patient's physiological parameters: Na+/K+ATPase pump activity, tissue pCO2, sympathetic system activity and microcirculation blood flow.

3. Oxygen saturation is a term referring to the concentration of oxygen in the blood. The human body requires and regulates a very precise and specific balance of oxygen in the blood. Normal blood oxygen levels in humans are considered 95-100 percent. If the level is below 90 percent, it is considered hypoxia.

Blood oxygen levels below 80 percent may compromise organ function, such as the brain and heart, and should be promptly addressed. Continued low oxygen levels may lead to respiratory or cardiac arrest.
In medicine, oxygen saturation (SO₂), commonly referred to as "sats", measures the percentage of hemoglobin binding sites in the bloodstream occupied by oxygen. At low partial pressures of oxygen, most hemoglobin is deoxygenated.

At around 90% (the value varies according to the clinical context) oxygen saturation increases according to an oxygen-hemoglobin dissociation curve and approaches 100% at partial oxygen pressures of >10 kPa.
A pulse oximeter relies on the light absorption characteristics of saturated hemoglobin to give an indication of oxygen saturation.

Applied Kinesiology testing
i) All muscles weak on testing
ii) Single muscle weakens on repeated muscle testing (aerobic challenge)
iii) Positive eyes into distortion up and down
iv) Weak muscle strengthens to Oxygen
v) Strong muscle weakens to Xanthine oxidase

Eyes into Distortion (EID)

1. Nutrition
2. Toxicity
3. Mechanics
4. Dehydration
5. Exercise
6. Allergy
7. Infection
8. Hypoxia
Patient Protocol for Hypoxia
From weakness patient strengthens to HYPOXIC eye position
Confirm using OXYGEN vial to strengthen
Challenge using following vials
PHOSPHOLIPIDS    HEMOGLOBIN    Co-ENZYME Q10
EPO, BSO, Borage    ALA                Co-Q10 in Rice bran oil
Black cumin        PBG
Flax, Chia          HMB
Grape seed          UPG III
Hazel, Hemp         CPG III
Macadamia           PPG IX
Olive
Peanut
Pumpkin
Super Omega 3
Walnut
WGO

Oxygen in the air
Alveolar membrane
Red blood cell membrane
Red blood cell membrane
Tissue cell membrane
Tissue cell mitochondrial membrane
Tissue cell mitochondria

Reactive Oxygen Species
Oxygen transport
Oxygen into the Lungs
By volume, dry air contains
78.09% nitrogen
20.95% oxygen
0.93% argon
0.039% carbon dioxide
and small amounts of other gases.
Air also contains a variable amount of water vapor, on average around 1%.

At sea level the partial pressure of oxygen (pO2) in the lungs = 21% of atmospheric pressure 760mm Hg = 160mm Hg.
At 16000ft with atmospheric pressure at 400mm Hg pO2 = 82mm Hg

Henry's Law of Solution states that the quantity of a gas going into simple solution at constant temperature is proportional to the pressure. The solubilities of oxygen, carbon dioxide and nitrogen are in the ratio of 2:50:1
Movement of gases is always from the region of high tension to a region of low tension. Oxygen will thus pass from the lung alveoli to the blood and then to the tissues. CO2 tension is higher in the blood so passes from the blood to the alveoli.

Oxygen is transported in the blood in 2 ways
1. Dissolved in the plasma = 0.3 volume %. Small but important in determining the oxygen tension gradient from the plasma to the tissues.
2. Combined with haemoglobin in the red cell.

Almost all the oxygen in the blood is bound to hemoglobin, so interfering with this carrier molecule limits oxygen delivery to the periphery.

Hemoglobin increases the oxygen-carrying capacity of blood by about 40-fold,
with the ability of hemoglobin to carry oxygen influenced by the partial pressure of oxygen in the environment, a relationship described in the oxygen–haemoglobin dissociation curve. When the ability of hemoglobin to carry oxygen is interfered with, a hypoxic state can result.

At tensions above 100mm Hg the haemoglobin is fully saturated with oxygen and the dissociation curve is plotted as a percentage saturation against tension.

The Bohr Effect
In addition to tension and haemoglobin content, the oxygen content of the blood depends upon the CO2 being carried simultaneously. An increase in pCO2 from the normal value of 40mm Hg shifts the oxygen dissociation curve thus less oxygen is carried at a given tension.
Oxygen transport

Blood leaves the lungs at an oxygen tension of 100mm Hg and returns at 40mm Hg.

Carbon dioxide transport

Only 4ml% is given off in the passage through the lungs which equals the amount taken up by the tissues.

Mechanics of Breathing
Lung volume

3400ml

3000ml

0ml

time

Tidal volume

Resting respiratory level

Lung volume

3400ml

1500ml

0ml

time

Forced expiration

Residual volume

Lung volume

5000ml

1500ml

0ml

time

Forced inspiration followed by forced expiration

Vital Capacity

Residual Volume
Tidal volume = 400ml
Only 250ml of this air reaches the alveoli, the last 150ml remains in the bronchial tubes and is called dead space air.

Chief muscles of breathing are the Diaphragm and the Intercostals.

Inspiration is an active process of depressing the diaphragm downwards and contracting the intercostal muscles \ moving the chest wall upwards and outwards.

Expiration is brought about by passive elastic recoil of the lungs and relaxation of the inspiratory muscles.
Mechanical Faults

1. Cranial
2. Cervical spine
3. Thoracic spine
4. Diaphragm
5. M/S joint
6. Sternoclavicular joint
7. Acromioclavicular joint
8. Ribs
9. Lumbar spine

Oxygen into the Blood
The alveoli are located in the respiratory zone of the lungs, at the distal termination of the alveolar ducts and atria. These air sacs are the forming and termination point of the respiratory tract. They provide total surface area of about 100 m².

The alveoli consist of an epithelial layer and extracellular matrix surrounded by capillaries. The alveoli contain some collagen and elastin fibres. The elastic fibres allow the alveoli to stretch as they are filled with air during inhalation. They then spring back during exhalation in order to expel the carbon dioxide-rich air.

There are three major cell types in the alveolar wall
1. Type I (Squamous Alveolar) cells that form the structure of an alveolar wall
2. Type II (Great Alveolar) cells that secrete pulmonary surfactant to lower the surface tension of water and allows the membrane to separate, therefore increasing its capability to exchange gases.

3. Macrophages that destroy foreign material, such as bacteria.

Re-inflation of the alveoli following exhalation is made easier by pulmonary surfactant, which is a phospholipid and protein mixture that reduces surface tension in the thin fluid coating within all alveoli. The fluid coating is produced by the body in order to facilitate the transfer of gases between blood and alveolar air.

Great alveolar cells also repair the endothelium of the alveolus when it becomes damaged. Insufficient pulmonary surfactant in the alveoli can contribute to atelectasis (collapse of part or all of the lung). Without pulmonary surfactant, atelectasis is common.
Plasma membranes consist of both lipids and proteins. The fundamental structure of the membrane is the phospholipid bilayer, which forms a stable barrier between two aqueous compartments. In the case of the plasma membrane, these compartments are the inside and the outside of the cell.

Plasma membranes of human cells contain four major phospholipids
1. Phosphatidylcholine,
2. Phosphatidylethanolamine
3. Phosphatidylserine,
4. Sphingomyelin
which together account for more than half of the lipid in most membranes.

These phospholipids in human red blood cells are asymmetrically distributed between the two halves of the membrane bilayer.
The outer leaflet consists mainly of phosphatidylcholine, sphingomyelin and glycolipids

Where as phosphatidylethanolamine and phosphatidylserine are the predominant phospholipids of the inner leaflet.

A fifth phospholipid, phosphatidylinositol, is also localized to the inner half of the plasma membrane.

Although phosphatidylinositol is a quantitatively minor membrane component, it plays an important role in cell signalling.

The head groups of both phosphatidylserine and phosphatidylinositol are negatively charged, so their predominance in the inner leaflet results in a net negative charge on the cytosolic face of the plasma membrane.
The outer leaflet consists predominantly of phosphatidylcholine, sphingomyelin, and glycolipids, whereas the inner leaflet contains phosphatidylethanolamine, phosphatidylserine, and phosphatidylinositol. Cholesterol is distributed in both leaflets.

In addition to the phospholipids, the plasma membranes of animal cells contain glycolipids and cholesterol. The glycolipids are found exclusively in the outer leaflet of the plasma membrane, with their carbohydrate portions exposed on the cell surface.

They are relatively minor membrane components, constituting only about 2% of the lipids of most plasma membranes. Cholesterol is a major membrane constituent of human cells, being present in about the same molar amounts as the phospholipids.
**Phospholipids**

**A Phospholipid**

- Polar head group (hydrophilic)
- Apolar, hydrocarbon tails (hydrophobic)

The unsaturated fatty acid tails are kinked and lead to more spacing between the polar heads and hence more movement.
R maybe
Choline
Inositol
Ethanolamine
Serine
Sphingomyelin

Cell Membranes

Passive transport  Active transport
Glycerol
- ATP
  - ATP kinase
  - Mg^{2+}
  - ADP

Glycerol-3-phosphate

Phosphatidate
- H_{2}O
  - hydrolase
  - P_{1}

Dihydroxyacetone phosphate
- Acyl-CoA
  - acyltransferase
  - CoA

Diacylglycerol

Plasmalogens

ATP
- glycerol kinase
- Mg^{2+}
- ADP

NADPH, O_{2}
- dehydrogenase
- NADP

H_{2}O
- hydrolase
- P_{1}

Phosphatidate

CTP synthase
- P_{1}

Diacylglycerol

CDP-Diacylglycerol

Cardiolipin
- CTP synthase
  - PP_{1}

Glycerol-3-phosphate

Phosphatidate
- H_{2}O
  - hydrolase
  - P_{1}

Diacylglycerol

CDP-Diacylglycerol

Phosphatidylglycerol

Phosphatidylcholine

Phosphatidylethanolamine

Phosphatidylglycerol
- CDP
ethanolamine transferase
  - CMP

Phosphatidylglycerol

Phosphatidylcholine
- CDP-choline transferase
  - CMP

Phosphatidylinositol
- CDP-choline transferase
  - CMP

Phosphatidylinositol

Phosphatidylinositol
- ATP
  - kinase
  - ADP

Phosphatidylinositol

Phosphatidylinositol-4-phosphate

Phosphatidylinositol-4,5-bisphosphate

Phosphatidylserine
- Serine transferase
  - Ethanolamine

Phosphatidylserine

Phosphatidylserine
- ATP
  - kinase
  - ADP

Phosphatidylserine
B-6 (P-5-P) is critical for the synthesis sphingolipids. These lipids are critical for cell signal transduction, and neural health. Abnormal lipid values have been identified in individuals with elevated urine pyrroles. This may be especially true for an omega 6 lipid, arachidonic acid.

Key nutrients for synthesising the phospholipids
Acetyl CoA (Vit B5, Magnesium, P5P)
NAD, NADPH (Vit B3 complex)
Mg, Zn, SAM (Mg, P-5-P, Folates, B12)
Choline
Serine
Inositol
Saturated fatty acids C16-18
Unsaturated fatty acids C18-24
Lecithin

Lecithin is a generic term to designate any group of yellow-brownish fatty substances occurring in animal and plant tissues composed of phosphoric acid, choline, fatty acids, glycerol, glycolipids, triglycerides, and phospholipids (e.g., phosphatidylcholine, phosphatidylethanolamine, and phosphatidylinositol).
Soybean-derived Lecithin dietary supplements are composed of 19-21% Phosphatidylcholine, 8-20% Phosphatidylethanolamine, 20-21% Inositol phosphatides, 33-35% Soybean oil, 2-5% Sterols, 5% Carbohydrates/free, 1% Moisture, and 5-11% Other phosphatides.¹

Lecithin is only found natural in natural fats, and is not found in processed foods. Foods containing lecithin include: chia seeds, butter, eggs, soy, pumpkin seeds and beef. Lecithin helps break up fats (emulsifier), and helps the body to absorb and use vitamins and calcium.

Pumpkin Seeds. These little miraculous seeds are high in nitric oxide which is what the body needs to heal and repair anything that needs to be healed. They have anti-inflammatory properties and are useful with arthritis and other joint discomforts.
They are high in minerals especially zinc, that help to increase bone density. They support the immune system and are an anti-parasitic.

Hemoglobin saturation
The quantity of oxygen carried by the saturated blood will depend upon the haemoglobin content of the red cells. With a normal haemoglobin of 14.5gm/100ml blood 20ml of oxygen will combine with the haemoglobin in every 100ml of blood (20 volume %).

The amount carried when fully saturated is called the oxygen capacity.
What hypoxia does to the brain

- Energy Failure
- Depolarization → Loss of Function
- Glutamate Discharge at Synaptic Cleft
- Opening of NMDA, AMPA Receptors
- Calcium Influx
  - Activation of Catabolic Enzymes
  - Activation of NO Synthase
    - NO Production
    - Cellular Injury