BE OUT OF BREATH FOR 10 MINUTES EACH DAY

THE SCIENCE BEHIND LIVEO2 SYSTEMS

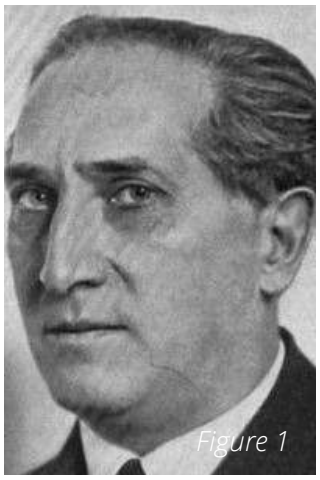


Figure 1

Theodor Brugsch (1), the head of the first Medical clinic of the Berlin Charite, gave this recommendation to his younger colleague Manfred von Ardenne (2) when he was asked about the key to maintaining good health in older age. The truthful simplicity of this advice between two doctors became undeniably apparent as von Ardenne, years later, published his clinical research on the Physiological and Technical Foundations of Oxygen Multistep Therapy. In this body of comprehensive research surrounding oxygen training Dr. von Ardenne discovered what he described as a "positive feedback loop" with a reversible switching mechanism" taking place in the endothelial cells of the capillaries. It is from this viewpoint that von Ardenne provides clinically significant protocols for the optimal reversal and thus deceleration of the positive feedback loop that is typically associated with the decline of health.

In a sense the positive feedback loop that Dr. von Ardenne is describing is the continual acceleration of the decline of the cardiovascular system primarily over the second half of life. A multitude of factors affect this cardiovascular and health decline, but it is known that middle age typically marks the start of a noticeable acceleration of this functional decline. (2) In positive feedback loops the rate of the process always continues to accelerate until the system produces an event. In this case, the event is ultimately death, but even that is preceded by any number of health consuming events. (3) While this sounds grim, the most significant information from von Ardenne's research is that the endothelial switching mechanism is dynamic in most cases and reversible. He proved that there is a clear and defined window of time where the functional decline is occurring prior to disease, as well as a certain threshold of oxygen training that when accomplished and maintained can result in complete or significant reversal of the capillary inflammation.


Figure 2

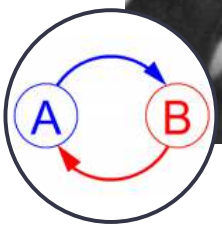


Figure 3

Through clinical observation and research, the key to this switching mechanism, affecting the narrowest cross section of the microcirculation, is the partial pressure of oxygen in the body. Dr. von Ardenne clinically proved and defined the guiding cellular bio-energetics that positively and negatively governs the feedback loop and switching mechanisms affecting the microcirculation. In general, a positive switching event is experienced during periods of hyperoxia such as those recorded through his Quick Oxygen Multistep Training Protocol (15 minutes). Or conversely, the feedback mechanism is evoked by systemically low partial pressures of oxygen, which is known as hypoxia. The events of short term hypoxia are known by many to produce beneficial results as the individual recovers from the hypoxic event.

However, chronic hypoxia overtime causes a multitude of negative effects on the body that are further reinforce and strengthen the feedback loop. Both scenarios of hyperoxia and hypoxia events affect the microcirculation and when understood they present vast implications as well as great potential when applied to training. Surprisingly this fundamentally basic knowledge of cellular respiration in the body is not often comprehended when assessing the fundamental cause of a person's condition.

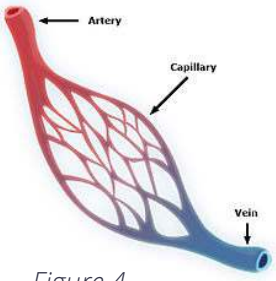


Figure 4

The significance of recognizing that the microcirculation of the body functions as a positive or reinforcing feedback loop can be best understood if we take a closer look at the physiology of the endothelial cells. When healthy, endothelial cells are slender elongated cells that align with the direction of the blood flow throughout the entire circulatory system from the heart to the smallest capillaries. (4) Commonly described as the "gate- keeper", endothelial cells (5) contain selective membrane bound receptors for proteins and hormones (just to mention a few).

These receptors, on the endothelial cells, create a semi selective barrier between the vessel and the surrounding tissue. It is the primary function of endothelial cells to control the passage of materials, including white blood cells, out of and into the bloodstream. Additionally vasoconstriction and vasodilation of the vessels by the endothelial cells systematically control blood pressure. Other functions of the endothelial cell include inflammation (systemic & local), new blood vessel formation, and repair of damaged or diseased organs by sprouting new capillaries. Incidentally endothelial cells also line the lymphatic vessels lending particular significance to Dr. von Ardenne's discoveries when addressing dysfunction of the lymphatic system. This physiological information concerning endothelial cells makes von Ardenne's observations concerning the bio-energetic control of the microcirculation all the more compelling. Especially that when under a primary oxygen deficiency the endothelial cells at the venous capillary end begin to swell and become fully round as oxygen deficiency is created in the cells of the vessel walls. Functionally this swelling of the endothelial cells limits and eventually all together prohibits their normal function, not to mention blood flow.

Dr. von Ardenne describes the swelling of the endothelial cells as the beginning of the positive feedback loop cascade. The negatively impaired switching mechanism starts as the venous end of the capillary as it is the most susceptible to lower oxygen levels. Moreover, the endothelial cells at the venous end of the capillary are now entangled in a much lower state of energy production associated with anaerobic metabolism. In this unnaturally lower energy state the cells lose potential toward maintaining their normal osmotic regulation pathways. As a result the ability of the cell's sodium/potassium pump is compromised and the surrounding tissues are flooded with hydrated sodium ions. Furthermore, the narrowing of the capillary vessels reduces blood flow and increases the viscosity of blood in the body due to stagnation. From von Ardenne's viewpoint it is apparent that the pathology of oxygen deficiency sets the positive feedback loop in to signaling the endothelial cells to change their shape, which in turn creates poor circulation, inflammation (chronic) and edema in the body. Or in other words a primary oxygen deficiency over time becomes a reinforced pattern within the circulatory system of the body.

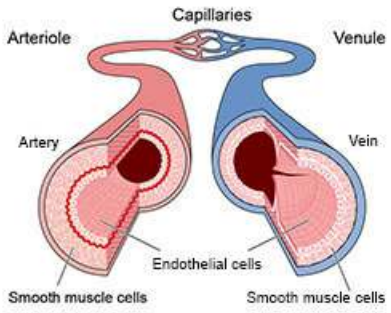
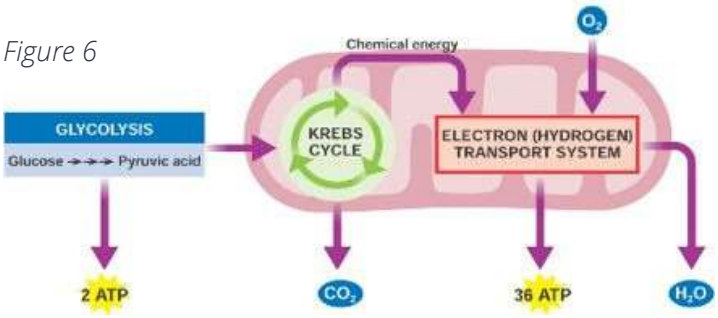


Figure 5

The above sequence of events is the pattern that takes place, in most cases, years before a disease diagnosis in the body. Specifically at first the body experiences this metabolic change and then it becomes the host to a variety of functional health conditions. Over time these conditions become reinforced and are defined as a progressive disease. All the while, the other cells in the body are concurrently experiencing an Adenosine triphosphate (ATP) deficiency as other areas of the body become reliant on anaerobic metabolism. These events are directly proportional to the overall deterioration of the oxygen status of the whole organism. When the progression of the pathogenic process is not attended to it becomes the next reinforcing event of the feedback loop. According to von Ardenne, the appearance and advancement of a disease is nothing more than the acceleration of the positive feedback loop triggered years ago in venous ends of the capillaries.

The significance of size in this recent yet manageable control mechanism of the endothelial cells becomes plainly important. The normal functions of the capillary vessels dictate that red blood cells must often travel in single file to pass through. The smallest endothelial cell lined capillaries of the body range in diameter from 5 to 10 micrometers. A red blood cell ranges in diameter of 6.2-8.2 micrometers. These are regarded as the normal tolerances of capillary blood flow. Many times it is also required that the red bloods cell must deform by elongating or folding to pass through the smallest diameters of the capillary. In this view, the deviation between flow with minimal resistance (good health) and flow that is impeded (poor health) in terms of the capillary exchange is minuscule (+/- 0.6 microns). In the cases of poor or impeded flow, there is little to no capillary exchange of oxygen for the tissues as well as little to no absorption of CO2 from the tissues. The net result is a decrease in pH in the tissues, which is normally advantageous for oxygen exchange into the tissues. Here this is of no help because the condition is a lack of circulation due to endothelial cell inflammation. It is for this reason that the oxygen deficiency will remain in gridlock until oxygenated blood flow is restored through the entire capillary exchange of the tissue.

Figure 6



Out of necessity, the tissue does have the ability to survive during these times when oxygen delivery to cells is not sufficient, but consequently this method of producing energy is far from optimal. To explore these processes we first need to understand that aerobic metabolism is supported by oxygen. There are three stages of aerobic metabolism: glycolysis (or fatty acid oxidation), the Krebs cycle, and the electron transport chain. (6) Together they comprise the major energy mechanism, aerobic respiration, which utilizes oxygen during normal metabolism. The key products are ATP and carbon dioxide (CO2). The ATP provides cells with energy for synthesis and replication while the CO2 stimulates oxygen delivery and breathing. For each molecule of glucose completely oxidized during aerobic metabolism the net number of ATP molecules theoretically obtained is 36. In all fairness to biological systems, there is some fallout due to inefficiencies and the most accurate approximation for our bodies is about 30 ATP molecules for each molecule of glucose consumed. As discussed below, aerobic metabolism is our only net positive process for energy production in the body. Therefore, our energy abundance, or lack thereof, in our body is determined by our capacity to maintain aerobic respiration. Put simply: cellular energy is the origin of health.

Anaerobic metabolism (7) on the other hand uses electron receptors other than oxygen in respiration. It is respiration without oxygen and is part of normal metabolism designed primarily for intense activities when quick but dirty energy production is absolutely necessary. Anaerobic metabolism has two stages: glycolysis and fermentation. Also known as the Cori cycle, anaerobic metabolism produces an immediate two ATP molecules per glucose molecule consumed. However, it is also an unsustainable cycle in that the lactic acid produced must be transported from the tissues to the liver to undergo gluconeogenesis. This process actually consumes six ATP molecules for each lactic acid molecule converted. The ATP production of the Cori Cycle actually produces a net loss of four ATP molecules for each molecule of glucose. Taking these totals into account for each anaerobic event the body endures it must recover through aerobic respiration, period. When we reach the point when we no longer accomplish this recovery regularly in our day to day lives the positive feedback loop is reinforced once more and the biological consequences grow stronger. From a critical needs viewpoint, oxygen is surely the immediate priority of the body to continue to live but also the first priority of the body over our entire life span in order to produce the energy needed to maintain our health.

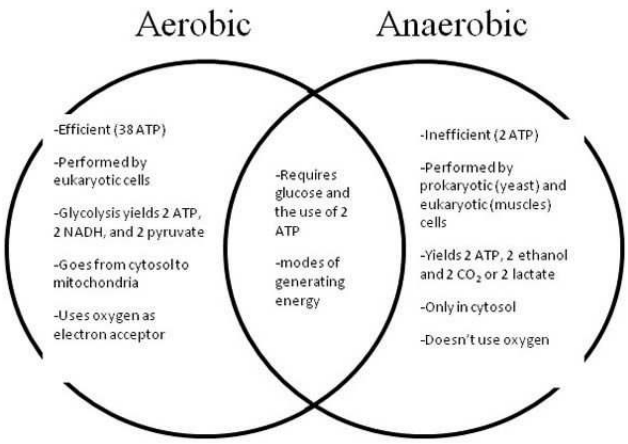


Figure 7

That being explained, Dr. von Ardenne intensely studied the mechanism to restore the oxygen flow through these chronically inflamed capillaries with the goal of restoring the aerobic respiration of the body. This discovery is in the body's ability to utilize oxygen above the rate of its consumption. Through research, von Ardenne determined that the partial pressure of oxygen at the venous capillary end (PO2-ven) was of critical importance to monitor the threshold at which the switching mechanism would result in the positive changes to the endothelial cells.

Again, here it is important to explain some of Dr. von Ardenne's clinical findings to continue and support the conclusions of this article. In general, a healthy individual at age thirty the PO2-ven varies dramatically throughout the body's tissues. As a resting baseline, von Ardenne established a PO2-ven for healthy thirty-year olds to be 41mmHg. In older age (75 years) an at- rest value of 35 mmHg represents a reduction of 6mmHg PO2-ven over 45 years. Additionally, in an individual of old age the PO2-ven also dramatically varies throughout the bodies tissues and is presumed to be approximately 6mmHg lower to the corresponding tissue PO2-ven found in thirty year olds. The PO2-ven is the determining factor for supplying the endothelial cells at the venous capillary ends with a therapeutic level of oxygen. The upper extremities—liver, stomach, intestines, skin, kidney, and spleen—all have PO2-ven values well above the normal resting PO2-ven in both youth and old age. The highest PO2-ven values associated with tissues in the body from von Ardenne's measurements is approximately 60mmHg. These differences indicate the body has as a variable priority and differentiated need for oxygen in various tissues. Consequently, if the determined normal PO2-ven thresholds are not being achieved regularly a loss of functionality of that tissue or organ increases as the time periods between normalization events lengthen or ceases to take place.

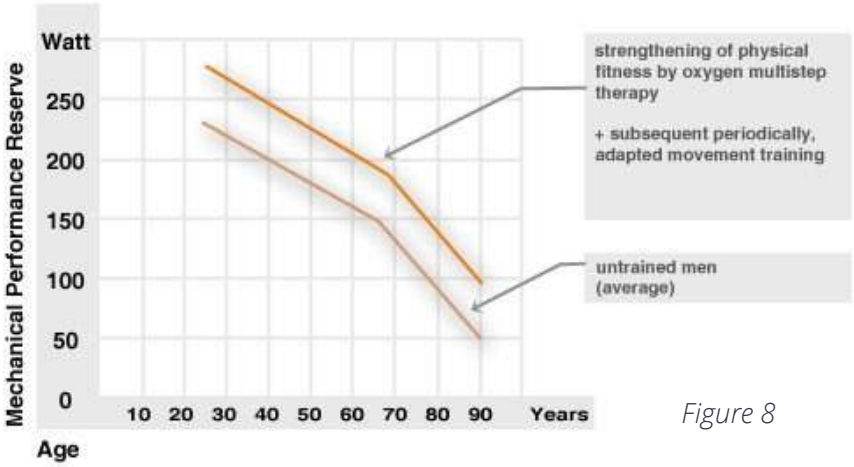


Figure 8

The key to resolving low PO2-ven values is to increase the arterial oxygen PO2-art to levels beyond what is generally obtainable even in youth. For example, in normal individuals age 30, the resting PO2-art is approximately 73mmHg. During moderate exercise the PO2-art naturally increases to (but normally does not exceed) 105mmHg while maintaining the hemoglobin oxygen binding (SpO2%) at 97%. This is the process of balancing between aerobic and anaerobic exercise. Too little effort and you don't reach a beneficial PO2-art. Too much effort and areas of your body shift over to anaerobic respiration which you must further recover from through aerobic respiration. The benefit is that through moderate exercise you can increase your resting PO2-art, but this still falls short of increasing the low PO2-ven values to a therapeutic threshold. This also explains why many individuals after a certain age or stressful event are never able to "catch up" once their oxygen status becomes chronically low. (8) If you have ever started an exercise regime and quit exhausted, after a few weeks or less, you know, first hand, the experience of being entangled in the positive feedback loop that von Ardenne describes.

Each of the scenarios above (too little effort vs. too much) has its purpose in the conditioning of the cardiovascular system but, for therapeutic levels of oxygen in the body von Ardenne focused on creating the highest PO2-art levels possible. The guiding rule is that: so long as the oxygen demand does not exceed the oxygen supply, PO2-art can be raised to levels otherwise unobtainable (above 140mmHg) and PO2-ven levels can be elevated (above 60mmHg) to satisfy even the most demanding requirement of specialized tissues in the body. Dr. von Ardenne's process was to clinically deconstruct the series of events that would allow the endothelial cells to not just partially open but to overcompensate and open completely in order to allow the maximum blood flow (oxygen) in to the capillaries. In doing so he developed multiple protocols which involved breathing large volumes of high oxygen content air along with simultaneous physical exertion. The result of elevating the heart rate and breathe rate while breathing oxygen concentrated air immediately resulted in a much higher PO2-art level. With PO2-art levels measuring in excess of 140mmHg, even in some participants age 75, von Ardenne's protocols were able to substantially increase PO2-ven levels during the session therapeutically reducing endothelial cell swelling. The reversible switch in the endothelial cells is the key component to oxygenating the surrounding tissues as it allows blood flow to re-enter the capillary. In doing this Dr. von Ardenne had discovered not only how to unlock but to fully open the gate-keeper's door to restore therapeutic levels of oxygen to the body. By far the most obtainable and equally effective protocol von Ardenne developed is the Quick Oxygen Multistep Procedure, lasting approximately only 15 minutes. The benefit of the Quick Procedure is that an individual can increase low PO2-ven levels quickly; daily if needed, and overtime return the switching mechanisms of the microcirculation to a significantly healthier status. The protocol needed to activate and maintain a therapeutic level of oxygen in the body no longer took days.

Beyond any other oxidative researcher of this century Dr. von Ardenne understood that delivery of oxygen in the body is an event controlled by the microcirculation. This is contrary to most theories which place primary focus on the heart, lungs, blood or oxygen. In all truthfulness they are the major players but the endothelial cells are the gate-keeper. When oxygen status and oxygen saturation of the body can be refreshed to the levels of therapeutic significance the ability of the body to produce healthy energy and thus regain functionality is drastically improved. Any biological system has a hierarchy of needs. The first of which is oxygen, flowed by water, and then nutrient.

Together, each of these critical needs is played out in the dynamics of the blood as it circulates throughout the body, which in return dictates the body's health. A person's constitutional durability to sustain an aerobic metabolism is the predominant factor that dictates our health performance throughout our lifetime. The gift that Dr. Manfred von Ardenne gave the world is a key to open wide the potential of the capillary exchanges in the body and thus experience healthy oxygenated living and also maintain that trajectory well into old age.

To find out more about LiveO2 with contrast training and how to implement Dr von Ardenne's Quick Protocol in your clinic or home feel free to call: 970-372-4344 or email sales@liveo2.com.