

Otto Warburg and Cancer

"Nobody today can say that one does not know what cancer and its prime cause be. On the contrary, there is no disease whose prime cause is better known, so that today ignorance is no longer an excuse," said Nobel Prize Winner Otto Warburg in a meeting of Nobel Laureates on June 30, 1966. Warburg is considered one of the 20th century's leading biochemists. He was the sole recipient of the Nobel Prize in Physiology or Medicine in 1931. In total, he was nominated for the award 47 times over the course of his career.

To not understand how acid and low oxygen conditions influences cancer is to not understand cancer. Over 80 years ago, Warburg showed that cells could always be made cancerous by subjecting them to periods of hypoxia. Cancer cells survive by utilizing a process that is advantageous in low oxygen environments.

It is not only how they survive, it is how they are created and as we need to see, there are many reasons for not enough oxygen reaching the cells. Unfortunately, except for Warburg's studies, little work has been done to investigate the relationship between hypoxia and cancer.

However, researchers at The University of Texas MD Anderson Cancer Center has unearthed a previously unknown phenomenon. They found that important regulatory molecules are decreased when **deprived of oxygen, which leads to increased cancer progression in vitro and in vivo**.



One of the secrets to disease and this whole question of oxygen levels is that a very bad feedback loop is created that takes our respiration down. All over the Internet people are arguing about causes of cancer and what comes first, depressed oxygen levels and acidity, or normal oxygen levels, no acidity and then cancer comes along out of the blue to cause acidity.

It is absurd to think that people are perfectly healthy and then suddenly cancer comes in from mars. Everywhere we read about preconditions that increase the incidences of cancer and none of these preconditions are healthy. For instance, diabetics, heavy drinkers, those exposed to toxins, radiation, heavy metals, strong emotional upset, heart disease and a long list of nutritional deficiencies, and very importantly, faster than the medical norm breathing that takes down oxygen levels causing acidity at the same time.

You have the power to open the door for a better health and understanding of your body!

Cancer Secret

D F Treacher and R M Leach teach, "Oxygen transport from environmental air to the mitochondria of individual cells occurs as a series of steps. The system must be energy efficient (avoiding unnecessary cardiorespiratory work), allowing efficient oxygen transport across the extravascular tissue matrix. At the tissue level, cells must extract oxygen from the extracellular environment and use it efficiently in cellular metabolic processes."

What happens is that **acidity depresses oxidation**, and increasing **alkalinity, even to a marked degree, greatly increases the rate of oxidation.**^[1] Meaning when acid conditions prevail the oxidative process inside the mitochondria is severely compromised and, its no surprise, as we switch to alkaline conditions we find that oxidation is remarkably facilitated.

According to Warburg, **damaged cell respiration causes fermentation**, resulting in low pH (acidity) at the cellular level. "In every case, during the cancer development, the oxygen respiration always falls, fermentation appears, and the highly differentiated cells are transformed into fermenting anaerobes, which have lost all their body functions and retain only the now useless property of growth and replication. Thus, when respiration disappears, life does not disappear, but the meaning of life disappears, and what remains are growing machines that destroy the body in which they grow."

The Warburg theory of cancer postulates that the driver of tumorigenesis is an insufficient cellular respiration caused by insult to mitochondria. In other words, instead of fully respiring in the presence of adequate oxygen, cancer cells ferment. Cancer is a metabolic disease, a fermentation caused by malfunctioning mitochondria, resulting in increased anabolism and decreased catabolism.

Hypoxia or anoxia results in a dramatic decrease in the levels of adenosine triphosphate (ATP). **Hypoxia is the stimulus that creates the need for a replacement for the lost ATP.** If the cell wants to survive (not suffer cell death) it must turn to fermentation and it does. When oxygen becomes limiting, mitochondrial oxidative phosphorylation (OxPhos) is restricted and pyruvate is converted to lactate instead.

Very impactful to cellular health is the level of oxygen each cell receives. Most tissues do not experience oxygen levels at 20-21%. In our lungs, oxygen levels are around 14.5% and in peripheral tissues oxygen can be as low as 3.4-6.8%. The term physiological normoxia is used to define oxygen levels between 3-7%.

Pathological hypoxia may occur in certain instances of loss or occlusion of blood vessels or, in such cases as cancer, leaky and inadequate vasculature. In these examples, O₂ levels tend to fall below 2%, but can range from 0.3- 4.2%.

The lowest level of O₂, or being oxygen-free, is referred to as an anaerobic environment. Many microorganisms, including bacteria within the digestive tract of humans and at the bottom of the ocean are considered anaerobic species.[2] Since [many of these species would be killed off by any trace of O₂](#), these microorganisms must be studied by scientists within an environment completely devoid of O₂.

Dr. Rockwell from Yale University School of Medicine (USA) studied malignant changes on the cellular level and wrote, "The physiological effects of hypoxia and the associated micro environmental inadequacies *increase mutation rates*, select for cells deficient in normal pathways of programmed cell death, and contribute to the development of an increasingly invasive, metastatic phenotype." [3] In response to hypoxia, mitochondria generate an initial burst of ROS.[4]

[Dr. Robert Rowan](#) says, "Warburg emphasized that you can't make a cell ferment unless a LACK OF OXYGEN is involved. In 1955, two American scientists, R.A. Malmgren and C.C. Flanigan, confirmed Warburg's findings. They found that oxygen deficiency is ALWAYS present when cancer develops. Warburg found that you can reverse fermentation simply by adding oxygen – but only if you do it early enough. He incubated cells in nitrogen, starving them of oxygen for regular but short periods. Starving the cells of oxygen caused them to begin fermentation. Restoring oxygen promptly enabled the cells to recover. But the longer they were oxygen starved, the slower and less certain the recovery. With enough oxygen starvation, cells don't recover. Once they reach a certain point, no amount of oxygen will return them to normal."

[Two papers appearing in the March 13 \(2008\) issue of the journal Nature](#) conformed again Warburg's theories. Led by researchers at Beth Israel Deaconess Medical Centre (BIDMC) and Harvard Medical School, the papers find that the metabolic process that has come to be known as the Warburg effect is essential for tumors' rapid growth and identifies the M2 form of pyruvate kinase (PKM2), an enzyme involved in sugar metabolism, as an important mechanism behind this process.

As tumors grow, they can outgrow their blood supply, leaving some of the tumor with areas where the tissue is oxygen starved, a condition known as tumor hypoxia. Conventional wisdom would suggest the lack of oxygen would slow growth. However, the opposite is true. Hypoxia leads to tumor progression.

"We showed that that hypoxia causes a down regulation of, or decrease in, quantities of Drosha and Dicer, enzymes that are necessary for producing microRNAs (miRNAs).

MiRNAs are molecules naturally expressed by the cell that regulate a variety of genes," said Dr. Anil Sood, professor of gynecologic oncology and reproductive medicine and cancer biology. "At a functional level, this **process results in increased cancer progression** when studied at the cellular level."

Conclusion

If the level of carbon dioxide in the blood is lower than normal, then this leads to difficulties in releasing oxygen from hemoglobin. Carbon dioxide and its twin sister bicarbonate control the pH of the blood. (Next week this will be fully explained in an essay entitled 'Hypocapnia (Lowered CO₂) in the Blood Leads to Reduced Oxygenation.')

Unless the body's pH level is slightly alkaline it cannot heal itself. Health is only possible when the PH of the body is normal. If your body's PH is not correct one cannot effectively assimilate vitamins and minerals. Our body PH affects everything.

The human body is 'alkaline by design but acidic by function,' so everything that effects balanced pH in the body matters. Every living cell in the body creates metabolized waste, which is acidic. The nutrients from our food are delivered to each cell, the cells burn with oxygen to provide energy for us to live. The burned nutrients become metabolized waste. If there is any impedance, whether into our out the cell walls, acid wastes build, create inflammation in the capillaries, cutting oxygen transport.

All waste products are acid; the body discharges the waste through urine, bile and perspiration. Without proper elimination, the acid waste produces the perfect environment for fungus, bacteria and viruses to flourish. Although our bodies work hard to dispose of acidic waste, eating acidic foods makes it harder for the body to eliminate waste.

In another chapter we will discuss in depth another major point made by Warburg. "**If our internal environment was changed from an acidic oxygen deprived environment to an alkaline environment full of oxygen, viruses, bacteria and fungus cannot live.**" The fact is that these infections are another major cause of cancer.

Special Note: I recently published [Grand Unification Theory of Cancer](#) to this essay in part as a response to other people's abuse and misrepresentation of Warburg's work on cancer. Certain people just cannot understand how much oxygen matters, how deficient it can get in certain areas of the body, and how that leads to most diseases and then on to cancer. The next essay in this series is entitled 'Hypocapnia (Lowered CO₂) in the Blood Leads to Reduced Oxygenation,' which is all about Danish scientist Christian Bohr, who noticed more than a century ago that hemoglobin binds oxygen more tightly at high pH than it does at low pH.

References

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[4] J Neurosci. 2007 Jan 31;27(5):1129-38. Three distinct mechanisms generate oxygen free radicals in neurons and contribute to cell death during anoxia and reoxygenation.