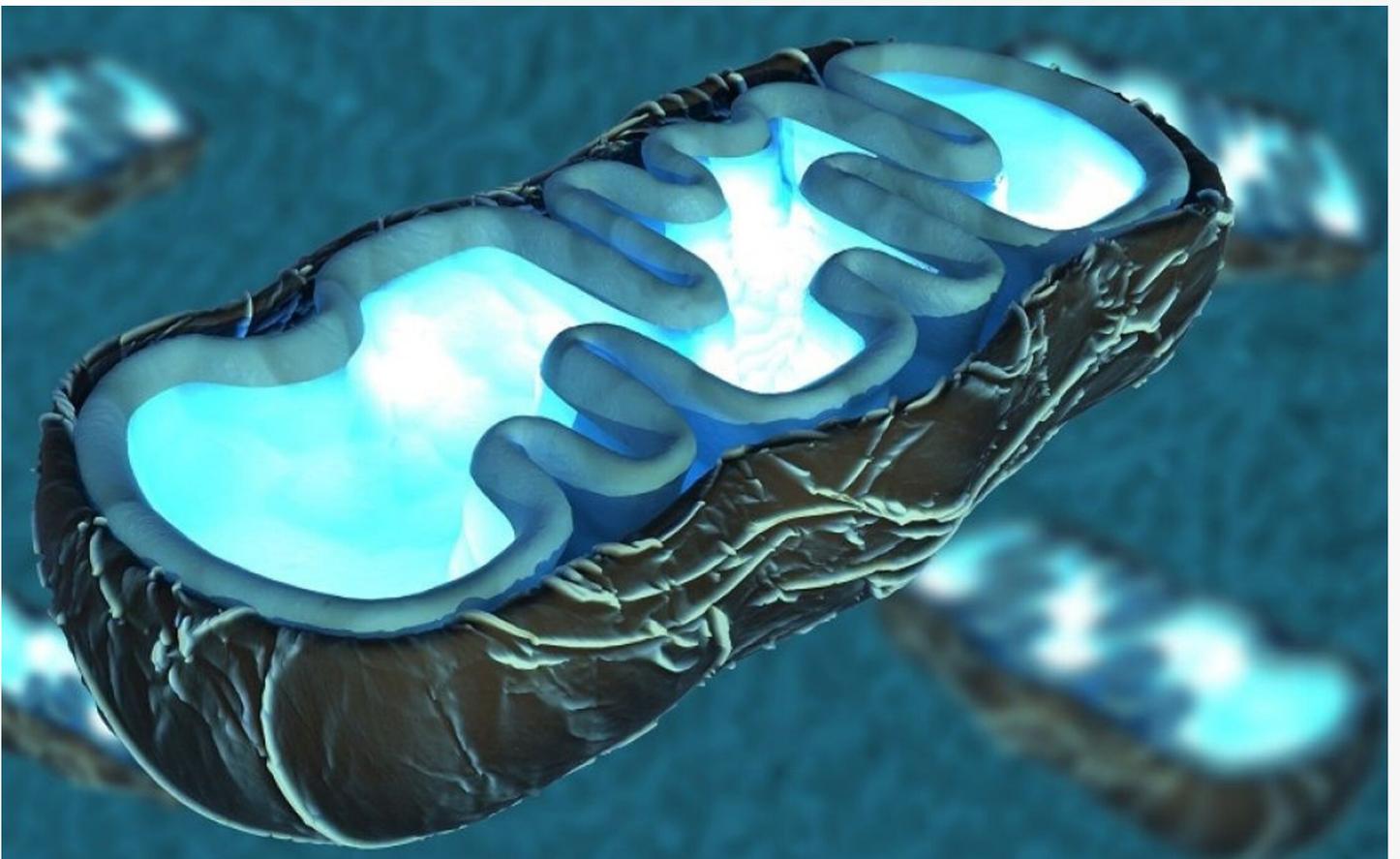


CONQUERING CANCER COURSE

MITOCHONDRIA DYSFUNCTION AS A CAUSE OF CANCER



BY

DR. MARK SIRCUS

MITOCHONDRIA DYSFUNCTION AS A CAUSE OF CANCER

Mitochondria are the cell powerhouse, on which amino acid, nucleic acid, lipid, and iron–sulfur cluster metabolic pathways converge. During the last decade, mitochondria have been recognized as key players in several aspects of cancer biology, including cancer development, metastasis, and drug resistance[i], due to their central role as receivers, integrators, and transmitters of intracellular signals regulating various processes[ii].

Mitochondria are highly dynamic organelles whose biogenesis and functions, depending on cellular needs, is under tight nuclear control, through the so-called anterograde regulation, which allows mitochondria adaptation to the ever-changing cellular milieu[iii].

Nearly a century of scientific research has revealed a number of notable differences in the structure and function of mitochondria between normal and cancer cells, including differences in metabolic activity, molecular composition, and mtDNA sequence, which is the genetic material inside the mitochondria.

Mitochondria are unique structures within every cell of our bodies. We have trillions and trillions of them, making up approximately 10% of our total body weight. They are considered the “powerhouses of the cell,” generating most of the energy in our bodies by converting nutrition into adenosine-5'-triphosphate (ATP). Thus it behooves us to find a magical medical formula that feed and protect our mitochondria and reverse their decline.

Mitochondria are semi-autonomous organelles of eukaryotic cells. They perform crucial functions such as generating most of the cellular energy through the oxidative phosphorylation (OXPHOS) system and some other metabolic processes. In addition, mitochondria are involved in regulation of cell death and reactive oxygen species (ROS) generation. Also, mitochondria play important roles in carcinogenesis via altering energy metabolism, resistance to apoptosis, increase of production of ROS and mtDNA (mitochondrial genome) changes.

The mitochondria are referred to as the body's energy furnaces because it is here that the nutrients extracted from our foods are converted into energy. This happens through a complex set of interactions known as the Krebs cycle (named after its discoverer, Sir Hans Krebs), in association with the

electron transport chain, which completes the work started by the Krebs cycle.

Essentially the Krebs cycle (also known as the citric acid cycle) involves a series of enzymatic reactions that transform proteins (in the form of their constituent amino acids), fats (as their constituent fatty acids) and carbohydrates (as glucose) into intermediate substances. These intermediates are then passed into the electron transport chain where they undergo a further series of reactions – receiving and donating electrons down the chain – to produce energy, in the form of ATP (adenosine triphosphate), CO₂ and water. The presence of sufficient oxygen within the cells is essential to the success of this entire process, as the term oxidation itself indicates.

Mitochondria in decline force the cells into survival mode, making them switch to emergency energy production. When the mitochondria become unable to adequately perform their functions, cells either die or undergo malignant transformation. Thus, it is no surprise that evidence exists showing that normalizing mitochondrial function is capable of suppressing tumorigenesis.

The mitochondria are the power stations of our cells. They are as important to our lives and health as electrical power stations are to modern civilization. We just cannot get along without them. If mitochondria get severely damaged, they die. If cells lose their mitochondria, they lose their power source, and they die. When enough cells die, we die or we get cancer, which are cells alternative to death.

[i] Vyas S, Zaganjor E, Haigis MC. *Mitochondria and cancer. Cell* (2016) 166(3):555–66. doi:10.1016/j.cell.2016.07.002

[ii] Ryan MT, Hoogenraad NJ. *Mitochondrial-nuclear communications. Annu Rev Biochem* (2007) 76:701–22. doi:10.1146/annurev.biochem.76.052305.091720

[iii] Hock MB, Kralli A. *Transcriptional control of mitochondrial biogenesis and function. Annu Rev Physiol* (2009)

MITOCHONDRIAL DERAILMENT

Dr. Michael R. Eades says, “As the high-energy electrons are passed along down the inner mitochondrial membrane they occasionally break free. When they break free, they become free radicals. These rogue free radicals can then attack other molecules and damage them. Because these free radicals are loosed within the mitochondria, **the closest molecules for them to attack are the fats in the mitochondrial membranes.** If enough of these fats are damaged, the membrane ceases to work properly. If enough of the membrane doesn’t work, the entire mitochondrion is compromised and ceases functioning. If enough mitochondria bite the dust, the cell doesn’t work and undergo apoptosis, a kind of cellular suicide. This chronic damage and loss of cells is the basic definition of aging.” (Note that Dr. Johanna Budwig’s Diet basic principle is to inject the best fats to heal these membranes.)

Mitochondria work by generating an electrical potential and a pH gradient across that inner membrane.

The mitochondrion is different from other organelles because it has its own DNA and reproduces independently of the cell in which it is found; an apparent case of endosymbiosis.[i] They really are not quite us in the sense that their genetic pool is outside of our own DNA that make us uniquely us. Unlike nuclear DNA, mitochondrial DNA doesn’t get shuffled every generation, so it is presumed to change at a slower rate.

Multiple Sclerosis is the most common inflammatory demyelinating disease of the central nervous system and is the leading cause of non-traumatic neurological disability in young adults. Researchers believe that mitochondria play a key role in chronic axonal loss in this disease. The mitochondria present within the chronically demyelinated axons will be functioning at full capacity for many years but eventually, despite antioxidant defenses, free radical damage will accumulate and mitochondrial function will become compromised. ATP concentration within the axon will decrease and the effect on axonal function will be profound.[ii]

Tissue damage in 2,4,6-trinitrobenzene sulfonic acid (TNBS)-induced colitis is accompanied by the arrest of mitochondrial respiration, loss of

mitochondrial DNA, and the expression of nuclear-encoded mitochondrial proteins. Selenium effectively protects colon mitochondria prevented inflammatory and necrotic changes. Selenium in a high dose is therefore a potential therapeutic agent in inflammatory bowel disease.[iii]

Our mitochondria are where the majority of free radicals are generated, so when high amounts of free radicals overpowers antioxidant defenses the battle for life is lost as dysfunctions in mitochondria accumulate, become overwhelmingly destructive. Excessive free radicals overwhelm the body's ability to neutralize them. We produce a natural antioxidant compound known as glutathione that works to minimize damage done by free radicals, but optimal levels tend to be lacking because the basic ingredients like magnesium, selenium and sulfur are deficient. Elevated pollution levels in urban environments create oxidative stress that adversely affects DNA and cellular health, while altering lipids and proteins within the mitochondria.

The mitochondria are extremely sensitive to heavy metals and general chemical insults. If the mitochondria are denied the basic nutrition they need to function, they cease to function normally.

Many avoid a simple fact—at the heart of Alzheimer's is mitochondrial dysfunction. This makes logical sense when we consider that our mitochondria are instrumental in producing the energy currency in our body, and without energy, nothing will work properly, especially the brain, which needs a lot of this energy. The only organ that has similar needs is the heart, which has its own order of intelligence and sensitivity to each second of life, which is represented in our heart rate variability (HRV).

“Damage to mitochondria is now understood to play a role in the pathogenesis of a wide range of seemingly unrelated disorders such as schizophrenia, bipolar disease, dementia, Alzheimer's disease, epilepsy, migraine headaches, strokes, neuropathic pain, Parkinson's disease, ataxia, transient ischemic attack, cardiomyopathy, coronary artery disease, chronic fatigue syndrome, fibromyalgia, retinitis pigmentosa, diabetes, hepatitis C, and primary biliary cirrhosis.

[i] The endosymbiotic theory concerns the origins of mitochondria and plastids (e.g. chloroplasts), which are organelles of eukaryotic cells. According to this theory, these organelles originated as separate prokaryotic organisms which were taken inside the cell as endosymbionts. Mitochondria developed from proteobacteria (in particular, Rickettsiales or close relatives) and chloroplasts from cyanobacteria.

[ii] Mitochondrial dysfunction plays a key role in progressive axonal loss in Multiple Sclerosis. Medical Hypotheses, Volume 64, Issue 4, Pages 669-677 H.Andrews, P.Nichols, D.Bates, D.Turnbull

[iii] High selenium diet protects against tnbs-induced acute inflammation, mitochondrial dysfunction, and secondary necrosis in rat colon. TIROSH Oren ; LEVY Eran; REIFEN Ram; Hebrew University of Jerusalem. ISSN 0899-9007 2007, vol. 23, no11-12, pp. 878-886

POISONING OUR MITOCHONDRIA WITH PHARMACEUTICALS

It is no secret that most drugs are mitochondrial poisons. A study published in the scientific journal Cell Reports, calls for caution when using this family of antibiotics because they are suffocating the mitochondria of a wide range of organisms. The authors of the study said that the effects were huge. “After several days of treatment with high doses of doxycycline, mitochondrial respiration was visibly altered. More surprising still, the consequences were observed all the way down the food chain, from mammals to flies to nematode worms to plants.

Dr. Gary G. Kohls says, “Common iatrogenic (drug- or doctor-caused) diseases can be caused by commonly prescribed drugs and/or commonly injected vaccine ingredients, which are making many of us highly drugged, malnourished, environmentally-toxic and also thoroughly vaccinated.” Dr. Kohl continues, “Many of these disorders are actually caused by prescription drugs, vaccines and/or other toxic chemicals that are poisoning the mitochondria in our brains, nerves, muscles and other organs. Thus we are being afflicted by preventable, iatrogenic- or industry-caused diseases.”

“All classes of psychotropic drugs have been documented to damage mitochondria, as have statin medications, analgesics such as acetaminophen, and many others. Mitochondrial damage is now understood to play a role in a wide range of seemingly unrelated disorders such as schizophrenia, diabetes, Parkinson’s disease, chronic fatigue syndrome, and nonalcoholic steatohepatitis. Recently it has become known that iatrogenic (physician or treatment-caused) mitochondrial damage explains many adverse reactions from medications,” writes Dr. John Neustadt and Dr. Steven Pieczenik. **Statin medications** are also implicated.[i]

Many **articles talk about how fluoroquinolones** damage mitochondria, which then leads to mitochondrial dysfunction, have been published. In ScienceTranslational Medicine, “**Bactericidal Antibiotics Induce Mitochondrial Dysfunction and Oxidative Damage in Mammalian Cells,**” it is noted that bactericidal antibiotics, including ciprofloxacin, a fluoroquinolone, “damage mammalian tissues by triggering mitochondrial release of reactive oxygen species (ROS).” What can we possibly say about a professional field (medicine) that still uses fluoroquinolones, which have been reported repeatedly to have horrendous side effects?

I received a letter from a professional colleague named George Eby in 2007 that stated that his daughter was destroyed by the terrible side effects of a special type of antibiotic called fluoroquinolones. He said:

“My daughter was stricken with this horrible affliction. Cipro sensitivity causes long term (multiple years to life) chronic pain, weakness and tendon weakness leading to tendon breakage and many other horrible effects, some physical and some mental. This is something that everyone needs to know about. We have been destroyed by cipro. I don’t think there is much anyone can do, except to give her magnesium, which is somewhat of an antidote. I am very worried, but I haven’t lost hope, but I am being realistic. Some of the tendon damage is necrotic and permanent. However, we have studies with rattlesnake venom that produce necrosis on animals and simply applying magnesium (chloride) and zinc (gluconate) topically, the necrosis vanishes.” Ten days later I received this email from George.

“Topical magnesium chloride for 10 days = well daughter!”

There is a power and a force in magnesium chloride that cannot be equaled anywhere else in the world of medicine. There is no substitute for magnesium in human physiology; nothing comes even close to it in terms of its effect on overall cell physiology. It goes against a strong gale wind of medical science to ignore magnesium chloride used transdermally in the treatment of any chronic or acute disorder.

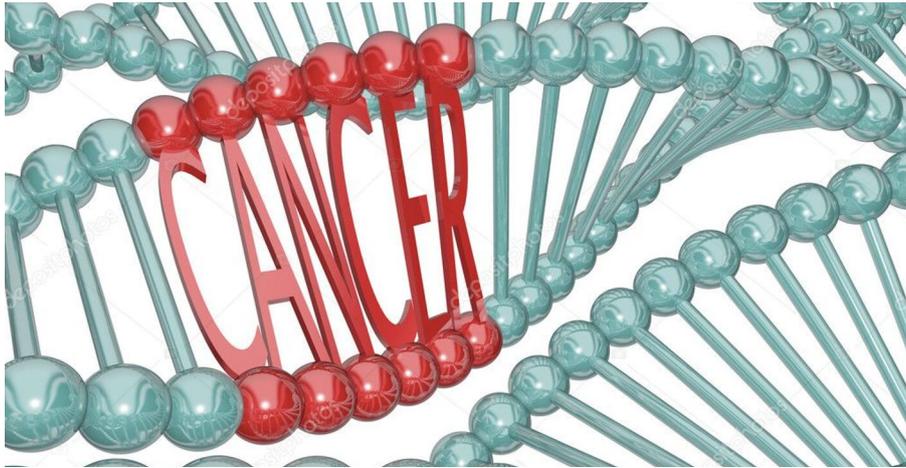
Obviously mitochondrial function needs to be supported, not impeded but that is just too difficult for the medical establishment, addicted to the use of mitochondrial poisons, to understand. **Dr. Katherine Sims** from Boston’s Massachusetts General Hospital explains why identifying potential toxic agents from medications to environmental factors is an essential part of managing mitochondrial disease. Dr. Sims says that **establishing mitochondrial toxicity is not an FDA requirement for drug approval**, so there is no real way of knowing which agents are truly toxic. Her list of mitochondrial toxic agents includes:

Table of Reported Drugs with Mitochondrial Toxicity

- Anticonvulsants
- Psychotropic Drugs
- Cholesterol Medications
- Analgesics and Anti-inflammatories
- Aspirin and the NSAIDS
- Antibiotics (specifically tetracycline, minocycline, chloramphenical, and Aminoglycosides)
- Steroids
- Anesthesia
- Surgery
- Environmental Agents
- Endogenous Stress Related
- Hormones

[i] *Mol. Nutr. Food Res.* 2008, 52, 780 – 788

MITOCHONDRIA AND CANCER



'Deregulated cellular energetics is one of the main hallmarks of cancer. Several underlying mechanisms of deregulated cellular energetics are associated with mitochondrial dysfunction caused by mitochondrial DNA mutations, mitochondrial enzyme defects, or altered oncogenes/tumor suppressors. Dr. Otto Warburg first proposed that tumor cells, unlike normal cells, exhibit increased glycolytic activity and reduced mitochondrial respiration even in the presence of oxygen. This phenomenon is known as the "Warburg effect." [i] Warburg first proposed that tumor cells, unlike normal cells, exhibit increased glycolytic activity and reduced mitochondrial respiration. This association between mitochondrial dysfunction and cancer was made as early as 1930.

Cancer cells do have dysfunctional mitochondria, which prevents their use of the citric acid [Krebs] cycle. Consequently, pyruvic acid, the product of glycolysis, which normally would enter the mitochondria for its total combustion into energy, is instead converted to lactic acid. In cancer, the cells abandon normal mitochondria production of ATP and turn to fermentation.

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 and that is where cancer begins. Restoring oxygen promptly enabled the cells to recover. (See lesson on Oxygen Deficiency as a Cause of Cancer).

Warburg also said that **glucose brings a cell's ability to use oxygen down**. One of the principle ways sugar does this is by **creating chronic inflammation in the capillaries** and other tissues thus cutting down on oxygen delivery to the cells. When we gorge on the long list of widely available junk foods our cells do not get the oxygen they need to function correctly.

It seems like no matter where we turn these days, we hear the word inflammation because at the heart of almost all diseases is an inflammatory process. It is no surprise since our lifestyles have become increasingly sedentary, and many rely on junk food to sustain themselves. Add in unfathomable stress levels, allergens and environmental toxins, not to mention increasing radiation coming from the environment and medical tests together, plus many pharmaceutical drugs themselves will increase inflammation because they strip the body of alkaline minerals.

Bicarbonate ions neutralize the acid conditions required for chronic inflammatory reactions. Hence, sodium bicarbonate is of benefit in the treatment of a range of chronic inflammatory and autoimmune diseases. To reduce and eventually stop destructive inflammations the body needs to be alkalized, which means CO₂ levels along with oxygen need to be raised. This is done over the long haul with mineral-rich vegetables, especially green leaf-vegetables and green protein powders such as spirulina, chlorella, and wheat grass or barley grass powder. However, until the inflammation is under control it is often helpful or necessary to use alkalizing remedies such as sodium bicarbonate for almost instant relief of many inflammation symptoms. Baking soda **elevates salivary pH and reducing inflammation in the mouth. Magnesium is the ultimate anti-inflammatory** and so is **oxygen**.

Dr. Philipp Mergenthaler and Dr. Andreas Meisel showed that depriving a cell of glucose, while giving it plenty of oxygen at the same time, blocks glycolysis and therefore forces the cell to revive its mitochondria and use the Krebs Cycle for energy.

Johns Hopkins Medicine reports that, "Cancer cells have been long known to have a "sweet tooth," using vast amounts of glucose for energy and for building blocks for cell replication. Now, a study shows that lymph gland cancer cells called B cells can use glutamine in the absence of glucose for cell replication and survival, particularly under low-oxygen conditions, which are common in tumors."

Writing in the Jan. 4, 2012, edition of *Cell Metabolism*, Anne Le, M.D., and a team of investigators collaborating with the Johns Hopkins Brain Science Institute, say the finding is critical for developing innovative cancer therapies because it offers “proof of concept” evidence that curbing the growth of B cell cancers can be accomplished by inhibiting a glutamine enzyme called glutaminase. The study also found that when oxygen is scarce, there is enhanced conversion of glutamine to glutathione, an important agent for controlling the accumulation of oxygen-containing chemically reactive molecules that cause damage to normal cells.

[i] Exp Biol Med (Maywood). 2016 Jun; 241(12): 1281–1295. Role of mitochondrial dysfunction in cancer progression

CURING CANCER BY BLOCKING GLYCOLYSIS WITH OXYGEN

'We can cure cancer by blocking glycolysis with oxygen. This forces mitochondria to become active again and use the Krebs Cycle for energy so that the cells can stop being cancerous and regain apoptosis. The chemical dichloroacetic acid (DCA), which increases the chemical reactions of the Krebs cycle in mitochondria, has been shown to kill cancer cells in laboratory tests and in animals. I never put DCA in the Natural Allopathic protocol because some very severe adverse effects such as encephalopathies, liver problems and severe peripheral neuropathies can occur.

Essentially the Krebs cycle (also known as the citric acid cycle) involves a series of enzymatic reactions that transform proteins (in the form of their constituent amino acids), fats (as their constituent fatty acids) and carbohydrates (as glucose) into intermediate substances. These intermediates are then passed into the electron transport chain where they undergo a further series of reactions – receiving and donating electrons down the chain – to produce energy, in the form of ATP (adenosine triphosphate), CO₂ and water. **The presence of sufficient oxygen within the cells is essential to the success of this entire procedure**, as the term oxidation itself indicates. If insufficient oxygen is delivered to the cells, this entire enterprise will be compromised.

Research published in June 2013 by researchers from the University of South Florida and Boston College using mice models reported that a “Ketogenic Diet alone significantly decreased blood glucose, slowed tumor progression and increased mean survival time by 56.7% in mice with systemic metastatic cancer. While Hyperbaric Oxygen Therapy alone did not influence cancer progression, combining the Ketogenic Diet with Hyperbaric Oxygen elicited a significant decrease in blood glucose, tumor growth rate and a 77% increase in mean survival times compared to the controls.

The Gerson Therapy treats the causes of cancer, degenerative diseases, toxicity and nutritional deficiency by flooding the body with nutrients from about 15-20 pounds of organically grown fruits and vegetables daily. Most is used to make fresh raw juice, up to one glass every hour, up to 13 times per day mostly from raw carrot, apple and green-leaf juices. Raw and cooked

solid foods are generously consumed. Oxygenation is usually more than doubled.

The German cancer researcher Dr. Paul Gerhard Seeger[i] demonstrated in 1938 that in most cases cancer starts in the cytoplasm, the jelly-like outer part of the cell, and especially in the energy-producing mitochondria. Here food fragments are normally oxidized in a series of enzymatic steps called the 'respiratory chain.' Seeger showed that in cancer cells this respiratory chain was more or less blocked, especially at the site of the important enzyme cytochrome oxidase. Without it the cell can produce energy only anaerobically like a fungal cell. This is very inefficient, and the resulting overproduction of lactic acid makes the cell and the whole body overly acidic.

Seeger and others found that cancer cells utilize only between 5 and 50% of the oxygen of normal cells. The virulence of cancer cells is directly proportional to their loss of oxygen utilization, and with this to the degree of blockage of the respiratory chain. In 1957 Seeger successfully transformed normal cells into cancer cells within a few days by introducing chemicals that blocked the respiratory chain. Seeger's most important discovery was the certainty that that certain nutrients, mainly from the vegetable kingdom, could restore cellular respiration in low-virulence cancer cells and, with this, transform them back into normal cells.

Seeger's finding that cancer originates in the cytoplasm and not in the nucleus was confirmed by other researchers. Between 1975 and 1977 they repeated an experiment 93 times in which they replaced the nucleus of a fertilized mouse egg with the nucleus of a cancer cell. In each case the egg developed into a healthy, cancer-free mouse and even the offspring remained cancer-free. Similar results were achieved with frog eggs.

Mitochondria are continually confronted with factors that can jeopardize how well they function. These factors include: hypoxic (low oxygen conditions), chronic stress and deep emotional shock, chronic sleep disturbances, hyperglycemia, **pharmaceutical drugs and antibiotics**, organic pollutants like pesticides, fungicides, heavy metals like **mercury and other environmental toxins**. These factors all cause mitochondrial dysfunction. Mercury is a mitochondrial poison. Data suggest that moderate levels of mercury administered over an 8 week period can affect adversely the integrity of mitochondrial membranes.[ii]

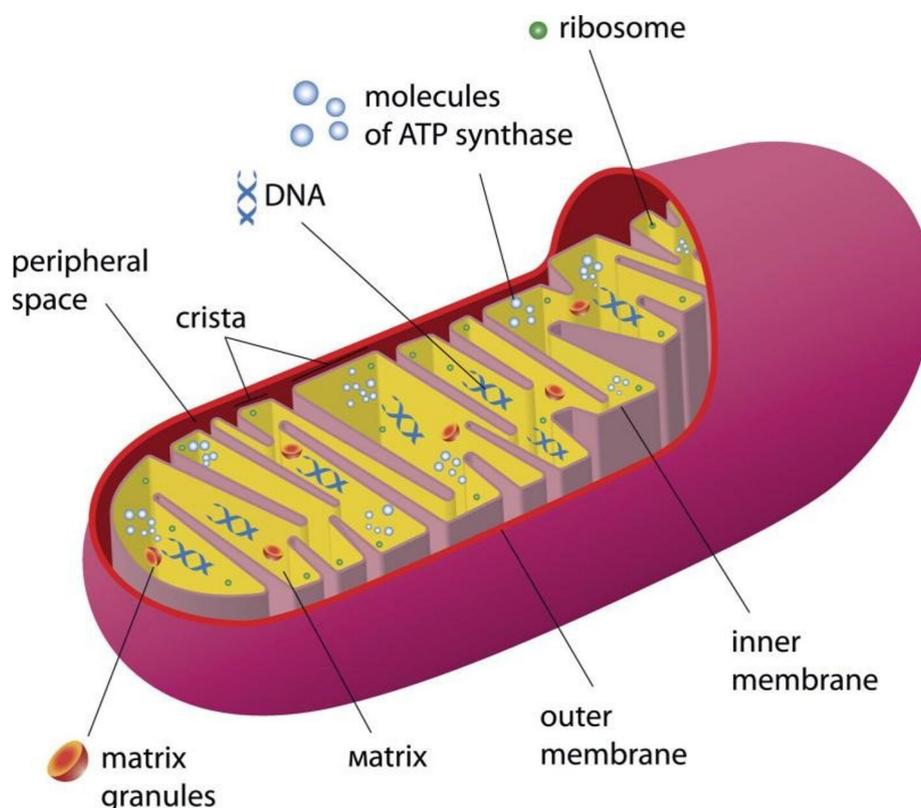
If too many mitochondria fail, there is nothing that can be done to prevent death. Any successful treatment can only prevent too many mitochondria from failing.

Dr. Majid Ali says, "Injured mitochondria mutate at much higher rates. Damaged mitochondria are exhausted mitochondria. Exhausted mitochondria cannot produce sufficient ATP molecules. An insufficient supply of ATP molecules means insufficient energy. Insufficient molecular energy means clinical chronic fatigue."

[i] The only book available in English is Seeger, P.G. and S. Wolz: Successful biological control of cancer by combat against the causes. Neuwieder Verlagsgesellschaft, Neuwied, Germany 1990. The most important book is Seeger, P.G: Krebs – Problem ohne Ausweg? ("Cancer – Problem without Solution?") Verl. f. Medizin Fischer, Heidelberg, Germany 1974, 2nd ed 1988

[ii] The effects of mercury ingestion on hepatic mitochondrial membranes of chicks. Poult Sci. 1976 Nov;55(6):2280-4.

MITOCHONDRIA AND CANCER



Mitochondrion

A large advance in cancer treatment can be attained through a revival of our cells mitochondria, which are among the first parts of the cell to become dysfunctional when they are deprived of oxygen-rich blood, are exposed to toxins, or are deprived of vital nutrients. The science that supports the above mitochondrial rocket fuel formula is quite extensive. Until now we could even say it was a secret formula because the studies and medical logic that sustains this presentation have existed but never been put forward in a comprehensive way before. Though a proper protocol for cancer will extend beyond this mitochondrial formula we can see it as the heart of a cancer protocol because when we change the performance of our mitochondria, we greatly change cancer dynamics.

Capitalizing to the maximum on the reality that cancer is a metabolic disease, that starts with dysfunctional mitochondria, we can reverse their degeneration and re-light a fire inside the cytoplasm with a strong mixture of the basic ingredients that mitochondria depend on, thus bringing them back to life. We can rain life onto these organelles, these factories of life.

The formula for human rocket fuel for the mitochondria includes but is not limited to:

- **Full spectrum light from the Sun & Vitamin D**
- **Hydrogen**
- **Oxygen**
- **Magnesium**
- **Bicarbonate (CO₂)**
- **Selenium**
- **Iodine**
- **Strong doses of red light, near infrared**
- **CoQ10 & PQQ**
- **Green Juices, Spirulina, Chlorella**
- **Intermittent Fasting**
- **H₂O - Full Hydration**

We will explore each of the above ingredients from our mitochondrial rocket fuel formula below and in Part Two and Three of the Conquering Cancer course in much more depth.

Mitochondrial damage accumulates over time, leading to a number of diseases including diabetes, neurological disorders, and heart failure and cancer. It is possible to reverse mitochondrial damage, but interventions are best made early on in the dysfunction before the damage becomes irreversible. Stronger mitochondria make for stronger brains and stronger bodies. So does consistency: mitochondrial biogenesis, or creating new mitochondria, becomes crucial for vibrant aging, optimal energy production, and protection against oxidative stress.

This formula delivers and works like a ramjet or afterburners in a fighter plane. Green juices add more charge into our mitochondrial rocket fuel. Wheat grass juice, barley juice or juices laced with spirulina or chlorella will take us to the moon and back in term of accelerating mitochondrial output partially because they provide the substrates that enable the mitochondria to more efficiently use light to create energy. Dietary chlorophyll metabolites can modulate ATP levels.[i]

[i] Lig. ht-harvesting chlorophyll pigments enable mammalian mitochondria to capture photonic energy and produce ATP Chen Xu, Junhua Zhang, Doina M. Mihai, Ilyas Washington. *Journal of Cell Science* 2014

SELENIUM



Lipid Replacement Therapy (LRT) can restore and help maintain mitochondrial membrane function by replacing damaged mitochondrial membranes so the **perfect form of selenium** would have selenium bonded to a lipid. This form was developed by a surgeon in New York who used to **inject it to treat cancer.**

Lipid Replacement Therapy, the use of functional oral supplements containing cell membrane phospholipids and antioxidants, has been used to replace damaged, usually oxidized, membrane glycerophospholipids in mitochondria that accumulate during aging and in various clinical conditions in order to restore cellular function. We should always remember Dr. Johanna Budwig's work and diet that provides the best lipids for mitochondrial recovery.

When selenium is bounded to a lipid, then we do double therapy with one substance, mineral plus Lipid Replacement Therapy (LRT), which is very helpful when our mitochondria are already damaged. When selenium is bound to a lipid the toxicity becomes less than one-thousandth of that of the elements in the forms normally available. So imagine how we can increase the dosage for great but safe effect.

Selenium improves mitochondrial function even in the absence of oxidative stress. Selenium has beneficial effects of endogenous antioxidant activity via GPx, restoration of mitochondrial function and stimulation of biogenesis, and may also reduce oxidative stress driven inflammation. (See lesson on selenium in part two or Conquering Cancer.)

The most common reasons for a loss of ATP/ADP power include the cell membrane losing its ability to store electrons and/or a depletion of the number of functioning mitochondria. These conditions can be brought about by:

1. Consuming trans or “plastic” fats, which destroy the cell membrane
2. Hypothyroidism, which reduces the number of mitochondria in cells
3. Heavy metals such as lead, mercury, and cadmium
4. Dental infections from decay in teeth, root canals, and in jaw bones
5. Toxins

IODINE



Mitochondria, by virtue of their biochemical functions, are a natural candidate as a direct target for the calorigenic effects of thyroid hormones. Going further, we can see that mitochondria are highly dependent on thyroid hormones (thus iodine) for their very existence. Thyroid hormones are like the “signal” to make more mitochondria. Thyroid hormone (T3) has a profound effect on mitochondrial biogenesis; without T3, there will be less or no mitochondria. On the other hand, if mitochondria are damaged or depleted due to some reason other than too little T3, then existing T3 has “nothing to act on.” You can have all the T3 in the world, but without mitochondria, there will not be any energy. Again, you can see the circular downward spiral of both host cell and mitochondria that can occur if either 1) too little or no T3 exists, or 2) too little or no mitochondria exist.

LIGHT HUNGRY MITOCHONDRIA

Dr. Fritz Albert Popp, a German biophysicist, has shown in a number of experiments that the cells in our bodies are always emitting low-level light radiation which he called "biophoton emission." Popp's experiments suggest that this light emission is the way in which cells communicate. "Light can initiate or arrest cascade-like reactions in the cells, and that genetic cellular damage can be virtually repaired within hours by faint beams of light. We are still on the threshold of fully understanding the complex relationship between light and life, but we can now say, emphatically that the **function of our entire metabolism is dependent on light.**"

Cancer, impart, is a result of the functional degradation of a cellular photon absorption pathway that is basic to the production of ATP. Dr. Heinrich Kremer, a German doctor known for his dissident work in the area of AIDS, points out that in cancer, there is a functional breakdown of a photon-mediated pathway for ATP synthesis in the mitochondria of our cells.

Dr. Kremer sees the origin of cancer differently than does mainstream medicine. He terms his new theory Cell Dyssymbiosis. According to Kremer cancerous cells do not originate from DNA mutations, but from a functional process that occurs in the mitochondria. ATP production, according to Kremer, is not based on chemical energy release, as taught in universities today, but rests on the absorption of photons of light. According to Kremer, "A low frequency pulsating electromagnetic field is induced by the constant flow of uncoupled, paramagnetic aligned electrons in the respiratory organelles."

Mitochondria love light, especially red light and near infrared. Both spectrums penetrate directly into our mitochondria. Both increased sun exposure (Dhar and Lambert, 2013; John et al., 2004; Kent et al., 2013a; Kent et al., 2013b; Levandovski et al., 2013) and the consumption of green vegetables (Block et al., 1992; Ferruzzi and Blakeslee, 2007; van't Veer et al., 2000) are correlated with better overall health outcomes in a variety of diseases of aging.

Cell movements require energy and thousands of energy-hungry chemical reactions go on in every living cell, every second, every day. The kind of energy cells use is chemical bond energy, the shared electrons that holds atoms together in molecules. The recharging of ADP to ATP requires a large energy investment, and that energy comes from the food we eat, the air we breathe and the water we drink. That energy also comes from light! When the mitochondrial functions are disturbed cancer cells switch intermittently or permanently to the archaic form of ATP synthesis in the cytoplasm (glycolysis) with, potentially, up to a 20-fold increase in the glucose turnover at the cost of the organism as a whole. All essential components of mitochondrial cell respiration are light absorbing molecules with characteristic “frequency windows” of absorption maxima from nearly UV spectrum to the longer wave yellow/orange spectral range of visible light up to 600nm. During a red light therapy treatment, chromophores within our cellular mitochondria absorb red and infrared light photons, and convert them into energy.

Cancer patients should know that damaged mitochondria can turn healthy cells into transformed cells, and that healthy mitochondria can reverse cancerous behavior in tumor cells. If they cannot do that they trigger cell death. Thus today, more than ever before, we need a formula for reviving and strengthening our mitochondrial. Metabolic normalization of cancer cells and concomitant inhibition of carcinogenesis may potentially be attained by induction of mitochondrial biogenesis and mitochondrial correction. (See ‘Lesson Light Deficiency as a Cause of Cancer’ in part two of Conquering Cancer.)

HYDROGEN AND THE MITOCHONDRIA

Hydrogen is one of the primordial elements that fueled the development of all life on Earth. Human beings cannot live without hydrogen. While science refers to us as carbon-based life forms, man is also a hydrogen-based life form. When plants absorb sunlight, they store negatively charged hydrogen ions through the process of photosynthesis. When you eat unprocessed plants, your body's cells utilize the nutrients in those plants with the electrical charge of the hydrogen ions in those plants. When your body burns hydrogen and oxygen, it generates the energy you need for the process of life.

Water has both the fuel (hydrogen) and oxygen, which provides the fire of oxidation. The word hydrogen comes from the Greek, meaning "water-former." Water is formed when hydrogen is burned (oxidized) by oxygen. It is created every day in our bodies as we burn hydrogen to create ATP. Hydrogen and oxygen participate in a continuous cycle that generates both water and energy. A Nobel Prize was awarded to Dr. Peter Mitchell in 1978 for his theory of chemiosmosis. According to his model, hydrogen is essential in the production of ATP. The first scientist to talk about hydrogen was Dr. Szent-Györgyi who won the Nobel Prize for discovering Vitamin C and its ability to cure scurvy in 1937. He also won a Nobel Prize for his work identifying the reactions that liberate energy from hydrogen. He explained one of the basic principles of biology: hydrogen and oxygen interact in a delicate balance releasing energy delivering it to cells in tiny portions.

Dr. Szent-Györgyi said: "Hydrogen is, in fact, the only fuel the body knows. The foodstuff, **carbohydrate, is essentially a packet of hydrogen, a hydrogen supplier and hydrogen donor**, and the main event during its combustion is the splitting off of hydrogen. So the combustion of hydrogen is the real energy-supplying reaction."

Water has both the fuel (hydrogen) and oxygen, which provides the fire of oxidation. The word hydrogen comes from the Greek, meaning "water-former." Water is formed when hydrogen is burned (oxidized) by oxygen. It is created every day in our bodies as we burn hydrogen to create ATP. Hydrogen and oxygen participate in a continuous cycle that generates both water and energy.

“The oxidation of hydrogen in stages seems to be one of the basic principles of biological oxidation. The reason for this is probably mainly that the cell would not be able to harness and transfer to other processes the large amounts of energy, released by direct oxidation. The cell needs small changes if it is to be able to pay for its functions without losing too much in the process. So, it oxidizes the H-atom in stages, converting the large banknote into small change,” writes Szent-Györgyi.

Szent-Györgyi was the first to show that the human body stores hydrogen in many of its organs. He called this ‘hydrogen pooling’ and he identified the liver as the organ that pools the most hydrogen because it requires hydrogen to neutralize free radicals produced during detoxification. This is what hydrogen does best—**neutralize free radicals and combine with them to turn them into water.**

Our mitochondria are where the majority of free radicals are generated, so when high amounts of free radicals overpowers antioxidant defenses the battle for life is lost as dysfunctions in mitochondria accumulate, become overwhelmingly destructive, all while oxygen deprivation sets in. Cancer comes to many because of this and more and more older people are having their brains begin to decay even as the body goes on to function more or less normally. Hydrogen is the ultimate antioxidant!

MAGNESIUM BICARBONATE – MEDICAL BREAKTHROUGH

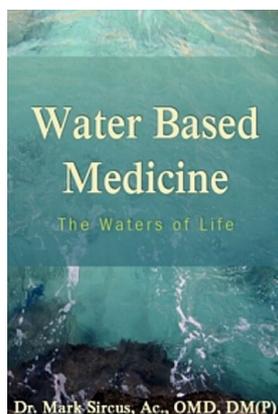
MAGNESIUM BICARBONATE IS THE ULTIMATE MITOCHONDRIA COCKTAIL.

Magnesium and bicarbonate together work to combat the drop in energy within the mitochondria during constant bombardment from toxins. First, magnesium bicarbonate protects the natural organic and inorganic phosphate buffers in the cytoplasm of cells. Second, magnesium bicarbonate neutralizes the acid produced as a result of metabolic processes and ATP hydrolysis. This allows more ATP to be hydrolyzed, or more energy to be made. Magnesium bicarbonate buffers the mitochondria in body cells from excess acid concentrations, which improves mitochondrial function and increases ATP.

Magnesium and bicarbonate work to enhance each other. They are mutually reinforcing because magnesium functions as a bicarbonate co-transporter into cells and bicarbonate acts as a transporter of magnesium into the mitochondria.

Increased oxidative stress, which correlates almost exponentially with pH changes into the acidic, is especially dangerous to the mitochondria, which suffer under oxidative duress. When our tissues become too acidic and lacking in magnesium necessary for ATP production cellular metabolism drops off and this can lead to obesity and diabetes.

“Mg²⁺ is critical for all of the energetics of the cells because it is absolutely required that Mg²⁺ be bound by ATP the central high energy compound of the body. ATP without Mg²⁺ bound cannot create the energy normally used by specific enzymes of the body to make protein, DNA, RNA, transport sodium or potassium or calcium in and out of cells. ATP without enough Mg²⁺ is non-functional and leads to cell death,” writes Dr. Boyd Haley.



Magnesium bicarbonate is the Holy Grail of magnesium administration offering a straight line into the cells. Specifically it is the key to firing up one's mitochondrial energy factories. One of my highest recommendations for ill people is to make and intake all their water with either hydrogenated and oxygenated water or with magnesium bicarbonate drinking water. Drink your way back to life. If one is going to fast on water do it with this types of water.

Magnesium bicarbonate is a complex hydrated salt that exists only in water under specific conditions. The magnesium ion is Mg^{2+} , and the bicarbonate ion is HCO_3^- . So, magnesium bicarbonate must have two bicarbonate ions: $Mg (HCO_3)_2$.

Magnesium bicarbonate neutralizes the acid produced as a result of metabolic processes and ATP hydrolysis. Magnesium bicarbonate buffers the mitochondria in body cells from excess acid concentrations which improves mitochondrial function and allows more ATP to be produced. When more ATP can be hydrolyzed, and more ATP can be produced, body cells have enough energy for optimum function.

Magnesium and bicarbonate increases energy in several ways. First, magnesium bicarbonate protects the natural organic and inorganic phosphate buffers in the cytoplasm of cells. Second, magnesium bicarbonate neutralizes the acid produced as a result of metabolic processes and ATP hydrolysis. This allows more ATP to be hydrolyzed; that is, more energy can be utilized. Magnesium is the lamp of life and has long been recognized as a cofactor for more than 300 enzymatic reactions. Magnesium is crucial for adenosine triphosphate (ATP) metabolism. Magnesium is required for DNA and RNA synthesis, reproduction, and protein synthesis.



The ideal water is alkaline because it is rich in magnesium and bicarbonate. Alkaline water machines that produce high pH water cannot hold a torch to waters high in magnesium and bicarbonate. It was the work of Dr Russell Beckett, a veterinarian with a PhD in biochemical pathology that paved the way to understand the significance of bicarbonate acting in conjunction with magnesium. **Unique Water** from Australia and **Noah's Water** in California, **Donat Mg from Europe** (natural spring waters), and a convenient **magnesium bicarbonate concentrate made in Florida** offer **water that is powerful medicine.**



Magnesium and bicarbonate rich mineral waters are easily absorbed. Because the pH in your body is controlled by bicarbonates sodium Bicarbonate can rapidly alkalize your body far more effectively than diet, but it can't be continued forever because of the excess sodium. That is why I recommend a product called **pH Adjust** because in addition to sodium bicarbonate it has potassium bicarbonate (reducing the sodium load and supplying essential potassium) as well as a dose of magnesium. Magnesium bicarbonate has no such problems and can be used long term.

Magnesium bicarbonate is one of the most convenient way to replenish our bodies with the necessary amount of Magnesium. Very high bio-availability, no Calcium present, and bicarbonate helps maintaining the blood pH. Magnesium bicarbonate is suited to help the body excrete excess of Calcium. The absolute best form of magnesium supplement is magnesium bicarbonate water, either in the form of natural spring waters or in water you make at home with the **Magbicarb concentrate.**

CONCLUDING CASE FOR BICARBONATES

Going back to medical basics, if there's one thing that mitochondria thrive on, it's oxygen. Cellular respiration is the process cells use to make energy. The mitochondria combine glucose and oxygen to make ATP and carbon dioxide. Hydrogen ions are flowing through ATP synthase to make ATP. The presence of CO₂ is a measure of health in cells and that is one of the reasons why bicarbonates are so useful in the treatment of cancer.

As CO₂ is a hallmark of health lactic acid is the hallmark of cancer. When we flood the body with bicarbonates it inhibits lactic acid production, reverses acidification, which fully rescues circadian oscillation. When the acidity of hypoxic patches deep in tumors is neutralized the worst hardest to treat cancer cells, difficult to defeat by even the most toxic means, become vulnerable.

This comes from the latest research from a [Ludwig Cancer Research study](#). In my [most recent essay on sodium bicarbonate](#) I make the case why bicarbonate should be used in every case of cancer because deep inside tumors, where oxygen deprivation and acidic conditions go hand in hand, bicarbonate comes to the rescue. The evidence for a return to more normal conditions in these cells is marked by a return of CO₂ and a diminishing of lactic acid.

Acid is produced as a response to hypoxia. Acidic conditions in tissues shut off a lot of things including circadian oscillation. The process of cancer starts in the mitochondria when normal oxidation and CO₂ production shuts down in favor of fermentation and the creation of lactic acid instead of CO₂. Reversing that reverses cancer though we never rely on only one substance to save a person of this frightening disease, as our human rocket fuel protocol suggests.

ADDITIONS TO THE MITOCHONDRIAL FORMULA

An important step in correcting damaged mitochondria involves addressing lifestyle factors. Studies show that increasing physical activity improves mitochondrial function, so encouraging regular moderate exercise is essential (Anand et al., 2008; Klement & Kämmerer, 2011; Seyfried, 2015). Combining exercise with a diet rich in organic vegetables and moderated in organic, grass-fed meats, free range poultry and wild caught fish and very low in refined carbs and sugar may be essential. In addition, implementing reduced stress practices, such as meditation or yoga, as well as ensuring good sleeping habits are also important. Finally, detoxifying the body by removing fat-stored xenobiotics that inhibit mitochondrial function while replacing essential components should substantially help improve mitochondrial function.

One of the greatest lifestyle changes we can make is in our diets. Numerous studies have linked caloric restriction to improved mitochondrial function and increased longevity because intermittent fasting induces mitochondrial biogenesis and bioenergetic efficiency.[i] Mitochondria in caloric restriction learn to increase oxygen efficiency, reduce oxidative stress byproducts, yet are able to "maintain critical ATP production."

[i] *Proc Natl Acad Sci U S A.* 2006 Feb 7; 103(6): 1768–1773. Published online 2006 Jan 30. doi: 10.1073/pnas.0510452103 *Cell Biology*