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Date: 11/04/2017 Written by: Jon Barron

Sugar and Cancer--Facts and Myths

If you spend any time wandering through the web searching for alternative health explanations of cancer, you'll eventually come across the name Otto Warburg. Then, if you choose to click on those links, you'll enter a world that rivals Alice's Wonderland. Dr. Warburg was a brilliant chemist, physiologist, and medical doctor who won the Nobel Prize in Physiology or Medicine in 1931. The problem is that:

- His work was far ahead of its time so that, for almost a century, the medical community didn't know what to do with it.
- Time has proven his work to be extremely accurate in the data he gathered but with fatal flaws in his interpretation of the data--an interpretation that Dr. Warburg backed away from later in his career.
- Pieces of both his data and flawed conclusions have been taken out of context and used to validate theories about cancer that, although not entirely wrong, are, nonetheless, crucially inaccurate on certain key points or, at the very least, misdirected.

An example of this kind of misunderstanding can be found in a comment we received to an article I wrote on cancer in 2010.

> "Don't forget that Dr. Otto Warburg was given a Nobel prize in Medicine for discovering the prime cause of Cancer in 1931. It appears that sugar is the culprit. Cancer was practically unknown in the last decade of the 1800's when the average American consumed 5 lbs. of sugar per year. The cases of Cancer increased proportionately through the years as consumption of sugar increased to about 135 lbs. per year in the present. CASE SOLVED!"

But the truth is Dr. Warburg didn't win his Nobel Prize for discovering the prime cause of cancer. Warburg was awarded the 1931 prize, not for his cancer work,

but for his work on cell respiration.[1] And although sugar plays a role in the progression of SOME cancers, there is no compelling evidence that it is THE cause of cancer. Case NOT solved!

But this leads us to the second misinterpretation of Dr. Warburg's studies--and this one originating from Dr. Warburg himself. He interpreted the data from his study to mean:

> "Cancer has only one prime cause. It is the replacement of normal oxygen respiration of the body's cells by an anaerobic [i.e., oxygen-deficient] cell respiration."[2, 3]

Or stated another way…

> "Cancer, above all other diseases, has countless secondary causes. But, even for cancer, there is only one prime cause. Summarized in a few words, the prime cause of cancer is the replacement of the respiration of oxygen in normal body cells by a fermentation of sugar."[4]

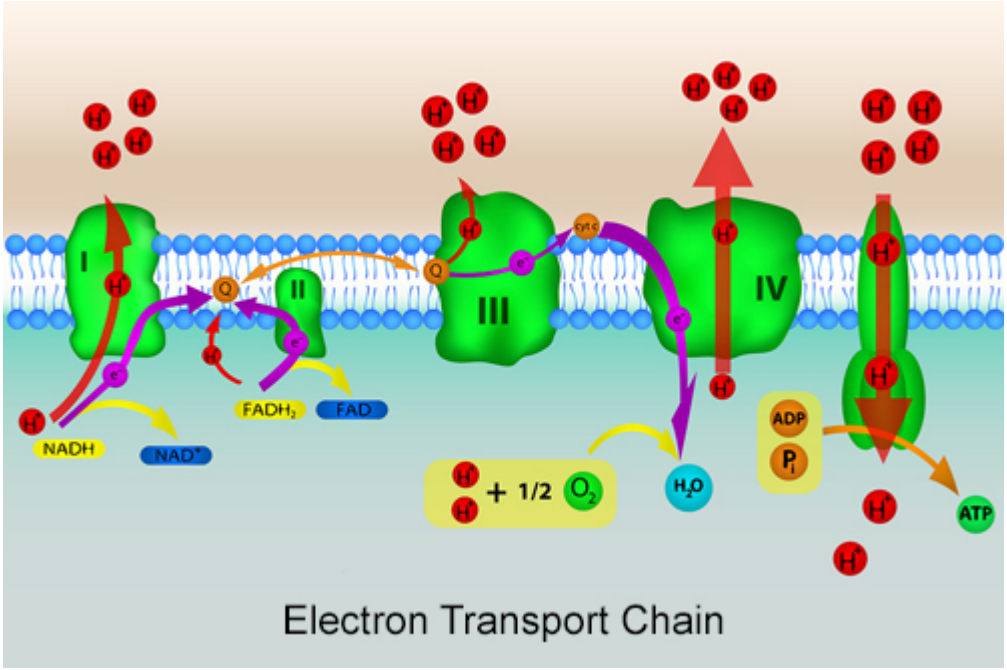
We'll get back to Dr. Warburg later, but for now, let's look at a recent study based on his work that has gotten a lot of attention in the press.

The Study: Linking Fermentation to Cell Proliferation

Introduction

Before we talk about the study, however, we need to cover a little background on how energy is produced in cells.

Background Concepts

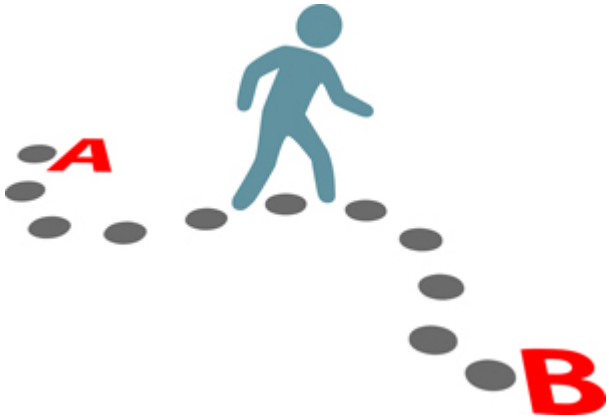


Normal cells, cancer cells, and yeast (yes, there's a reason we're talking about yeast) all need sugar to function. They break down sugar molecules and transform them into molecules they can use to produce energy. However, there are two pathways they can use to accomplish this end. When oxygen is present, normal cells use a three-step, aerobic process, which is highly efficient.

- Glycolysis is the metabolic pathway that provides the first step in the aerobic process by converting glucose into pyruvate. Very little ATP is produced in this step, and no oxygen is required. This step is anaerobic.
- The Krebs Cycle is the second step in the process. It oxidizes the pyruvate formed during the glycolytic breakdown of glucose. The pyruvate molecules are systematically broken apart to release energy. However, as with glycolysis, very little ATP is produced, and no oxygen is used. When oxygen is limited, as in anaerobic exercise, the body temporarily converts pyruvate into lactate, which allows for glucose breakdown--and thus energy production to continue. As with glycolysis, this step too is anaerobic.
- Electron Transport Chain and Oxidative Phosphorylation is the third step and the only step in the process that requires oxygen. Here is where ATP, the ultimate cellular energy molecule, is produced. This step is aerobic.
    - When the body has plenty of oxygen, pyruvate is shuttled to the aerobic phosphorylation pathway to be further broken down for more energy.

- Anaerobic glycolysis (without oxygen) will produce 2 ATP molecules for every molecule of glucose. But aerobic glycolysis that follows through both the Krebs Cycle and Phosphorylation will produces 29-30 molecules of ATP for every molecule of glucose. It is up to 15 times more efficient.5
- In normal human cells, anaerobic glycolysis is the last resort to keep up with energy demands because it's far less efficient than the aerobic alternative. But not so with cancer cells. Even when ample oxygen is available to break down glucose and use it as fuel, cancer cells are genetically programmed for anaerobic sugar fermentation. This preference of cancer cells for anaerobic glycolysis is called the 'Warburg effect'.

Which brings us to yeast. Yeast is one of the most prominent examples of eukaryotic cells. Eukaryotic simply means that cells have a nucleus and other organelles enclosed within membranes. In other words, all the cells present in the human body are eukaryotic--even red blood cells. (Although red blood cells have no nucleus, they are eukaryotic because they contain a nucleus during development but eject it to make room for more hemoglobin.) Why is this important? Quite simply, yeast cells are a perfect match for human cancer cells. They display high fermentative activity as well as rapid cell proliferation under aerobic conditions, just like mammalian cancer cells.6 Yeast also has the same class of proteins that is linked to many cancers. Mutations in the genes that code for these proteins, called Ras, can often contribute to cancer cells' ability to grow unchecked. In cancer, these Ras proteins can be far more active than in normal cells.



To connect the dots, as we've already discussed, if oxygen is **not** present, your cells use an anaerobic pathway (glycolysis), the same process that yeast cells use to produce energy. In healthy human cells, glycolysis is the last resort to keep up with energy demands because it's far less efficient than the aerobic production of ATP. But in cancer cells (and yeast), anaerobic glycolysis is **the only** cellular energy producing process available. This is what Warburg discovered. This is the Warburg effect.

Yeast, as we've already discussed, also provides another window into understanding cancer in that it has the same class of proteins that is linked to many cancers in humans. Mutations in the genes that code for these proteins, called Ras, can often contribute to the ability of cancer cells to grow unchecked. In cancer, these Ras proteins can be far more active than in normal cells. The main advantage of using yeast in studying the Warburg effect is that it's not affected by the additional regulatory mechanisms of mammalian cells, which conceal crucial underlying processes. Using yeast as a model organism, the researchers could examine the connection between Ras activity and the highly active sugar metabolism in yeast.

After studying metabolic activity in cancer cells, Warburg suggested that high glycolytic activity may be causally related to the cancerous state,~~7~~ while in yeast high glycolytic activity also correlates with the most rapid cell proliferation. There is a striking correlation between the rate of uncontrolled cell proliferation, the aggressive metastasis character of cancers, and the extent of the ‘Warburg effect'.~~8~~, ~~9~~ **However, despite many studies, Warburg's suggestion remains controversial as to whether strong fermentation is a cause or a symptom of cancer since no clear molecular link between glycolysis and proteins controlling cell proliferation has been identified**.~~10~~, ~~11~~

And this is what the study looked at.[12]

What the Study Revealed

Although the study did not confirm Warburg's hypothesis about sugar being the "cause" of cancer, its results do explain how cancer cells' energy production processes are different from normal cells. It found that one particular kind of protein can be activated by sugar. Mutations in that protein have been linked to cancer, especially pancreatic and colon cancer. Notably, the study did find that sugar stimulates cancer cells and makes tumors more aggressive. The discovery provides evidence for a positive correlation between sugar and cancer, even if not causative.

A recent study found that sugar stimulates cancer cells and makes tumors more aggressive.

Unlike normal human cells, yeast and cancer cells favor fermentation of sugar over respiration. The study reveals an evolutionary conserved mechanism linking fermentation to activation of Ras, a major regulator of cell proliferation in yeast and mammalian cells, and a "prime proto-oncogene product." As the researchers stated, "Our results suggest that the Warburg effect creates a vicious cycle through Fru1,6bisP activation of Ras, by which enhanced fermentation stimulates oncogenic potency [The vast majority of glucose and fructose entering a cell will become converted to Fru1,6bisP (fructose 1,6-bisphosphate) at some point]…Our research reveals how the hyperactive sugar consumption of cancerous cells leads to a vicious cycle of continued stimulation of cancer development and growth… Thus, it can explain the correlation between the strength of the Warburg effect and tumor aggressiveness. This link between sugar and cancer has sweeping consequences," said lead researcher Johan Thevelein.

The bottom line is that the study's findings suggest that the most common cancer-causing genes, called Ras proteins, fuel aggressive tumors with their sugar intake. In short, sugar "awakens" existing cancer cells, making them multiply and expand rapidly, according to these scientists. As Thevelein wrote in a press release, "The

hyperactive sugar consumption of cancerous cells leads to a vicious cycle of continued stimulation of cancer development and growth."13

So, What Does It All Mean?

It would be easy to jump to a conclusion here--as many people did based on Warburg's original work--that sugar "causes" cancer. That jump, however, would not be warranted. There's a huge difference between "feeding" an existing cancer and "causing" it in the first place. As Thevelein told Newsweek, "Some people are interpreting that we have found a mechanism for how sugar causes cancer, but that is certainly not the case."14 Instead, Thevelein said, his work shows just how sugar is broken down differently in cancer cells. He went on to say that although his work might mean that cancer patients should eat a low-sugar diet, he stressed that his work does not mean that eating a low-sugar diet before a cancer diagnosis might lower a person's risk.

As it turns out, there are two reasons for his reluctance to go down that path.

- Unless you have diabetes, it's hard to change blood sugar levels by eating more or less sugar. Healthy bodies regulate blood sugar levels no matter how much sugar you eat.
- In real life, not all cancer cells are the same. Some cells may take up a lot of sugar and not grow and some may not take up much sugar at all and still grow aggressively.

As it turns out, his reluctance is backed by other studies. In 2012, a major study that tracked more than 300,000 people investigated the association of total sugars, sucrose, fructose, added sugars, added sucrose, and added fructose in the diet in terms of their risk with 24 different malignancies.15 It found that sugars were not associated with a higher chance of developing most major types of cancer, including colorectal, breast, prostate or pancreatic cancer. But high sugar levels are *possibly* associated with an increased risk of some rarer forms of cancer, including types of lung or esophageal cancer.

Nevertheless, Warburg aficionados have locked onto his statement that, "The prime cause of cancer is the replacement of the respiration of oxygen in normal body cells by a fermentation of sugar." Well, if everything you've read so far hasn't convinced you that the case for sugar causing cancer is weak, then you might want to consider the fact that by the end of his career, Warburg backed off from his own claim that sugar and low oxygen caused cancer--instead pointing to chemicals used in agriculture and added to food as its ultimate cause.16 This caused him to become something of a health advocate. He insisted on eating bread made from wheat grown organically on land that belonged to him. When he visited restaurants, he often arranged to pay for a cup of tea, but to be served only boiling water, from which he would make tea with a tea bag he had brought with him. He was also known to go to great lengths to obtain organic butter, the quality of which he trusted.

Today, mutations in oncogenes and tumor suppressor genes are thought to be responsible for malignant transformation, and the metabolic changes Warburg thought of as causative now are considered, instead, to be a result of these mutations.17

The bottom line is that although the study found that high blood sugar could cause cancer cells to grow and multiply faster, the findings do not prove that eating (or not eating) sugar has any effect on the onset or development of cancer. And keep in mind that many other factors have changed over the last 100 years in addition to the increase of sugar in the diet--such as 80,000 chemicals never before seen in nature unleashed upon the environment and the great increase in cigarette smoking seen after WWII. And sugar does not explain the increases in cancer found in areas such as Love Canal, Chernobyl, and Erin Brockovich country. To

claim that sugar is the cause of cancer--CASE SOLVED--is simply not supported by the facts. Sorry.

Tweet To claim that sugar is the cause of cancer is simply not supported by the facts.

Conclusion: What You Should Do

The main source of confusion here is that there are multiple definitions of cancer in play, and people tend to use them interchangeably--shifting from one to the other as suits their argument of the moment. As for the medical community, it's now attempting to move past this problem by saying there's no such thing as "cancer." Each manifestation of "cancer" is actually a separate disease with a separate cause and requiring its own unique treatment.

But I would suggest that still leaves us with our core conundrum. And that is that there is a fundamental difference between a single cell turning "cancerous," and what we refer to as cancer. They are not the same thing. When you make this distinction, you can see that all cancers follow a similar pathway.

1.  The DNA in a single cell changes so that it becomes cancerous.
2. Your immune system fails to identify and eliminate that cell--a task that it is designed to do.
3. The cell begins to replicate creating what we refer to as cancer.
4. Once replication begins, the malignant cells, which know your body intimately since they arose from your body, can begin to protect themselves from your

immune system--hiding from it, or even coopting it.
5. Once hidden from your immune system, the cancerous mass is now free to develop a support network such as generating blood vessels to feed itself.
6. It also begins to coopt your metabolism so that it begins to produce sugar from proteins through a process called glycogenesis--dietary sugar no longer required. Literally, your body consumes itself to produce the sugar your cancer requires to feed itself--a process known as cachexia, or wasting syndrome. In the end, you literally die of starvation as your body bends more and more of its resources to feeding the cancer.
7. And if you're not dead yet, cells break off from the original mass and metastasize throughout your body, spreading the cancer to multiple organs, which absolutely finishes the job.

The thing is, once you understand this progression--and particularly the chasm between steps 1 and 3, you realize there are concrete steps you can take.

1. DNA changes

In your body, as part of the normal metabolic process, you produce anywhere from a few hundred to as many as 10,000 cancerous cells each day. Everybody does. So, why doesn't everybody get cancer? Because your immune system can recognize each of those aberrant cells and remove them from your body. That's what a healthy immune system does. So, keep your immune system optimized.

Incidentally, brand new research has demonstrated exactly how many mutations it takes to turn a cell rogue--between one and 10.[18]

- Just one mutation to drive thyroid and testicular cancers.
- Four mutations to make breast or liver cancer.
- 10 mutations to create colorectal cancer.

2. Immune system failure

Then why do some people get cancer? Because one of three things happens (and, more often than not, all three together):

1. You expose yourself to toxins and outside influences (such as heavy metals, radiation, rancid fats, viruses, bacteria, parasites, etc.) that dramatically increase the number of cancerous cells that your body produces so that not even a healthy immune system can handle the load.

2. You compromise your immune system to the point that it can no longer handle all the cancerous cells your body produces, thus allowing some of them to take root and establish themselves. And keep in mind that although sugar and low pH may not necessarily "cause" cancer, they certainly weaken your immune system, which compromises your body's ability to prevent isolated rogue cells from becoming cancer. In that sense, excess sugar and refined carbohydrates in the diet can be a causative factor in the onset of cancer.

3. Circulation (blood, lymph, energy) is impeded, leading to both 1 and 2 above.

3. The mutated cell begins to replicate

This is a crucial point in the process. There is still time for your immune system to do its job--but you have no symptoms, so you probably don't know that you need to make any changes to nip things in the bud. That's why you probably want to follow something like the Baseline of Health program as a matter of course so that your immune system is already optimized and you're regularly detoxing, which allows your body to directly attack the emerging cancer before step 3 goes too far.

4. Defeating your immune system

Once replication has been established and the cancer is able to hide from your immune system, the game changes. Whatever approach you take needs to be much, much more aggressive. And you'll need to incorporate repeated rounds of very specialized anticancer herbs--or drugs, if that's your bent.

5. The cancer develops its support network

Depending on how big the mass is, you may need to consider surgery to remove the mass--to buy time to pursue an aggressive program.

6. Cachexia

At this point, you're likely beyond any known medical treatment. Now, your only hope is likely to be a full-on, full-time alternative protocol.

7. Metastasis

While I have seen people come back from this point, the odds are not good.

Let's be perfectly clear here: not everyone gets well, no matter what program they use--medical or holistic. That's the nature of life. Sometimes it's simply because there are so many variables. For example, if your house is concentrating radon gas seeping up from the ground below and you never checked for it and didn't know, then you could be doing every therapy program in the world and your odds of overcoming lung cancer would be significantly lessened. Then again, if you live in the middle of farm country and are continually exposed to pesticides, that too lessens your odds, no matter what you do. Sometimes, you just don't know. Even in those cases, your odds are still significantly better on a program designed to detoxify your body rather than on a program that adds more toxins to it.

It's much easier to stop cancer from taking root than to make it go away.

Also, it's important to remember that every day of your life your body produces anywhere from a few hundred to as many as 10,000 cancerous cells as part of its normal metabolic processes. That's why I say that you're never completely cancer free. The only question is: can your body deal with those cells and prevent them from taking root and multiplying? It's much easier to stop cancer from taking root

by intervening at step 1 than to make it go away as you move up the steps. That's it, pure and simple. Any program that reinforces your body in that agenda is good and will improve your odds dramatically. Any program that undermines it is "questionable." The choice is yours.

https://youtu.be/jgJKaP0Sj5U
Killer T cell attacking cancer

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