Dr. Ron Ehrlich: Hello and welcome to “Unstress” where we try to get a grip on some of the things that stress us and hopefully what to do about it. I'm Dr. Ron Ehrlich. Cancer. Now one in two men, one in three women, will contract cancer by the age of 60 or maybe 65. Before we put that all down to getting older since 1971 when President Nixon declared a ‘war on cancer’ the incidence has gone up 25 to 30 percent and that is allowing for the aged lifespan increase. Childhood cancers are also on the rise and I doubt if there is a single person listening to this that doesn't know someone within their immediate family or friends or maybe even themselves who haven't had cancer. I'm putting my hand up here and I can certainly name quite a few members of my family and friends.

Now in order to solve a problem, this may sound obvious, but in order to solve a problem, it really helps if you know what causes the problem particularly if you want to target your treatment to that problem. So, what causes cancer? Now everyone will have their own list of triggers; nicotine, environmental, chemicals, and toxins, radiation, infection or a family genetic history. The accepted theory for the last 40 or 50 years at least is that it's a genetic issue with those triggers causing genes to mutate and then go out of control. It's actually referred to as the ‘somatic mutation theory’. Somatic referring to the cells of the body.

The answer to that problem then would be to target the genes of the cancer cells but there are quite a few problems with that approach. One, cancer cells don't have the same genes from one person to another. So, my prostate cancer cell genes will be very different from someone else's cancer prostate cancer genes. So, that's number one.

Number two, even within my own body unlike all normal cells which share the same genetic makeup the cancer cells in one person are all quite different. They are random, and they have chaotic mutations.

Three, in order to target those chaotic random genes in cancer cells you can't really be very targeted. You need to go through in a sort of a hand-grenade or use an automatic machine gun and kill lots of cells and its why chemotherapy has so many terrible side effects because healthy cells are affected as well as cancer cells.

What if there was something else going on? What if there was an important step in between the triggers of nicotine and environmental toxins, stress etc. and the genetic mutation? What if there was a step in between those two? What if we understood that step and targeted that which in turn killed only cancer cells and came with no or minimal side effects? My guest today is Professor Thomas Seyfried. He received his Ph.D. in genetics and biochemistry in 1976. So, he was certainly not shying away from a genetic basis to this and other conditions.

About 18 years ago he became interested in the idea that mechanisms of metabolisms specifically how we get our energy might be significant. That is how normal cells, normal human cells throughout the body get their energy and concluded that this knowledge could be useful in managing many chronic diseases including challenging neurological ones like epilepsy and perhaps the most challenging one of all cancer. That is getting down to the biochemistry looking at how cells produce energy. Cells need energy to survive, thrive and

multiply. So, how they produce it as you will hear is very important. And equally important is to know how cancer cells produce their energy and if there was a difference between cancer cells and human cells after extensive research exploring and expanding on work done by a Nobel Prize winner Otto Warburg, this was about 80 years ago the challenges that very concept. He wrote a ground-breaking book “Cancer as a metabolic disease” and the metabolic therapies that he refers to include caloric restrictions, fasting, ketogenic diets and hyperbaric therapy.

Now Thomas mentions hyperbaric therapy so just to briefly put you in the picture that involves breathing pure oxygen in a pressurized room or tube. You may have heard of it in relation to scuba diving and its very well-established treatment for decompression sickness. Other conditions treated with hyperbaric oxygen therapy include serious infections and wounds that won't heal as read as a result of diabetes or radiation therapy. In a hyperbaric chamber, the air pressures increase to three times higher than normal air pressure under those conditions your lungs gather more oxygen that would be possible breathing pure oxygen and normal air pressure. And your blood carries that extra oxygen throughout your body and it helps fight infections and stimulates the release of substances like growth hormones and stem cells which promote healing. I don't want to focus too much on it other than to explain it a bit here. He touches on it and you may not know what he's actually talking about.

There are some really important concepts we discuss here. This is relevant to every single one of us. I hope you enjoy this conversation I had with Professor Thomas Seyfried.

Welcome to the show Thomas.

Dr. Thomas Seyfried: Thank you, Ron, it's a pleasure to be here.

Dr. Ron Ehrlich: Thomas we're talking about cancer today and some really, really fundamental issues about it. I wonder if we could just start from a very basic question because we hear it so often the word cancer. What is actually cancer? What's going on?

Dr. Thomas Seyfried: Cancer is a very simplistic definition. It's just cells that are no longer regulated in their growth. So, it's dysregulated growth. Cell growth out of control. And this can happen in blood cancers or solid tumour cancers you know any kind of a tissue where the cells of our body begin to proliferate, no longer in control and that's basically dysregulated cell growth is the definition.

And now the cells, of course, can grow very rapidly and a mass but what frightens most people and what is most difficult to manage is when they spread from their primary site of origin to other tissues, the metastasis or metastasis if you will. This makes cancer much more difficult to control using conventional treatments.

Dr. Ron Ehrlich: Yeah, now the war on cancer was declared I think by Nixon in the 1970s and I know we were always told we're getting older and that's why we are but how are we actually going in this war on cancer?

Dr. Thomas Seyfried: Well, it's not going very well at all worldwide. I was in China and they have four million cases a year I think over ten thousand people a day dying from cancer in China. In the United States, it's over 1,600 people a day dying. It's usually linked to the size of your population. So, you know, it's a certain percentage of your population but the important thing is in the United States the rate of increase for cancer deaths is now slightly faster than the rate of population increases. So, and as a percentage of course but so that means we're not doing very well in this, in fact, it's an abysmal failure if you ask me.

And so, it's a failure worldwide it's not just the United States I think most countries are having the same problems. There's more cancer and more people are dying from cancer and we have no therapies that have made any major impact on the progression of the disease.

Dr. Ron Ehrlich: Which kind of begs the question and I think it's, I know we are going to talk about this what is the origin of it? What causes cancer?

Dr. Thomas Seyfried: Well, this was the I address this in my book it was the oncogenic paradox which has perplexed the majority of cancer researchers in the field clinicians as well as basic researchers and that was first to my knowledge was pointed out by Albert Szent-Györgyi who won the Nobel Prize for his work on vitamin C, but he was the first person to define this aquagenic paradox. Like how it is possible that you could get cancer from so many provocative agents such as radiation, carcinogens, viruses, inflammation, hypoxia, rare inherited mutations, age. So, all of these are risk factors for the development of cancer but what was the problem was there never appeared to be any common pathophysiological linkage between any of these so-called risk factors and the origin of the disease.

And then what I did was simply link the origin of the disease. Every one of those risk factors does one thing, they have one thing in common and that is they all in one way or another damage the respiration of our cells. The organelle called the mitochondria in some way become damaged as the result of any one of these so-called provocative agents. So, the paradox now has been resolved. Cancer can come from any number of different agents any one of which could be the preceptory initiation of the disease.

For example, in a breast tumour if you have an occluded milk duct that leads to an insight to inflammation this could damage the mitochondria of the cells in that region thus putting them on the path for dysregulated cell growth.

So, the initial step in all forms of cancer is it is it damage to the respiratory control system which regulates the growth of the cell and consequently the origin of the disease. And this was pointed out many years ago by Otto Warburg, but he didn't have all the facts at that time, but he had that he pretty much understood the origin he just didn't he wasn't able to link it to all the different things that we have done since then.

Dr. Ron Ehrlich: I thought when we talk about respiration might be worth just reminding our smokers they may not be up on biochemistry as well as we are. How a normal cell produces its energy?

Dr. Thomas Seyfried: Well, almost we all breathe that's why you know we breathe air and as a matter of fact when we sleep we don't stop breathing, aren't we? We have control systems in our brain and the in the brain stem that allows us to continue to breathe even while we're sleeping because the breathing is necessary. We bring in the oxygen which serves as the common electron acceptor and that forms water and we generate urine and we breathe moisture out of breath. And we also exhale CO2 and the CO2 the carbons come from the foods that we eat. So, the energy that we generate comes from the foods that we eat together with the oxygen that we breathe and together this is how we get our energy. And you know the waste products are basically CO2 and water in the foods that we actually are able to digest and use other foods and things are eliminated and as wastes.

But we obtain the nutrients and the energy from this process and this is called aerobic respiration which takes place in the mitochondria of all of our cells. This is how except erythrocytes our blood cells don't contain mitochondria, but they ferment they have no nucleus, so they can't divide but you know they have a limited half-life. They're not long-lived cells like we have in our brain or in our heart and other places but all the cells in our body get the oxygen in the blood, so we breathe in the air goes through the lungs. There's an exchange of gases so the CO2 comes out the fresh out goes into the bloodstream and the bloodstream themselves in our blood the erythrocytes deliver the oxygen to our tissues. And there's an exchange of gases there and we generate the energy through this is what we call the normal respiration. We breathe in and we exhale, and the waste products are water and CO2.

Dr. Ron Ehrlich: And in each cell this quite a few mitochondria?

Dr. Thomas Seyfried: Yes. It could vary depending on the cell, but muscle cells are loaded, heart cells are loaded with mitochondria because that they're constantly in an energetic situation. Brain cells our normal neurons they are loaded with mitochondria.

So, some cells have more mitochondria than others. In the prostate gland, there are much fewer mitochondria actually in some of the cells. But you know by and large with the exception of erythrocytes primarily very most of the other cells have varying numbers of mitochondria. And they're like a spaghetti, it's like it's a kind of a spaghetti organelle, it's like strands of spaghetti you all through the cytoplasm.

So, and this is where we bring in the glucose into the cells and the from the food that we eat eventually gets broken down into glucose which is a sugar and that goes right into the cells where it's metabolized through the ancient pathway of glycolysis to pyruvic acid which then goes into the mitochondria to generate the energy with CO2 and water as the waste.

Dr. Ron Ehrlich: And that currency is the ATP?

Dr. Thomas Seyfried: Yes.

Dr. Ron Ehrlich: So, in a normal aerobic respiration a cell produces a lot of ATP?

Dr. Thomas Seyfried: That's right. And it depends on how much ATP the cell actually produces and it's depending on the electrical gradient across a particular membrane. So, and

that gives you the power of the differential from outside to inside. The ionic gradients like in the heart it's a minus 86 millivolts which is quite a steep gradient and that's needed because the heart is a muscle and it needs to contract. And the energy to maintain that gradient comes from ATP which is generated in the mitochondria.

So, one of the main sources used of energy in the cell is membrane gradients and they'll make up anywhere from forty to seventy percent of the expended energy in a cell is used to make membrane gradients. And if you stop making ATP there's no longer a gradient. It reaches equilibrium and that's death. The fastest way you take cyanide and it stops the electron transport chain in all cells quickly and you die very quickly. So, that emphasizes how powerful and how necessary respiration is for our living state.

Dr. Ron Ehrlich: Which segues nicely into what's the difference between that and the cancer cell?

Dr. Thomas Seyfried: Well, the cancer cell because it sustained this damage to the respiration. And believe me, the cells at first will try to correct the damage. Cancer doesn't usually start acutely it usually starts chronically. So, there's a chronic interruption of energy through respiration. And some cells can't deal with that. Like if you have a brain cell neuron in the brain and the energy from respiration is disrupted in any particular way that cell will die. It will never become a cancer cell. Heart cells rarely have ever become tumours muscle doesn't often become tumours because the cell will die.

All these cells that have the capacity to upregulate and the ancient pathways of fermentation can form cancer and most of these are epithelial cells or glial cells in the brain and these kinds of cells they have the capacity to up-regulate these ancient pathways of fermentation.

Now you have to realize all living organisms on our planet started off as fermenters. That is getting energy without oxygen. And we had no oxygen in the atmosphere when the earth was first formed for billions of years we had no oxygen. And everything all the living organisms at that time fermented and those ancient pathways are still in ourselves, but they only perform an initiation of the metabolites. They're not the key. With evolution, the fusion of cells that could capture and use oxygen with cells that could not, and they became these hybrids symbiotic kinds of cells. And those were the origin of who we are and most and most respiring species.

So, this little organelle was able to capture oxygen and use it to produce energy but the first part of the energy process of these ancient fermentation pathways that all the cells on the planet used and what the cancer cells are simply doing is falling back on the ability of these ancient pathways to generate energy.

So, they lose the capacity to get energy from oxygen and then start to get energy from a fermentation. And what they do is they ferment lactic acid which comes from glucose and they ferment sucks in acid which comes largely from glutamine and some other minor amino acids. So, they ferment glucose and glutamine. So they fall back on this pathway and what drives these fermentation pathways are these so-called oncogenes. So, when people hear about it's a genetic no, no, these oncogenes are facilitators of fermentation pathways. They're

not the cause of cancer they facilitate the ability of a tumour cell to generate energy without oxygen. And that's the origin and this is what happens.

Dr. Ron Ehrlich: So, that I mean that is a very fundamental point here isn't it? I mean how one sees the oncogenes because this has been the focus. I mean the alternative to this as an origin is what has been going on for so long now and that is this focus on the genetic origin.

Dr. Thomas Seyfried: Well, here's the situation because you talk about tumour suppressor genes and oncogenes and you've fallen into the gene think gene trap. And what we know is that when the respiratory system is damaged in any particular cell the mitochondria form these reactive oxygen species and these are what we call reactive oxygen radicals; superoxide, nitric oxide, the nitrogen radical. You know these damaged these damaged DNA and proteins and lipids and that's the origin of the mutations that everybody studies. So, everybody's looking for these so-called cancer mutations. They're all coming as downstream epi phenomena side effects of damage to the respiration.

So, these mutations essentially affect they're not the cause of the disease. And the oncogenes, of course, are dysregulated but they are the transcription factors they up-regulate these fermentation pathways. So, oncogenes are always activated in these tumour cells so that the tumour cell can bring in fermentable fuels in to burn for energy. I wouldn't say burn, they don't burn they ferment. So, they use these ancient pathways to get the energy that they need. The oncogenes are the facilitators and the mutations that people think are important are all downstream effects. They're not the cause they're the effect. They mean essentially very little, yet the field is all focusing on that and how is that where's that gotten us?

Dr. Ron Ehrlich: Yeah, we're going to get into that back to that. Back to the energy just I asked the question there are there a lot of mitochondria in human cells in healthy cells, are there a lot of mitochondria in cancer cells?

Dr. Thomas Seyfried: Yes, there are. Now interestingly enough some very, very aggressive cancers like some breast cancer it's very hard to find the mitochondria in there but they're there but they're very diminutive and they're structurally abnormal. However, they do produce, and we've now recognized this very recently, they do produce substantial energy but from a fermentation in the mitochondria, it's called mitochondrial substrate level phosphorylation. It's an ancient pathway that can generate a large amount of ATP when oxidative phosphorylation or respiration is defective. Well, it's in all the textbooks and if you look at the Krebs cycle which is always a very complicated thing for students. There's one little pathway in the Krebs cycle or the tricarboxylic acid cycle where ATP is produced without oxidative respiration. In cancer cells that pathway becomes massively upregulated, so you can generate a substantial amount of energy from mitochondria but it's not coming through oxidative phosphorylation, it's coming from this ancient fermentation pathway. And this is what distinguishes but they use glutamine as the fuel for that pathway.

So, once we understand now that we know what's driving the cancer cell where they're getting their energy from, it's very simple to target the glutamine and the glucose and take away the energy that these cells are needing, and they die. They can't survive without fermentation energy. And this is the what Warburg originally thought but he only focused on

the glycolytic pathway using glucose. He never knew about the amino acid pathway and that's what we know. We've now written about this and we're studying this and very few people in the field acknowledge this because they all think that respiration is normal in cancer cells because they take in oxygen. And this is absurd because the oxygen they've taken in is not generating the ATP. The ATP is coming from a different site in that organelle.

Dr. Ron Ehrlich: Now the thing that always fascinates me and I myself have had prostate cancer, so I know this goes on that the profession has readily embraced this idea that cancer cells use glucose preferentially to … they love glucose. And so in PET scans what do they do? Tell our listener about PET scans because this fascinates me that the profession is willing to accept it diagnostically but hasn't made the leap into therapeutics. Tell us about a PET scan first.

Dr. Thomas Seyfried: Well, you know, yeah, well, so what you do is you take a glucose molecule and you put a marker on it like a good fluorodeoxyglucose. You can put a little tracer on it and when you inject it into the into the blood of the patients it will be taken up more avidly in the cancer cells than in the surrounding tissue and then it lights up like a Christmas tree, these metastatic lesions or a tumour itself. And that's as you said because they have an avid, they don't prefer glucose they have no choice it's not a preference it's a dependency. If the ability of the cell to generate energy through respiration is defective, then in order to make up for that very highly efficient system and you use an inefficient system the inefficient system is then dependent on a far greater amount of the material coming into the cell. So, if you're going to ferment glucose to get the same amount of ATP as you did when you respired when you did respiration you have to take in a massive amount of glucose because it's so much and less efficient than respiration.

So, consequently, glucose transporters on the cancer cells are highly up-regulated so when you give a labeled glucose for PET scan it lights up these cancers. And then some people say well it's not all cancers because you know we do glucose and there are some very aggressive cancers that don't light up on fluorodeoxyglucose. And they even burn glutamine. Put the glutamine tag on them and you'll see the difference.

So, they're either taken in glucose or glutamine or both. They can't survive without these fuels. No tumour cell can survive without glucose and glutamine. So, that the management of the disease becomes remarkably simplified and all you do is take away glucose and glutamine the pet goes away, and the tumour goes away and that's what we're seeing.

Dr. Ron Ehrlich: Wow I mean that's huge because let's just before we go into how we approach that and it is as simple as that? Is it as simple as just removing glucose and glutamine from a person and the tumour will die?

Dr. Thomas Seyfried: Yeah, I mean it’s embarrassingly simple. Now the people say well how can it be because people have been studying the wrong thing for decades. It's now I don't want to make it sound like it's that like you targeting glucose is extremely easy because you use ketogenic diets and once you do that you can you can actually use insulin you push glucose out of existence. So, those cells that are heavily dependent on glucose are dropped dead instantly. It's the glutamine that requires a little bit more sophistication because

glutamine is part of our immune system and gut cells and glutamine is needed by many of our normal cells.

So, when we target glutamine we do it strategically we don't do it like a bull in a China shop. I mean you have to know how to pulse and degrade glutamine slowly and the tumour when you have the glucose under control there's no glucose in the system and it all the normal cells are burning ketones then you strategically pound out the glutamine a little bit without harming the rest of the body. It's just that you just have to use common sense for crying out, but you know a lot of people don't understand the biology cancer. So, consequently, they're doing all these insane things like radiation and chemo and all this nonsense because they don't understand the biology of the problem. And it's actually an embarrassing once this what I'm telling you becomes known people are going to say this has been a big disaster for so long and has harmed so many people. Well, we could have done this or that we could have solved the problem and that's where we're going with this.

Dr. Ron Ehrlich: Wow. I just have to pause there for a moment because as you say you know the implications of that are so huge. Why the resistance? I mean, I think I know the answer to this but maybe you could share that with our listeners why the resistance?

Dr. Thomas Seyfried: Well, because people have been locked into a dogmatic view of what they thought cancer was and a dogmatic view on anything. It is so powerful, it's a religion. You can’t change the person's religion by telling them that the other religion is better. If a person spends his entire academic career thinking that a situation was in one way and then someone comes along and tells them it's a different way, it's very difficult to accept and despite the evidence that could be presented. “No, no it can't be it's not true if it were that easy we would have all done with it what no that's not true at all”. You've been locked into a mindset and a dogmatic view of what that is.

You go back and look at the geocentric and heliocentric origin of the solar system. I mean for decades everybody thought the earth was the centre of the solar system and Copernicus who you know was the first to identify the problem was vilified and it took it took quite a minute a century to accept from the Catholic Church that the earth was not the centre of the universe of the solar system even despite all that they threw Galileo in a house arrested him for crying out loud for challenging the dogmatic view.

So, we have the same situation here. The dogmatic view is cancer is a genetic disease. The pharmaceutical companies have launched all these immunotherapies based on the gene theory. If the gene theory is incorrect and all of this other stuff is largely nonsense.

Now every now and then you'll find a person that will respond really well to one of these. “Oh, look it's working great” but they're not talking about the other 80% of people who didn't respond so well or who have suffered immensely as the result of this approach. You know, you're using radiation… so, people, they got a huge revenue generation for radiation therapy in these clinics. Are you kidding me? I mean a lot of these hospitals generate depend on radiation as a revenue source. Well, all of a sudden you're going to say “Hey, you don't need to radiate anybody. We can kill these tumour cells by targeting glucose and glutamine”. These guys look like a deer-in-the-headlight they don't know what to say. They've never been

trained, they know very little about the biology of the disease and you come along and tell them this and what are they going to do they're going to say well it can't be right.

Dr. Ron Ehrlich: Because the genetic theory of it would demand that there was a consistency like when you looked at colon cancer in ten patients you would see consistency in the DNA of the colon cancer. But that's not what they find, is it?

Dr. Thomas Seyfried: No, it's all different every cell on the tumour is a different genetic entity. So, you know one cell may have a certain group of mutations another cell may have another group of mutations, no two cells have the same mutation. Some cancer cells have no mutations and nobody talks about that. So, when you start putting all the facts together about the gene theory then it becomes like you can't believe anyone would believe it yet they do and then when you tell people that it's not this kind of a thing in their worldview says it was and they're involved in an NIH research grants it's not only from the National Institutes of Health it's your country Germany, they're all. They're all being funded for research on hunting for various cancer genes and if the genes are all epiphenomena downstream effects then we're wasting millions and millions of dollars on stuff that has no relevance. Very little relevance than the nature of the problem. So, you have this worldview that's actually wrong and how is that worldview been doing in the battle against cancer? This is the reason why we have very little progress because people are not studying the correct thing nor are they adapting these things for the clinic. We are now treating patients in Turkey and Egypt with the concept of cancer is a metabolic disease and the patients are doing really well, quality of life is good and they're living, they're living in a better state and we can do this worldwide with no problem it's just that people have to be retrained.

And that's another thing there are very few physicians out there that number one they don't understand the biology and number two they're locked into a treatment protocol the standards of care that seem to be written in granite, that nobody seems to be able to change. And this is another tragedy why are they inflexible in Australia I'm telling you there's a lot they're the same they're no different than the United States they're no different in Germany England they're all locked into this mind view we got our users radiation, we use toxic chemicals why are you using radiation and toxic, well we have to kill the tumour cells. But we can pull away from the glucose and glutamine and do the same thing without harming the patient. Well I can't be right that can't be right otherwise they don't read the literature they don't understand the biology, and this is so consequently you have this continuing disaster worldwide.

Dr. Ron Ehrlich: So, let's just talk about this approach or the I mean obviously the understanding of the underlying cause is critically important I can't overstate that, I mean tell us about the approach. I mean it is simple but what is it? I mean we talk about ketogenic what does explain to our listener what that means?

Dr. Thomas Seyfried: Yeah. Well, what we did we published a paper my physician friends and research colleagues Don D'Agostino and John Maroon they're a neurosurgeon from the University of Pittsburgh.

Dr. Ron Ehrlich: Yeah, we talked to Dom a few weeks ago.

Dr. Thomas Seyfried: Yeah, he was on my paper you know, and we put it together it's called press pulse and basically the first step we do is we bring the blood sugars down as quickly as possible in these patients. So, we either do a water only fast or we transition from ketogenic diet to therapeutic fasting. And the bottom line is you just got to get the glucose down and one and when the blood sugar goes down the inflammation and the micro and tumour microenvironment goes down and you actually start to kill cells through various killing mechanisms apoptosis.

So, what it does is it makes the whole microenvironment less angry, less inflamed which then slows down a tumour. So, you're starting to slow it down and you know you're taking away the abnormal blood vessels and this kind of thing. And then so once the patient is into therapeutic ketosis then we begin to treat, we call therapeutic ketosis kind of a press. It brings the body into a new metabolic state where the normal cells get healthier and the tumour cells get weaker. Many of them die. We use various other forms of therapy to reduce anxiety. Many cancer patients have anxiety because they have this view that there they have a life-threatening condition. They have anxiety because they're sometimes mistreated by toxic chemicals, which makes them feel terrible. So, anxiety elevates blood sugar and you need to reduce anxiety so there's various kinds of yoga, massage therapy, music therapy whatever it is going to be able to lower your anxiety levels lower the blood sugar levels.

And then we use drugs that will further target insulin, further target glucose like insulin or 2-Deoxy-D-Glucose. You got to be careful you know we as doses timing and scheduling that's we're working on. And then we use hyperbaric oxygen because it's very interesting if you take away the fermentable fuels like glucose and glutamine and this the reactive oxygen species now kill the tumour cell. Glucose and glutamine put up a protective shield around the tumour cell and that prevents them from being killed by these toxic radiations and chemo but if you remove the glucose and glutamine and they form their own reactive oxygen species and die from internal, they explode from inside rather than being treated from the outside. Beautiful it's a very elegant non-toxic way to kill these cells.

Dr. Ron Ehrlich: Just to remind our listeners the hyperbaric means a chamber where oxygen is increased.

Dr. Thomas Seyfried: Yeah, you put the patient into a pressurized oxygen. You know a lot of athletes use this. It's very interesting that insurance companies will cover hyperbaric oxygen therapy for people that were severely burned from radiation therapy to treat their cancer. Sometimes the gut gets all damaged from the chemo, but the insurance company so okay do hyperbaric oxygen we'll cover hyperbaric oxygen to try to repair the tissue damage that you sustained from being treated for cancer. This is nuts. If you did the hyperbaric oxygen part of the treatment they don't cover that. It's actually part of the therapy you can kill tumour cells with hyperbaric oxygen as long as the patient is first in therapeutic ketosis and then you can target glucose and glutamine simultaneously while the patient is in hyperbaric oxygen.

So, Don showed some beautiful work on this and the patients seem to do really well as well. It's a non-toxic way of killing tumour cells but you got to first put the patient into therapeutic ketosis and if you target a little bit of glutamine while this is going on it's even an additional attack on the tumour cell. So, there's a lot of ways you can do this. It's actually it's not a how

many different unbelievable ways you can kill cancer cells without harming the patient what because now you're targeting their very fundamental weakness. This is a completely different strategy than what we're using in the clinic presently to treat most cancer patients.

Dr. Ron Ehrlich: So, putting people into therapeutic ketosis is the press, what's the pulse?

Dr. Thomas Seyfried: The pulse would be hyperbaric oxygen. It would be drugs that are that are pulsed that would work together with the diet they work synergistically like we're using a glutamine targeting drug now called sisasian or leucine. It's a drug that's been known for years but never been used in a press pulse console it's unbelievable it's so powerful and it can kill cancer cells massively with minimal toxicity when used with ketogenic diets. So, these drugs that were formerly quite toxic and misused and not understood have a new life which makes them very, very therapeutic when used in the correct approach.

So, we use that as a pulse hyperbaric oxygen as a pulse, insulin is a pulse and we and we work the pulses off the press and that we don't what we're trying to do is degrade the tumour slowly rather than you know all at once and then bring as we degrade a tumour slowly we bring the normal cells into a much greater state of health.

So, as you're killing off cancer in your body you're also bringing the whole body into a new state of metabolic homeostasis. So, our patients some of the people that I know, I'm not a physician but my clinical friends who can do this tell me it's unbelievable. You can get people that have cancer and type 2 diabetes and you get rid of both the type 2 diabetes and cancer you know, and metabolic imbalances and all this stuff recorrect itself and at the same time you blast out the tumour cells in a strategic way, not harming the rest of the body. The whole thing is it's really elegant. If people knew how to do this man, it would be a lot of fun and for the patient as well as the practitioner but unfortunately, too few people know anything about this they don't understand it and therefore it doesn't go you it's not used.

Dr. Ron Ehrlich: And ketogenic what does that tell our listener what that actually means in terms of carbohydrate intake or you know to put a person into ketosis? What is the carbohydrate intake that one should be aiming for?

Dr. Thomas Seyfried: Well we don't know exactly because everybody's a little bit different so we that's why we published the glucose ketone index calculator. And what this does is you take a blood monitor like a precision extra blood glucose ketone monitors like what people with diabetes would have except that it also measures ketones as well as glucose so the same meter, it's a little handheld meter. You take a small drop of blood from the fingertip and then you would put the drop of blood on the glucose stick and then the same get the value for that and then put the new ketones strip into the meter and you get the value for the ketone. And then we convert everything to the same unit millimolar and you just divide the ratio of the glucose and the blood by the millimolar of ketone in the blood and you come up with the singular number cause the ratio of glucose to ketone. So, most people eating a standard Western diet would have a GKI of about 30 to 40 which would be considered a lot of glucose and very little if any ketones.

But if you stop eating carbohydrates or stop eating completely what happens is obviously blood sugar goes down and as blood sugar goes down insulin goes down and then your body starts turning towards natural stored fats and you start making these water-soluble fat breakdown products called ketone bodies and they can replace glucose in the majority of the cells in our body. In other words, the cells in our body evolved to burn either glucose or ketones and when we don't eat glucose then becomes unavailable largely and we start burning fats and our ratio our GKI starts to go down. It's like a golf score the lower the score the better the better you do.

So, if you can get one point zero or below that means the patient is in therapeutic ketosis. They're burning more ketones than they are glucose. And then we can use drugs to push that glucose down even further once the patient is in ketosis because there all of our cells are now recent we don't we don't need glucose. So, you can push the glucose way down. Even the brain is now burning ketones, so you can push blood sugars way down. So, that's how we know and as I said cancer patients have anxiety so it's harder to push their GKI down than it is a normal person who just wants to get into ketosis. But you know once physicians understand this there's going to be a lot of ways that we can get the ratio down in these cancer patients.

And then so this then enters the state of therapeutic ketosis and it can vary from one person to the next. So, some guy might be able to eat a little bit more carbs, than another guy but the bottom line is you got to get that one point zero or below because that's when the tumour cells are going to be under maximal pressure they won't be able to compete with normal cells and consequently they'll die. And it's not a complicated thing. We've seen it over and over again not only in patients but in the preclinical models that we work with.

But you know that's one point but and then the body of course will they say well our liver can make gluconeogenesis that's true but once we have the body transition to ketosis we can get rid, we can we can actually use insulin and other drugs to push those blood sugars down to a very, very low level. So, the tumours are going to be starved of these things and the normal cells try to compete directly against the tumour cells for the fleetingly small amount of glucose. It's unbelievable and the tumour cells lose every time because they have all these mutations that prevent them from adapting to this new environment.

Dr. Ron Ehrlich: So, that's the glucose part of it. What about the glutamine? Tell us glutamine is an amino acid so tell us how we deal with glutamine?

Dr. Thomas Seyfried: Yeah, glutamine is the most abundant amino acid in our body. Okay, in the bloodstream you look at amino acids a lot of the blood is loaded with amino acids all kinds of fuel. Don't forget the bloodstream is our conduit to supply, remove and supply energy and remove wastes it's our ultimate connector through all parts of the body. So, glutamine is the most abundant and we and we can synthesize it from glucose, so we can actually make glutamine from glucose. That's why it's considered non-essential amino acid, however, it's so essential for so many functions the urea cycle all of our immune system cells use tremendous amounts of glutamine. So, we have to use kid gloves when we touch glutamine because we so many of our normal cells need the same fuel, but the cancer cells

are using that fuel to generate energy ATP whereas the normal cells are using it as a building block material not so much for generating ATP but doing all the other things.

So, we have two cells that need the same fuel for different reasons. One cell is dependent on it for energy and this cell uses it to do its normal metabolic functions. So, when we target glutamine we have to use drugs. There's no dietary manipulation of glutamine like we can manipulate glucose through the diets and things like this. So, glutamine has to be done in my mind with various kinds of drugs. And there are a series of different kinds of drugs that must be used. And it has to be done as I said timing dosage and scheduling because you don't want to harm your immune system. If you kill a lot of cancer cells our immune systems cells have to come in and pick up the corpses. You have to remove the dead cell bodies from the area where they were otherwise you get infections and other kinds of problems. And that's our immune cells and they need glutamine also.

So, if we're going to take away glutamine we kill the tumour cell but at the same time we can give glutamine back to stimulate our normal cells to pick up the corpses. It's an unbelievably nice strategy it's just that you got to know what you're doing you have to be educated and you have to know the biology of the system and then there's going to be all kinds of new ways to do this. I'm just outlining some of the generalities here.

Dr. Ron Ehrlich: What are some of the drug that used for glutamine?

Dr. Thomas Seyfried: Well, that's what I said. I said…

Dr. Ron Ehrlich: Oh, yeah. We have links to that article. I've got that article on my desk.

Dr. Thomas Seyfried: Yeah. And there are a number of different… We use chloroquine. Chloroquine is the anti-malarial drug. We use EGCG which is the active ingredient in green tea extract. These all target various aspects of the glutamine pathway. So, if you know how to use these drugs strategically you can degrade the glutamine ability of a tumour while at the same time you're shutting that front door of glucose and therefore the tumour becomes checkmate. It can't survive. There's no other fuel in the microenvironment that can keep these cells alive in sufficient quantities. Yes, they can use some other amino acids. Yes, they can use a little and this is not enough of that stuff around. It's not there. You got to have a logistic supply of the fuel to keep the cell alive and if the two main fuels are restricted they don't live long on anything else that might be around.

Dr. Ron Ehrlich: Now something that characterizes almost all conventional cancer treatment is side effects. Whether it's the side effects of the chemotherapy, the surgery, the drugs. What are the side effects of this approach?

Dr. Thomas Seyfried: Well, you know, if you don't do it right constipation I guess maybe could be one of the side effects because I worked in the epilepsy field for years using ketogenic diets in preclinical systems and working with my physician colleagues. You know, imbalance. You can have certain kinds of maybe a little hormonal imbalance but not so much but usually, electrolyte imbalances can happen. But this is all so easy to correct. I mean just a little bit of blood work and tell you whether you need to tweak this or that. So, it's not

terribly. There's no hair loss. You know there might be a little light-headedness at the beginning when you start to transition away from glucose to ketones because our bodies are addicted to glucose, so we have these withdrawal symptoms that might be there a little bit but none of it's compared to what you know none of it is compared to the side effect of radiation and toxic poisons.

I mean this is tremendously different. So, you know, now it does require some degree of compliance on the part of the patient and it does require some knowledge on the part of the attending physician to know how to tweak the system that might become a little imbalanced. Like for example a lot of cancer patients are given vitamin D as a supplement because they get vitamin D deficiency after chemo or radiation or something like this. But when you do ketogenic diet metabolic therapy the fat in our bodies are being used for energy and vitamin D is stored in fat. So, sometimes you can have an excess of vitamin D during the course of the treatment. So, physicians need to be aware of this. So, constant monitoring of blood works the various electrolytes and markers in the blood are a key element to how you use metabolic therapy for killing cancer cells. But all of this is easily measured the knowledge base on this is so deep so with most physicians can look at a blood workup and say "Oh, a little too much here a little too little there and we can adjust these. We put them on give them a little bit more you know electrolyte supplements to reduce some of the potential imbalances that we may have". But this is very simple compared to you know the horrific adverse effects that you get from standards of care. Which you know, throw your whole body. You're blowing out your microbiome you're creating all kinds of metabolic issues that we don't see nearly any of that in metabolic therapy.

Dr. Ron Ehrlich: Now this has been that's fantastic. I got to tell you this. But listen if you were giving someone advice who's had cancer who wants to avoid it, well what would be a few tips that you give them?

Dr. Thomas Seyfried: Well, there's two things here one is to avoid cancer which falls into the realm of prevention which you know, we know what causes cancer as I said it's the oncogenic paradox. Any provocative agent from the environment that could damage your respiration would put you at potential risk for developing a neoplasm, a group of cells growing out of control. So, you can't get cancer if your mitochondria are healthy. I would say even Warburg said this about eighty to ninety percent of all cancers could be prevented by preventing by protecting your mitochondria against oxidative damage. So, therapeutic ketosis allows your mitochondria to be very healthy and would significantly reduce cancer risk. So, the very fact of putting a person in therapeutic ketosis would reduce risk. So, you know, exercise. Everybody talks about its diet and lifestyle exercises but no there are so many people either their job prevents them from doing this or they throw caution to the wind or whatever the hell it is. You know people they're the same everywhere you know that and besides the high glucose foods that these mass-produced nutritionally depleted foods. They taste great, but they also create systemic inflammation putting cells at risk. So, therapeutic ketosis would eliminate that but at the same time, a lot of people like to eat high carb foods. So, it's a balance you know. You know what you need to do a lot of people don't do it.

But then once you have the disease then it becomes a different thing. Okay, the strategy that we take to eliminate the disease now becomes one where we target and kill tumour cells

while protecting the normal cells. So, there's one issue of prevention the other is the management.

Dr. Ron Ehrlich: And I would imagine that incorporating regular fasting into your annual protocol you know if you went do you go through a water fast yourself several times a year. Is that… I know Dom was doing that occasionally?

Dr. Thomas Seyfried: Yeah, well, Dom is like that. I'm not like that you know, but I do it yeah, I did it. But is it nice? No, no, it's hard. Are you kidding me? Yeah you know everybody out easy to talk about. You try not eating for three days and see how you like it, right? You know a friend was feeding his dog he had to leave the room he was overcome after three days of water only fast. So, I mean this is not easy. It's not easy I mean it's like whoa yeah, the first day you can get through the second day you know and then of course if you can do it, it becomes a little bit less difficult each time you do it. But Dominic is listen, he's living there. He's living the style you know. I know what he's got.

Dr. Ron Ehrlich: He looks like it too.

Dr. Thomas Seyfried: Oh, yeah.

Dr. Ron Ehrlich: He looks amazing.

Dr. Thomas Seyfried: Yeah, most of us don't do that. You know, if we have the problem you know we know what to do and we try to do the best we can, but you know most people want to live it.

Dr. Ron Ehrlich: I think once somebody has been diagnosed with cancer and faced with an alternative of chemo, radio, surgery often a combination of the three with all that entails not only the anxiety but the assault physically. I mean it's almost a no-brainer, isn't it?

Dr. Thomas Seyfried: Yeah. You know, when our friends from Turkey you know, they were forced to use they used metabolic therapy they did hyperbaric oxygen, keto, they did the whole thing, but they still had to use a little bit of chemo. Because they would fall out of compliance with rules and you know lose licenses and things like this. So, I said to them "What do you think as a professional how these patients would do if you took away all the chemo?" He said, "They'd do better". I mean why are you introducing any toxic molecule into your body when you don't need to? So, and this is the whole thing. We think by using metabolic therapy we can annihilate and get rid of these tumour cells without having to subject any toxicity to our body.

Dr. Ron Ehrlich: Because I guess success rate is it one interesting question because it's often quoted as a five-year survival or two-year survival or even only a few months survival. A drug is considered successful if it extends life by a few months. What's the success? What are we seeing? What are you seeing clinically in this ketogenic approach, in this metabolic approach?

Dr. Thomas Seyfried: Yeah from the papers that have been published so far listen we have a lot of patient's individuals who have contacted me who are living far longer with stage four cancers they're all out three, four years doing well and people say well these are anecdotes they can't be real. You know when you have a pile of anecdotes build-up one after another I mean when is everybody have a fluke and an anecdote I mean what's going on here? But the Turks my friend in Turkey, Istanbul they have the largest patient group and we're trying to get these things published as quickly as we can. But you know they have quite a few they treat only stage four cancers all different kinds lung, pancreas, ovarian you know all these really bad triple negative breasts and things like this and their patients seem to be doing good not everybody survives. I mean it's like anything. Some people get so beat up by chemo and radiation that their bodies can't rally in any way and they just can't you know, they were there, they had a window of opportunity and it was taken away by some horrific toxic thing and their bodies can't rally. But their average survival for stage four lung cancer was 44 median survival was 44 months compared to 6 to 11 months with all known standards of care. So, clearly, they're way beyond, the survival rate is so far and the quality of life is so much better. And we're still perfecting this. This is not a this is not a completely established I mean we're making it better all the time in fact so many of these guys once they realize what's going on they make these suggestions and we actually can improve this very significantly.

The problem is that there's we don't have enough case reports and then they say well we need a clinical trial. Well, who's going to do the clinical trial, right? Who's going to pay for the clinical trial? Who knows how to do the clinical trial? You're not going to get the people who don't know anything about this running a clinical trial. The trial involves press pulse. How many people out there in the oncology world understand press pulse? How many people out there who can who can apply it to their patients? Right now, there's a lack of skill and knowledge. There's a lack of knowledge basically this needs to be training they need to know what they do and then they then you can take a few patients and do this. So, it can't be done double-blind crossover because everybody knows you're getting drugs, diets, hyperbaric oxygen. You get all this stuff.

And the bottom line is how long can I keep a patient alive who has stage four cancer without toxicity and that's the bottom line you know. And we can do that and upend it by my friends in Turkey and now in Egypt, we're doing it in Egypt and to do it and doing it in Hungary. The problem is so many medical school's cancer clinics are locked into what they do day to day and then you come along and say "Hey, listen, we don't want to do what you do day to day". They get reactive, they will just be "This can't be right". Then you have this big wall of resistance to doing this and this is the biggest problem right now. We know what to do we pretty much know how to do it the problem is who's going to do it? And otherwise, you know and then you have to change. The system has to be changed. The system right now is not working so we should know that.

Dr. Ron Ehrlich: You know, Tom just taking a step back from all this because we've covered you know, this is mind-boggling literally mind-boggling and fabulous. But I want to take a step back from it just finally before we finish and ask you this question and this is removing yourself from your position in this research field. As a consumer we're all consumers of health we're all on our own health journey, what do you think the biggest challenge is for people today on their health journey through life in our modern world?

Dr. Thomas Seyfried: Yeah, well, this is I think we move forward as a species based on the technological advances that we develop, and every technological advance comes with you know, certain risks. So, you know, the capture of fire or initially you know people got burned but they also move forward and in developing all kinds of new technologies. And I think that sometimes the food industry has created many foods that put us at risk for not only cancer but a lot of other diseases. But I think if we are aware I think if we understand and we are aware of things, at least we have the choice to make it. We can make a decision as to whether we want to go in this direction or that direction but when people have been not aware and sometimes they're given misinformation this creates problems. But I think you know we move forward with technology and some of this can be extremely good and some of it can put us at risk for different conditions.

I mean we have Alzheimer's disease you know as a growing problem which again is a type of chronic disease coming from in my mind metabolic imbalances. In fact, my Alzheimer's patients are hypometabolic. They have very low glucose in that they can't get enough… This is why their risk for cancer is reduced. Alzheimer's patients are reduced the risk for cancer because they can't get enough glucose into the brain and some other organs. So, you can't run you can't drive the cancer beast without glucose so there they're lower on that. But why some neurons develop plaques and tangles others die? Why some cells become cancers and there are other cells who have these other issues? So, but we all know that there it's related to chronic inflammation mostly coming from our industrialized societies. And until we recognize this I think… but at least that's the recognition I think most people understand that. I think what they don't understand is there is a potential non-toxic address. I don't say a solution but it's certainly a way to manage this and significantly reduce the numbers of people dying.

Dr. Ron Ehrlich: Tom, thank you so much for joining me today. This has been fabulous. We're going to have links to that article the press pulse article that's sitting right here on my desk but we're going to have links to it, so people can read it as well. Thank you so much.

Dr. Thomas Seyfried: Yeah, thank you.

Dr. Ron Ehrlich: Amazing and so fundamentally important. What is the origin of cancer? Is it a genetic condition the so-called somatic mutation theory? As I mentioned a lot of chemotherapies focus on this. Or is it a metabolic problem with the mitochondria in our cells which go out of balance and cause genetic mutations and proliferation? It's an important point because it gives us a vital step, how cells produce energy and does that differ from human cells and cancer cells. The answer is it does.

We started this conversation a few weeks ago with Professor Dominic D'Agostino but today we really focused on the cancer aspect of it. I must admit when I reflect back on my own diagnosis of prostate cancer three or four years ago I think, and I think that if I would have understood this better I may have gone through the metabolic therapy that Thomas described and then retested myself with another MRI 12 months later to see whether cancer had increased or decreased. Look I know it's of course very complicated. I know that personally because emotions get involved in decisions are made. But I'd like to put this idea out there and it's actually not a new one. It's been around for a long time, but current research is filled

into you know gaps. So, it makes so much sense also and it gives you control and most importantly apart from all of that is that no nasty side effects because you are targeting cancer cells.

Fasting is another topic we're going to expand on in the coming weeks and months. Professor Dominic D'Agostino's said something a few episodes ago which resonated with me, “Has there ever been a time in human history when some form of fasting intentional or otherwise wasn't part of our human experience?” Contrast that now with our overabundance of seemingly cheap food at least in the Western world. Stay tuned we'll be exploring this theme further in the weeks ahead. This is all just too important to not revisit. So, until next time this is Dr. Ron Ehrlich. Be well.