The Tim Ferriss Show Transcripts
Episode 12: Rhonda Patrick
Show notes and links at tim.blog/podcast

Tim Ferriss: Hello, ladies and gentlemen. Welcome to another episode of the Tim Ferriss show. I'm so happy to have you listening. Let's start off with a line of wisdom for this episode, and that is "Don't sweat the petty things, pet the sweaty things" from none other than George Carlin. What a genius. Check out his workload, and his creative process. He's an amazing comedian, and an amazing thinker; and an awesome haircut. Moving on, this particular episode is for all the nerds out there, all the dorks out there, all the biohackers out there, or really, anyone who's interested in life extension, the dangers and promises of supplements, performance enhancements, and all that kind of stuff.

Quite frankly, you should be interested in that stuff. My guest is none other than Rhonda Patrick, PhD, a friend of mine who works with Dr. Bruce Ames, who is famous for developing a number of tests. He's also the 23rd most cited scientist in all fields between 1973 and 1984; more than a decade.

That's nuts. Dr. Patrick, Rhonda – in this case – also conducts clinical trials, has performed aging research at the Salk Institute for Biological Studies, and did graduate research at St. Jude Children's Research Hospital – which I highly recommend you donate some money to. I've done some work with their child genome project. There, she focused on cancer, mitochondrial metabolism, and apoptosis. She's very, very smart, she is very, very well armed with data. She knows how to perform research, and she knows how to translate it for a lay audience.

We do get deep in the weeds in a few spots, and what I would say is just bear with us, grit your teeth, listen through it – maybe listen to it at 2x or 3x speed, and you will find nuggets in this podcast, in this episode that make it very worth the listen. This episode is brought to you by Blue Host, which is the hosting company I used to host my very first website, very first blog.

They're very strong with WordPress. Check out what they have to offer, and you can find special offers for listeners in this podcast at bluehost.com/tim. So without further ado, I would like to introduce

you to Rhonda Patrick, and thank you so much for listening. Here we go.

Rhonda Patrick: Okay, cool.

Tim Ferriss: We are live. Another spectacular – well, I shouldn't say that. Another fascinating – for me, at the very least – episode of the Tim Ferriss Show. Dr. Rhonda Patrick is here with me. How did we first connect? How did that come together?

Rhonda Patrick: We first connected because originally, I read your book [inaudible] in the sauna, no less. –.

Tim Ferriss: That's where all the trouble starts.

Rhonda Patrick: I read it in the sauna, in graduate school. Of course, the book fell apart because of the keep. I first became aware of you, I was like, "This guy is pretty cool, and we kind of think alike in terms of some of the scientific thinking, and also efficiency". I moved to the Bay area, and I got in touch with WellnessFX.

Tim Ferriss: That's right.

Rhonda Patrick: Because, I thought they were really cool. I'm like, "This is great. I'd love the idea of quantifying different levels of minerals, vitamins, hormones, and lipid profiles. Being able to measure what you're doing at base line, and then make dietary changes, and then measure again, cut out the middle mean – the physician – who most of the time doesn't know a lot about nutrition". I went to this event that WellnessFX had, [inaudible] that talk where you attended.

Tim Ferriss: That's right. With Justin Major.

Rhonda Patrick: Justin Mager, who – that's where I first became aware of him. I don't really know much about him, but I became friends with Jim Kean.

Tim Ferriss: Yeah. Jim's a beast.

Rhonda Patrick: Jim's cool. He's really cool.

Tim Ferriss: Yeah. For those of you who don't know, Jim was a CEO of WellnessFX. I think he's 50, or 51, and the guy can do like 20 handstand push-ups, and outplay me in any possible sport. I mean, he's –.

Rhonda Patrick: Guinness Book of World Record holder; which, by the way, I share that in common with him.

Tim Ferriss: Wait a second. Alright, so hold on. We're going to come back to that. Jim is – Bruce wanted to be the fittest 50-year old in the world. He didn't make it that long. I would say Jim would have to be at the very top. I think he's currently training for the master's division at the cross fit games. He's just an incredible human being. I didn't realize that – I'd forgotten that you were at the Fireside Chat. Guinness Book of World Records, tell me about this.

Rhonda Patrick: I was a professional jump roper when I was a young child. I know. It's not a very common thing that people are professional at, but I was. I started jumping rope when I was seven.

I had joined this international rope skipping organization, where I was basically doing demonstrations at Sea World, L.A., traveling around the world, starting jump rope teams at different schools, and I got into commercials when I was a kid because I was just that good at it.

Tim Ferriss: Were you a solo jump roper, or was that a team?

Rhonda Patrick: It was a team, but I would do solo, we did team stuff. I got into the Guinness Book World Record multiple times because of the team work where we – every year, at jump rope camp, in Denver, Colorado would cram a bunch of people under one long rope, and we could have the most people jumping as many times. We'd break our world record every year, so I was probably in it like four or five times, when I was nine, ten, and 11.

Tim Ferriss: That's amazing. Where did you grow up?

Rhonda Patrick: I grew up in San Diego.

Tim Ferriss: San Diego, the jump rope capital of the world.

Rhonda Patrick: No.

Tim Ferriss: No, I'm kidding.

Rhonda Patrick: Definitely the surfing capital. I was a surfer, as well, a bit.

Tim Ferriss: Let's flash forward then, from the jump roping empire to your scientific career.

For those people who might not know you, what's a brief number of bullets in terms of some of the credibility points that you bring to the table with this type of thing? Some people may be familiar with your work through visiting your site, or your [inaudible]. Of course, you also did a guest post on my blog related to heat adaptation, and how to use hyperthermic conditioning for endurance, and other types of purposes. For those people who don't have any baseline, what are some of the bullets?

Rhonda Patrick: Bullets are – I was a biochemistry/chemistry major at USD. I decided that I wanted to go to graduate school, but I wanted to gain experience in biology, so I worked at the Salk Institute for Biological Sciences for two years, where I did research on aging using small nematode C. Elegans worms, where I could genetically manipulate them, and extend their life span by two-fold.

I loved biology at that point, it was just like, "Wow, this is so cool". I decided to go to graduate school. I wanted to do cancer research, and specifically, I was interested in pediatric cancer, so I went to St. Jude Children's Research Hospital, in Memphis, Tennessee. I trained there for six years, did research on mitochondrial metabolism, and apoptosis and its relationship to cancer. I got a really good paper [inaudible] out of that. Then, I decided I wanted to try – I wanted to apply these really good scientific techniques, and all this knowledge I learned in graduate school, and I wanted to do clinical research, but I wanted to bring real science to clinical research.

Tim Ferriss: What does that mean?

Rhonda Patrick: Well, sometimes clinical research involves looking at some end point like, mitochondrial infarction, or heart attack, or some sort of event that occurs, and they don't really look at mechanism. I decided that I was going to use some of these techniques that I learned from doing mouse work, and from doing cell culture.

Where, you're teasing apart pathways and doing all these – looking at mechanistic interactions. I decided I wanted to apply that to people. You can do that by getting blood cells, and looking at what's going inside their body through this lens of what's going on in their blood cells.

Tim Ferriss: Right.

Rhonda Patrick: That's what kind of led me to go to the lab that I wanted to, with Bruce Aimes, who also is very interested in nutrition and micronutrients, which is another interest of mine. Preventative medicine, I think, preventing micronutrient deficiencies, things like magnesium, Vitamin K, and Vitamin D; these essential minerals and vitamins that we need, for a variety of different biochemical pathways in our body. I think that these deficiencies over time, cause insidious damage that rears its head as age related diseases later like, cancer, neurodegenerative diseases, diabetes, and things like that. I thought it would be a great match, and I have no doubt that I made the right decision.

Tim Ferriss: Your mentor was –? Let me get this right. What was he? Was he the most, or second most cited?

Rhonda Patrick: The most cited.

Tim Ferriss: The most cited.

Rhonda Patrick: I'm probably going to botch this, as well. It was over a ten-year period.

Tim Ferriss: Over a decade.

Rhonda Patrick: In all fields.

Tim Ferriss: That's ridiculous.

Rhonda Patrick: It is ridiculous.

Tim Ferriss: That's crazy.

Rhonda Patrick: He's pretty awesome. He's 85 years old now. He used to be the chairman of the biochemistry department at Berkeley, and he's professor emeritus there, but he moved his lab. He was always on the forefront of translational research. He moved his lab to Jones Hospital because you can work with MDs, and we get a lot of patients –.

Tim Ferriss: What do you mean by "Translational research" in this case? Are you talking about DNA?

Rhonda Patrick: Translational research means applying mechanistic discoveries that we find in science by doing a lot of mouse model work.

Tim Ferriss: Into practice.

Rhonda Patrick: Into practice, where they're like –.

Tim Ferriss: Got it. Going from the lab to the hospital, or on the bench.

Rhonda Patrick: To the bench. Exactly.

Tim Ferriss: Okay. Now, this makes sense. I've read your work, and followed your work for a while now, and have found exactly that type of translation, what makes a lot of what you do interesting to me, and I think, applicable to other people. Now, of course, there are many other people who prematurely jump from theory to practice. Sometimes, looking at – I always mess these up – in-vitro. Translating in-vitro to –.

Rhonda Patrick: In-vivo.

Tim Ferriss: In-vivo.

Rhonda Patrick: Yeah.

Tim Ferriss: Prematurely. Let's talk about the micronutrient inadequacies. I've noticed, for instance – and this was chronicled in – before our body, a bit. Identifying micronutrient deficiencies in my case, had a very dramatic selenium deficiency, which adversely affected testosterone production among other things.

So what causes these micronutrient inadequacies or deficiencies: Vitamin D, magnesium, Vitamin K, an obviously, Vitamin D gets a lot of play in the media.

Rhonda Patrick: Right.

Tim Ferriss: What are the causes? Why do people not get enough of these? Assuming, let's just say for the sake of argument, that they're not consuming purely empty calories.

Rhonda Patrick: Right.

Tim Ferriss: So if they're not on the fast – the McDonald's, Wendy's, and Burger King breakfast, lunch, and dinner diet.

Rhonda Patrick: Right. So the reality is if we're talking about – when I say micronutrient inadequacy versus a deficiency, I'm not talking about someone that is – when you're really deficient, and you're at

the point where you're having a clinical manifestation of that deficiency for example, Vitamin C and scurvy. When you have scurvy, that's not the first sign of deficiency; that's pre-mortality. That's the sign that you're going to die.

Tim Ferriss: Inadequacy could mean it's in the labs within the "Normal range" but it's not where you would –.

Rhonda Patrick: Not necessarily. Inadequacy means you're not so deficient that you're going to have a clinical symptom that's measurable like you're gums are falling out.

Tim Ferriss: Yeah.

Rhonda Patrick: But you will, for example, not be making collagen properly because, that's where vitamins use a co-factor for. In the case of micronutrients like magnesium and Vitamin K; so magnesium is at the center of the chlorophyll molecule, so it's found in dark leafy green vegetables. Men need around 400 milligrams a day, women about 320 or so. People aren't meeting those requirements because they're not actually eating enough of the foods that have magnesium.

There's a bunch of reasons for that. There's also a lot of confounding factors: athletes often sweat our more, so they actually require more than non-athletes. Then, you have things like magnesium being tied up in phytates, which is like the phosphorous source in plants.

That is hard for us to digest, or our absorption isn't – we still get it, but it isn't as bioavailable. There are a lot of things. I think mostly, the No. 1 thing is we aren't eating enough dark green leafy greens. Magnesium is essential for about 300 different enzymes in your body. We, in our lab, we have a theory, which we are now starting to prove, which is called the "Triage theory". What this theory is, is that during our evolution, we went through periods of starvation where we couldn't get enough food.

These periodic points where we go through starvation, we think that our body has very strategically set up mechanisms that can ration micronutrients to the proteins and enzymes in our body that are essential for survival, for reproduction, the sodium-potassium pump, and clotting; you don't want to hemorrhage up. All of these proteins that require micronutrients for short-term survival get to pick their pick first.

Whereas ones like enzymes involved in DNA repair, which repair DNA damage – well, DNA damage accumulates over time, and that doesn't have a problem until the fifth or sixth decade in your life.

Tim Ferriss: Well past [inaudible] your usefulness.

Rhonda Patrick: Exactly. We started to test this. We were looking at it. If you look at cofactors, the way they work, you have enzymes in your body, and these enzymes are what are doing everything. You have a DNA repair enzyme that needs magnesium, there's a binding constant. That protein will bind to this cofactor, to this mineral at a certain rate. You can look at proteins that are involved, for example, Vitamin K, that's involved in the clotting of your blood, versus other proteins that require Vitamin K, which are involved in making sure you don't get a calcification in your bloodstream.

Clotting is a very essential, short-term survival protein. As I just mentioned, you don't want to hemorrhage up. Versus this other protein, that's involved that needs Vitamin K to work, it's essential to make sure you don't have calcification of the arteries.

Well, that's [inaudible] later in life. We look at the binding constants of those two proteins, and sure enough, the one that's involved in clotting has a much tighter bonding, so more of it's going to that protein.

Tim Ferriss: Got it.

Rhonda Patrick: What we think is going on –. Let me just mention, about 60 per cent of the U.S. population has inadequate levels of Vitamin K. 45 per cent of the U.S. population has inadequate levels of magnesium.

Tim Ferriss: For more own clarification, it would seem then, in this particular case, if you have an inadequate intake of magnesium or Vitamin K, what you do consume would be [inaudible] to the short-term needs, but you'll suffer the consequences of then, non – suboptimal leveled DNA repair, for instance.

Rhonda Patrick: Exactly.

Tim Ferriss: Which could lead to mutations, which lead to cancer.

Rhonda Patrick: Exactly. With the Vitamin K, you'll have calcification in the arteries, which can lead to cardiovascular diseases, which can lead to brain vascular diseases.

What we think is going on is there is these micronutrient inadequacies are causing what we call insidious damage, where it's a little bit of damage every day.

Tim Ferriss: More of attrition.

Rhonda Patrick: Right. It's just going on, going on, and going on. By the time you're 50, or 60 years old, you start to come down with these age related diseases. They're age related diseases for a reason. We think that getting people up to snuff on their micronutrient intake will – is a very important role in preventative medicine because we're going to – instead of trying to patch someone up after they're falling apart, we're going to extend the healthier part of their life. Extend their health span.

Tim Ferriss: It's very difficult to acutely reverse a chronic condition that has reached a precipitation point where you're exhibiting massive symptoms like Alzheimer's. What do you suggest consuming for Vitamin K, for instance?

Rhonda Patrick: Vitamin K is also in plants, in dark plants. Vitamin K1 is.

Tim Ferriss: K2, you'd find in fermented –.

Rhonda Patrick: Right, like natto, I think.

Tim Ferriss: Yeah, natto.

Rhonda Patrick: If you're liver –.

Tim Ferriss: Kimchi.

Rhonda Patrick: Kimchi, I think has some levels of it, as well. Most people don't eat kimchi. Natto – is it "Natto" or "Natto".

Tim Ferriss: It's "Natto".

Rhonda Patrick: Natto. Yeah because, you're Japanese.

Tim Ferriss: Yeah. Most Americans are not going to eat natto for sure. It is – Japanese feed natto to foreigners as a parent might feed a child a lime to see them make funny faces. I guess most Americans are not

going to eat that. Fermented food sources, if you want to really go off the deep end with that, you can [inaudible]. He's very much for the fermented foods. You were saying –.

Rhonda Patrick: You convert K1 to K2 in your liver.

Tim Ferriss: Yeah. [Inaudible].

Rhonda Patrick: Yeah. I don't see a problem with that.

Tim Ferriss: Sure. I'm fine. Let the liver do what it does best.

Rhonda Patrick: Right. You want to keep your liver happy, so if your liver's working, it should do it.

Tim Ferriss: Green leafy vegetables.

Rhonda Patrick: Green leafy vegetables are really good for magnesium and Vitamin K.

Tim Ferriss: What does your diet currently look like? I know you mentioned – I did a bit of inadvertent, intermittent fasting today. What does your daily food look like? You mentioned your smoothie. I'm sure people would love to hear about that.

Rhonda Patrick: I do. I highly recommend – I have a Vitamix, but whatever your favorite blender of choice is, whatever, Blendtec, whatever it is you like. A blender that has a good –.

Tim Ferriss: A powerful motor.

Rhonda Patrick: Exactly.

Tim Ferriss: The Vitamix, for you guys, I do have a Vitamix. I put off getting one for 15 years, and now, I wouldn't trade it for anything. It will outlive me. It's going to last forever.

Rhonda Patrick: I use it every day. What I do is in the morning, I make a smoothie that consists of a lot of kale, spinach – spinach or chard depending on what I have – two large carrots, a tomato, avocado and then, I put an apple, and banana.

The avocado and banana are really nice because it gives the consistency of the smoothie. Frozen berries, and sometimes I'll switch out with different citrus fruits. Almond milk – almonds are

really high in magnesium. Almond milk; I like unsweetened because I don't want a bunch of extra crap.

Tim Ferriss: Yeah.

Rhonda Patrick: I get unsweetened almond milk, and sometimes I'll put my protein powder, or glutamine. My gut likes glutamine.

Tim Ferriss: I take glutamine on an empty stomach, once, every morning.

Rhonda Patrick: Nice.

Tim Ferriss: Yeah.

Rhonda Patrick: Then, I blend it up, and that is my breakfast, and brings me into lunch. Lunch, I usually have leftovers from dinner. I try to eat pretty healthy.

Tim Ferriss: What might that look like?

Rhonda Patrick: It can be some left over salmon, and spinach.

Tim Ferriss: Kentucky Fried Chicken. No, I'm just kidding.

Rhonda Patrick: Turkey chili.

Tim Ferriss: Pretty much along the paleo-ish lines.

Rhonda Patrick: Yeah. I'm not quite certain on all the paleo –.

Tim Ferriss: I'm going to get – I want to ask you about some common misconceptions/exaggerations, perhaps.

Rhonda Patrick: Well, I may, or may not know because, I don't know really, exactly what paleo is. Honestly. Meat, and berries, and vegetables, and not processed foods. That's kind of my understanding. I haven't really read a lot about it. It makes sense to me.

Tim Ferriss: It appears that in general, you're avoiding refined carbohydrates.

Rhonda Patrick: I do.

Tim Ferriss: Consuming a lot of green, and getting a spectrum of colors.

Rhonda Patrick: Exactly. A spectrum of colors. That's my –.

Tim Ferriss: Good way to go.

Rhonda Patrick: Good way to go. Exactly.

Tim Ferriss: As it relates to diet, I'm curious to know if you have any thoughts on the somewhat religious fervor which with a lot of paleo folks rally against: phytic acid, tannins, and so on.

Rhonda Patrick: I, at one point, tried to do a little bit of reading on that, and I just didn't find the phytic acid convincing enough for me to start cooking my kale than blending it.

Tim Ferriss: Right.

Rhonda Patrick: I haven't done extensive research on that, so I can't say for sure it's not a great thing to do, or is a great thing. Personally, I go with my raw kale. I haven't convinced myself.

Tim Ferriss: No worries. There are a couple of things related to this that we can talk about. Take magnesium, for instance, there are many people out there, I'm sure, who take magnesium supplementation. Ditto for selenium, ditto for fill in the blank. This is a country known for the most expensive urine in the world – at the Olympics, at least. That's sort of the running joke. Vitamin and minerals, good or bad. I know you've said before that context matters. Where do you stand on supplementation?

Rhonda Patrick: It's a little complicated when it comes to supplementation. Now, if we're just talking about minerals, for example.

Minerals are really tricky because, they are required as cofactors for a lot of enzymes, and because they're very small, a lot of these minerals are very similar in their structure. Magnesium and calcium are right next to each other on the Periodic Table, and they both have this 2 plus charge. What happens is if you take a bunch of magnesium, or supplementing with a bunch of magnesium, and you're not getting enough calcium, the enzymes in your body that need calcium, start to take the magnesium, and it kind of trashes those enzymes. They don't work as well because they need calcium, not magnesium. This is something that happens.

Tim Ferriss: Yeah.

Rhonda Patrick: If you're going to supplement with minerals, I think you really need to be careful. You want to make sure you're getting the right balance of them. You want to make sure you're not getting too

much, as well, of one or the other. With magnesium, I've seen studies where they show that the maximum dose you would absorb from a single dose is somewhere like 123 milligrams. Anything over that is not bad, though sometimes you'll get a relaxing effect in your gut, so it can help your bowels, it'll help the peristalsis.

Tim Ferriss: Sure.

Rhonda Patrick: There's other things as well, I think that's [inaudible] but taking 700 milligrams of magnesium a day, and if you're not getting your calcium, that could be a problem. I'm always a little hesitant about supplementing with minerals.

Tim Ferriss: Alright.

Rhonda Patrick: In terms of vitamins, I think that –.

Tim Ferriss: Hypothetically, you could achieve –. Do you think it's possible to achieve that type of disruption with natural foods, if you're consuming an overabundance of foods containing magnesium, do they typically also provide the calcium?

Rhonda Patrick: You do typically have the calcium there with them.

Tim Ferriss: Okay.

Rhonda Patrick: There seems to be a pretty balanced ratio. I don't know for certain if you were to de excessive amounts of dark greens. Calcium is also in the greens, as well, like kale and chard. Potassium is in there. That's the other one, sodium, and potassium.

That's actually a really good question. I haven't really thought about that.

Tim Ferriss: I'm curious because people seem to figure out a way to kill themselves with an excess of just about anything, including water. You'll find people die of – what is it? Hipernutremia, which would be excessively low levels of sodium after over consumption of water. The sodium-potassium pump seizes to work properly, and they have heart attacks when they're running marathons, for instance. Especially, in the U.S., where there's this "More is better" mentality.

I always wonder what the dose is that will make the poison, even for the naturally occurring stuff. We don't have to go down that rabbit hole. It's less – it's obviously harder to achieve that than just

popping a handful of pills, which you can do in a handful of seconds.

Rhonda Patrick: You can.

Tim Ferriss: Yeah.

Rhonda Patrick: It is always good to be aware of what doses you're taking with vitamins and minerals. In terms of vitamins, I think – there are widespread micronutrient deficiencies, as I mentioned.

About 70 per cent of the population has inadequate Vitamin D, and we talked about Vitamin K and magnesium. There's calcium, as well. There's a lot of these micronutrient deficiencies. Supplementation can be good because it can help fill those gaps.

Tim Ferriss: Yeah.

Rhonda Patrick: However, if you're a person that is unhealthy in terms of you have a disease like cancer, then all bets are off because, cancer cells, like everything that normal cells like – but it's like fuel for the fire. For example, this is folic acid. Folic acid is a vitamin that we make – we make folate in our body. Folate is important for thiamine synthesis. Thiamine is one of our DNA nucleotides. If you don't get enough folate, or folic acid supplement – supplementing with folic acid – you can actually cause your DNA to mis-incorporate uriacil, which is part of RNA, into where the thiamine is supposed to be. This causes strand breaks in your DNA. It causes double strand breaks.

Actually, our lab did an experiment where we did folate deficiency, and compared it to UV radiation, and it was just like getting UV radiated by not having enough folate.

Tim Ferriss: Wow.

Rhonda Patrick: It can cause strand breaks in your DNA, which lead to cancer. However, if you already have cancer, because cancer cells are – they've overcome a variety of different [inaudible] pathways, they're growing, and reproducing rapidly because of that, they're making daughter cells. Well, their daughter cells need DNA to make these cells, so they're stuff that helps them make them have DNA. If you're supplementing with folic acid, and you have cancer, you're actually giving these cancer cells the precursors they need to make more cells. If you think about one of the most

famous chemotherapy drugs out there, Methotrexate, it inhibits folic acid synthesis.

Tim Ferriss: Interesting.

Rhonda Patrick: These cancer cells are rapidly proliferating – cells in your gut, and your skin, and also hair, your immune cells; they're also rapidly proliferating cells, and they get affected as well. But cancer cells –.

Tim Ferriss: Yeah. It's so tough because I think about a cancer [inaudible]. A lot of my – of course, if you had a couple of million readers, you're going to have some set that suffers from cancer in various forms. I've had very personal experience with interacting with people in my family, but also my readership with cancer. It seems like by the time you're 40 or 50, you have microscopic cancer cells, but they're – it's a disease-free state, in so much as they're not proliferating out of control. The question becomes, if you have the seeds of cancer cells, how do you behave?

For instance – I know that people all the way up to [inaudible] in some cases are using [inaudible], and they're using Glucophage – Metformin.

Rhonda Patrick: Metformin.

Tim Ferriss: Prophylactically to control their fasting glucose levels, and to obviously manipulate how their liver handles glycogen and things like this, so that they can avoid going prediabetic, but keep it at an even lower state, to effectively starve cancer cells of glucose. That's the idea, to extend lifespan – functional lifespan. If you have dietary interventions, which would be potentially limiting processed carbohydrate intake, or high glycemic, or high glycemic index load – rather – foods. At what point do you decide to try to starve – starve your body of folic acid?

For instance, I know that I appear to be a bad methylator, and have had a number of people recommend to me that I use methylfolate.

Rhonda Patrick: Do you have an MTHFR polymorphism?

Tim Ferriss: Yeah. I do have an MTHFR polymorphism. The MTHFR gene, also nicknamed the mother of – for precisely that reason. Very highly related. I do have an MTHFR polymorphism, and I've been taking methylfolate.

So now I'm 36, I tend to follow a slow carb diet. My fasting glucose, my hemoglobin A1C, which is kind – vastly oversimplified, with kind of a running average over three months of your fasting glucose level. All very good. At what point, if I know that cancer cells are likely present in some [inaudible] form, do I make changes? That's something that I struggle with. I don't know. Maybe just keep tracking it until you have something that can be imaged.

Rhonda Patrick: I think in a sense, where your – if you have a small amount of pre-cancer cells in your body, having a good immune system becomes critical. You do, your immune system needs folate. I think focusing on having good mechanisms in play that can get rid of those pre-cancer cells, so there's a variety of different mechanisms our body has. When those happen, we activate genetic pathways like P53, which induces the cell death of these cancer cells.

We've got our immune system. If your immune system is working well, then it's going to kill those cancer cells. Something that – you bring up a really important point, which also gets me back to this whole context thing. What you're talking about, is you've already initiated cancer, so you've already gone through that cancer initiation where you've acquired enough damage to make a cell abnormal.

Tim Ferriss: Right.

Rhonda Patrick: What usually happens – cancer initiators are different than cancer promoters, which allow cancer cells to grow and proliferate. Initiators are usually damage to your DNA from oxidative damage, nitration, UV, and there's a variety of micronutrient deficiencies.

Tim Ferriss: Too much flying.

Rhonda Patrick: You're right. Basically, you get a mutation in the gene that can end up having an abnormal cell. Once you have that abnormal cell, this is where cancer promotion comes into play, where things that can give growth factor signals. This is where something like IGF-1 –.

Tim Ferriss: This is what I want to talk to you about because – so IGF –.

Let's jump into IGF-1. If you can explain what IGF-1 is? It stands for insulin-like growth factor 1, but it's also something that has been promoted as for instance, a sports energetic. You can use IGF-1 for performance enhancement.

Rhonda Patrick: IGF-1 does great things. IGF-1 is downstream of growth hormone. When your pituitary makes growth hormone, it induces your liver to make IGF-1. Also, other things induce IGF-1, exercise, for one, so you can really – exercise is a potent inducer of IGF-1.

Tim Ferriss: What type of exercise?

Rhonda Patrick: I don't know if there is a certain type, but I know that exercise itself can induce the muscle cells to make it, so it's independent of the liver. Your muscle cells will make its own IGF-1, so it's a sort of mechanism in going through the whole growth hormone pathway. A very potent nutrient in [inaudible] IGF1 is actually protein, and there's a very good reason for that.

Protein induces IGF-1 because IGF-1 activates the mTOR pathway, which is required for protein synthesis. It makes sense that when you're eating protein, and taking amino acids –.

Tim Ferriss: You need more IGF-1.

Rhonda Patrick: Right. You're basically going to induce that whole pathway that's like, "Okay, I'm going to incorporate this to make new proteins in my body". It's well known that protein is actually one of the most potent inducers of IGF-1, which is probably another reason why eating protein helps put a pack on muscle. IGF-1 is a very potent growth factor. It can promote the growth and the repair of skeletal muscle. It also is very important for – it can cause neurogenesis in the brain, so it can cross blood-brain barrier, and you can also make it. It's a growth factor, so it's helping your neurons grow.

Tim Ferriss: Side note: if you want better cognitive performance, get off your – and do some exercise. Quite aside from IGF-1, you have BDNF, brain drive neurotrophic factor.

There's a book called, "*Spark*" that gets into a lot of this, but the Cliff notes is, if you want better dendrite growth, and cognitive performance then, physically move. Get out, and physically move.

Rhonda Patrick: Completely agree. IGF-1 is good. Right?

Tim Ferriss: Yeah.

Rhonda Patrick: There's a flip side, and that flip side is first of all, if we're talking about IGF-1 activates AKT pathway. AKT is just a lot of things. One, it's more than the glucose metabolism that you're talking about, but another thing that it does is that it inhibits something

called FOXO, which is a very important transcription factor. FOXO, when FOXO is not inhibited, it gets into the nucleus, and it activates a variety of genes that are involved in stress resistance. It activates a variety of antioxidant genes, genes that are involved in DNA repair, and genes that are involved in degrading bad proteins.

Tim Ferriss: How does IGF-1 affect FOXO?

Rhonda Patrick: It negatively regulates it. When I was doing this research back at the Salk, with worms, these worms have genes that we have.

It's really amazing. When we would inactivate IGF-1, cut it off –.

Tim Ferriss: Longevity went up.

Rhonda Patrick: The worm would go from living 15 days to 30, and it was amazing because, I would look at just a [inaudible] normal worm, versus the one we would inactivate their IGF-1 pathway, and they would be – let's say 13 days, that 13-day-old worm that was normal, was like barely moving around. This other dude was just moving. It was like a young worm.

Tim Ferriss: It was ripping.

Rhonda Patrick: Yeah. They've done a variety of mechanistic investigations to figure out why, and a lot of it has to do with the FOXO pathway where it's like these worms are just resistant to stress. That's a bad thing about having too much IGF-1. The other bad thing is the context. If you're healthy, and you don't have a bunch of pre-cancerous cells, IGF-1 is great because it's muscle repair, muscle growth, neurogenesis.

If you do have a bunch of pre-cancerous cells around, it's not a good idea to have a lot of IGF-1 because it's a growth factor. It's a proliferative signal that's letting these cancer cells grow. Grow, grow, and grow.

Tim Ferriss: How do you thread the needle and hit that Goldilocks point? The more I read – it sounds so depressing, but the more I read about longevity, the more it seems that life is sort of a quality versus quantity proposition where you can –. For instance, if you want to extend your life span as a male, there's pretty compelling evidence that stopping ejaculating is a pretty good idea; the less you ejaculate, the longer you live. I can send you some weird stuff like, looking at studies – that have not been performed on humans, of course, but there are [inaudible]-constriction.

There's the debate of whether you need across the board [inaudible]-constriction to achieve the life extension benefits that seem to correlate to [inaudible]-constrictions.

Maybe it's protein cycling, and maybe it's any number of things. Let's say you take a monkey, don't allow ejaculation, and give them a sub-cloro diet. Their hair thins out, [inaudible] to the floor. Yes, they live longer, but they're miserable monkeys. They're just not very happy little monkeys. What I have to wonder is, if I want greater thermic effective food, and I want better cognitive function one could argue for a higher protein diet. That would give you a day-to-day superior experience. Feel free, I want you to pick anything apart that you can, but on the flip side, you're increasing IGF-1, and basically pouring fuel on a potentially fatal fire, if you have pre-cancerous cells.

Rhonda Patrick: Yes. Also, the FOXO is getting inhibited.

Tim Ferriss: The FOXO is getting inhibited, so you're having a day-to-day superior experience with what would seem to be a Faustian bargain in cleaving off life extension benefit.

Do you think that is a either/or proposition? How do you get the best of both worlds? Is that possible?

Rhonda Patrick: I think there is a possible way to get the best of both worlds. It depends on what eating a high protein diet means. For me, eating a high protein diet is like eating some sort of meat every day. If you're looking at getting some of those benefits of having genes expressed that are involved in stress resistance, there's ways to do that through hormetic responses; hormesis. Which is basically giving yourself a little bit of stress. Things like polyphenols, like the EGCGs in green tea, that's what they do.

That's how they exert a lot of their positive effects, is through a hermetic response, where they activate NRF-2, which activates a whole host of genes involved in like glutathione peroxidase, all these antioxidant genes.

Tim Ferriss: Good.

Rhonda Patrick: Yeah. Heat stress exercise, these are all forms of stress that stress your body.

What happens is your body's response to that stress is to activate genes involved in stress resistance. I think that doing things that are like a little hormetic responses where little types of good stress like heat stress, exercise, green tea, curcumin is another one that's also hermetic, and red wine – the [inaudible] in red wine do it. Of course, there's the whole alcohol part. I think hormesis is a way to get those stress response genes activated.

Tim Ferriss: Like the [inaudible] like Westley.

Rhonda Patrick: I'm just not following –.

Tim Ferriss: He inoculates himself against the poison to kill the Sicilian when that is on the line.

Rhonda Patrick: Exactly. I think that's a – hormesis is kind of a cool way to do that. Getting all your micronutrients, making sure your DNA repaired genes are working. There's an environmental component, as well.

Environmental meaning the way we age to a caustic damage happening in our body from just damage, metabolism, or immune system, all that stuff is breaking down stuff, it's causing damage to our DNA, it's causing damage to our lipid. Some membranes cause damage to our protein, and these things get dysfunctional over time. Making sure we can keep all those systems working well. Getting those micronutrients is another great way.

Tim Ferriss: Do you know what would be really fascinating? My dream was to [inaudible]. We can talk about this state of science, and funding, and all that, as well, but we'll stave that off for a little bit longer. I would be really fascinated to look at the bio-chemical and genetic profiles of two cohorts. First cohort is high protein, moderate to low fat, moderate to low carbohydrate, so very, very common. A lot of paleo folks, a lot of "Healthy" folks are just avoiding processed carbohydrates.

Then, in the second cohort, ketogenic people, who are following very high fat, low carbohydrate, and moderate protein diets. The Atkins are even more so sort of epileptic diet.

Rhonda Patrick: Right.

Tim Ferriss: Where they're consuming like cream and cheese, and all this stuff to see what their FOXO status is. I'd be really curious to –.

Rhonda Patrick: That would be very interesting. I think that if you're looking at someone who's following, from what my understanding is of a paleo diet, I think even though they're eating a lot of protein, and getting a lot of IGF-1 because they're not getting all this other excess damage, and I think they try to get enough micronutrients, from my understanding.

Tim Ferriss: Yeah, sure.

Rhonda Patrick: They try to get a lot of these micronutrients, as well from their grains. In fact, if you look at their inflammation levels, there's been some people – they don't call it a paleo diet in some of these studies, but if you look at what they eat, it's kind of paleo-like. They've got low c-reactor protein, low inflammation, so it's like –.

I think, in that sense, it's kind of like you're eating protein, you're activating IGF-1, but you're exercising, you're cutting out all the other crap, you're getting all your micronutrients to repair the damage. I think there might be a healthy balance there, where you're not –.

Tim Ferriss: It could also just be that everything you consume will have – as we currently understand them with our current state of the art science, a positive and negative effects. It's not a matter of choosing good things, and avoiding bad things. It's about choosing the right combination of things, all of which have pros and cons, so that you're like a personal balance sheet. If you were running a company, it would be in the black, and not in the red. Sort of choosing those combination factors.

Speaking of which, can you – let's talk about genetics a little bit. I brought up methylation, and the – gene earlier, but we didn't really explain what that means. Could you explain to people what methylation is? Can you delve into that a little bit?

Rhonda Patrick: Yeah. I can explain a little bit about epigenetics, and the role that methylation plays in that. Epigenetics is basically referring to changes in gene expression. When you have a gene, it has to be expressed. It has to be expressed to be active, to do what it's supposed to do to make the protein, it needs to make to do the function. What you have here is your DNA is wound up in protein called histones, and this makes up your chromosomes, and they're wound up real tightly.

You'll have methyl groups which can attach to certain regions of

your DNA, CPG islands in your DNA. Usually, when those methyl groups adapt to your DNA, what happens is transcription factors have to [inaudible] as one of those common bind to a promoter region of a gene to activate it to turn it on. When methylation groups are there, it's physically impossible for that transcription factor –.

Tim Ferriss: There's something covering that –.

Rhonda Patrick: Yeah, it's literally, a physical block.

Tim Ferriss: Yeah.

Rhonda Patrick: What happens is a gene will be turned – it's there, but it will be off; it won't be active. So methylation usually refers to turning a gene off, but not always. You can also have methylation of the histones. Acetylation is another epigenetic mark, acetyl groups –.

Tim Ferriss: Is it "Acetyl" or "Acetyl"? I've always wondered because, I only read the damn thing.

Rhonda Patrick: Sometimes I call it –.

Tim Ferriss: Like I said "Acetylcholine", or "Acetylcholine"?

Rhonda Patrick: Acetylation, it's one of those "Potato" "Potato".

Tim Ferriss: You say "Tomato" I say "Tomato".

Rhonda Patrick: I don't think there's really a convention, I hear both. It's kind of like "Autophagy", and "Autophagy", I hear that in scientific seminars.

Tim Ferriss: Autophagy?

Rhonda Patrick: Autophagy is actually what I hear more frequent, now.

Tim Ferriss: That sounds very Queen's English.

Rhonda Patrick: Yeah. Autophagy.

Tim Ferriss: That sounds better than autophagy. I used to say "Democracy" when I was a little kid. It always bugged me. I knew it was wrong, but I couldn't say it the other way. Every time I say "Autophagy" I feel like I'm saying "Democracy". Autophagy.

Rhonda Patrick: Autophagy. I think that's pretty standard now.

Tim Ferriss: Sorry. Side note: autophagy is a cell eating itself or destroying itself.

Rhonda Patrick: Yeah, it's destroying all of the dysfunctional organs like dysfunctional mitochondria, and it's a very healthy thing to be able to do because you don't want nasty stuff building up in your cell.

Tim Ferriss: Yeah, that makes sense. I'm so happy I have autophagy. I interrupted this. Methylation is usually referring to these methyl grids effectively blocking the turning on of genes.

Rhonda Patrick: Exactly.

Tim Ferriss: Got it.

Rhonda Patrick: So what's really cool is that –.

Tim Ferriss: When someone says they're a "Poor methylator" does that mean that they're bad at putting those methyl groups in place, or that they're bad at removing those methyl groups so that those genes can be turned back on?

Rhonda Patrick: I think when someone says they're a poor methylator, they probably don't know what they're talking about.

Tim Ferriss: I'm sure that's the case. Which is why I'll avoid saying it in the future.

Rhonda Patrick: Yes. There are enzymes that add methyl groups on, and there are enzymes that demethylate, and there's whole classes of them.

The NTHFR is a specific enzyme that's very involved in the methylation pattern of [inaudible], methylating [inaudible] when a bunch of home assisting –. It also does generate some of the methyl group. It's not that it's adding it – you're not adding it to all your other genes, but I think specifically, the NTHFR –.

Tim Ferriss: Got it. Enzymes. I was told basically, the diagnosis that I was given was "You have this polymorphism of the NTHFR". Which is an enzyme, or a gene, or is it a snip?

Rhonda Patrick: A gene – what the polymorphism is?

Tim Ferriss: Yeah.

Rhonda Patrick: A polymorphism is just a variation in the gene that changes its –.

Tim Ferriss: So you get non sense [inaudible].

Rhonda Patrick: You make a protein, and a protein is this enzyme.

Tim Ferriss: The NTHFR is the enzyme?

Rhonda Patrick: It's both. There's a gene, and the gene makes an enzyme. Your gene is the DNA blueprint, which then makes RNA, the RNA gets translated into protein.

Tim Ferriss: I was told, "You have this particular variant, or polymorphism –".

Rhonda Patrick: Yeah, your blueprint screwed up.

Tim Ferriss: "NTHFR, it's screwed up. You are a bad methylator, therefore you have more trouble recovering from exercise". That was roughly, the train of thought that I was delivered. Is that accurate, then? It would kind of make sense if I have this variant that screws up my ability to – you were saying, take home assisting, and turn it into –.

Rhonda Patrick: Yeah, well, actually, it also does generate methyl groups that are using this other cycle called the SAM cycle, which actually does make a lot of methyl groups for a variety of different other epigenetic marks. I think ultimately, someone with that polymorphism that's not aware of it, can have – not have enough methyl precursors around. If that makes sense.

Tim Ferriss: Yeah.

Rhonda Patrick: For other enzymes to go and add them to different gene regions.

Tim Ferriss: I see.

Rhonda Patrick: It's fascinating because diet and [inaudible] can actually change that. There is a study – a classic study that was done at Duke University, a few years ago. They took mice that are lab mice that have yellow fur. They have yellow fur because of a gene they have called Agouti gene, makes them have blonde hair, basically.

Tim Ferriss: Sounds like a line of handbags.

Rhonda Patrick: It's really a bad thing, though because, that same gene predisposes them to Type 2 diabetes, obesity, and cancer. These mice –.

Tim Ferriss: Not a good trade-off.

Rhonda Patrick: It's like blonde hair looks nice, but they get fat, and they come down with cancer –.

Tim Ferriss: They get fat and get cancer.

Rhonda Patrick: What these researches that Duke did was they took female mice, and they fed them with a really high folate diet, and B12, three weeks before they got pregnant. What they found was that the offspring of those Agouti mice no longer had yellow fur, they had brown. When they looked in their DNA, what they found was that the Agouti gene had been silenced.

Tim Ferriss: Wow.

Rhonda Patrick: Methylated. It turned off the gene. These mice no longer had blonde fur, and they also weren't predisposed to get cancer, and they weren't obese. This high folate diet in the female mouse before she was impregnated, turned off that Agouti gene in her eggs, actually. It's really kind of cool. There's other things, stress, for example, inflammation affect methyl groups –. The whole epigenetic field – I'm like on this epigenetic kick right now. I just think it's so easy.

Tim Ferriss: Epigenetic, just so I can understand this, but also it's a term I've heard a lot. "Epi", as I understand it, is sort of "On top of" like, "Epidural" or "Epidermis".

Rhonda Patrick: Mm-hmm.

Tim Ferriss: Epi is – epigenetics represents the class of – the spectrum of factors, exterior factors, behavioral factors that can affect your hardware – so to speak – your genetics.

Rhonda Patrick: Your blueprint. Exactly.

Tim Ferriss: Turn them on, turn them off.

Rhonda Patrick: It's exactly like you said, you'll have a methyl group sitting on top of your DNA, in this really important region where things need to bond to turn it on. It'll stop, or you'll have acetylation in a part of your – mostly, it's histones, which open up the histone DNA complex, and allow stuff to come in. It kind of does the opposite; acetylation usually turns on genes. Epi – exactly, sit on top of your

DNA, and they turn them on or off just based on other things can't come in. It's a physical –.

Tim Ferriss: So the methyl groups and the acetyl groups would be examples of epigenetics.

Rhonda Patrick: The two best known examples.

Tim Ferriss: Which can be affected by diet, exercise, etc.

Rhonda Patrick: Exactly. Affected by stress, diet –.

Tim Ferriss: The epigenetics is not the exercise and diet that can affect A, B, and C itself. It's actually those intermediary groups, methyl and acetyl groups.

Rhonda Patrick: Exactly. The cool thing about epigenetics is that – they're working on this right now, so they've figured out the human genome.

Now, they're trying to figure out the human epigenome, so there's tons of genes that are patterns of methylation, acetylation, and all of these things. What they're finding is that this stuff can actually be passed on to your offspring through the sperm DNA, through your eggs. Well, not your eggs, but –.

Tim Ferriss: Don't judge.

Rhonda Patrick: You get it. I'll give you an example, there's another study that was published a couple of years ago – actually, there's been a series of [inaudible] where they take these male mice –.

Tim Ferriss: Yeah.

Rhonda Patrick: It's kind of nice to work with males because then it's not like in-utero, it's not something that's happening during pregnancy.

Tim Ferriss: Yeah.

Rhonda Patrick: They take these male mice, and they feed them a really high inflammatory diet like, corn oil or they just give them tons of Omega 6, and just crap. These mice get obese, and they get Type 2 diabetes. What they found is that they have offspring – female offspring that are skinny. They feed their offspring a normal diet. They don't give them much inflammation type of foods. These female mice are lean, but they get Type 1 diabetes.

What they found was that in the father, this corn oil diet, this inflammatory diet actually turned off a gene in the sperm DNA, that's involved in the pancreatic islets of insulin production.

Tim Ferriss: Wow.

Rhonda Patrick: I know. Isn't that scary? Epigenetics is kind of terrifying in the sense where you're like beholden to what your parents did, but then also, you can change your –.

Tim Ferriss: Better stop drinking those phytoestrogen shakes, or whatever.

Rhonda Patrick: Yeah, right.

Tim Ferriss: Wow.

Rhonda Patrick: The epigenetic factors is basically, you're altering the expression of your genes without actually doing any sort of nucleotide change. There's no nucleotide change in the sequence of the DNA. It's just –.

Tim Ferriss: It's like putting my DNA –.

Rhonda Patrick: Yeah, on and off.

Tim Ferriss: The chassis is the same, but you're just slapping on God knows what.

Rhonda Patrick: Here's the thing that's really cool, that I recently – there's a paper – a series of papers that have been coming out over the last five years where they've been able to look at aging cells, and they've done it from – they started out with blood cells from people.

They've been identifying these methylation patterns as we age. It seems as though – which makes sense to me because all these little – inflammation, oxidative stress; all these factors are changing methylation patterns, and this is happening as we age. They're finding now that there's absolutely – there seems to be a systematic change in methylation groups. They've been able to now look at these methylation patterns from blood cells and people, and identify their age with 96 per cent accuracy, within four years. That's amazing to me. You're telling me you can look at someone's methylation pattern, and tell –. It's almost like measuring [inaudible].

Tim Ferriss: Now, is that – is it corresponding to their calendar age, or is it a biological age?

Rhonda Patrick: Great question. There are outliers, so it does correspond to their chronological age, for the most part, within four years, plus or minus.

There are outliers, and so now they're trying to figure out – some people look biologically much younger than their chronological age. Their methylation pattern looks younger.

Tim Ferriss: Young.

Rhonda Patrick: Right. Some people look biologically much older than the chronological age. Then, they started comparing males and females, and they found that males had their methylation patterns age like 4 per cent faster – looked 4 per cent older than the female counterpart. Then, they started looking at cancer cells, and cancer cells. They'd get cancer tissue from a person, and then they'd get a tissue that was non-cancerous from a person, and they found that their cancer cells looked like they were – their methylation patterns were aged like 40 per cent faster. Those cancer cells had accelerated their aging.

Tim Ferriss: Weird.

Rhonda Patrick: It's really kind of –.

Tim Ferriss: Cancer cells are so weird.

Rhonda Patrick: They are weird. They're extremely smart.

Tim Ferriss: Yeah.

Rhonda Patrick: They figured it out. Well, to a certain point because then they take over the host, and then they can't survive anymore. The thing that really gets me is it seems like there may be a genetic program for aging.

Tim Ferriss: Yeah.

Rhonda Patrick: Of course, people will say, "Well no, aging – it's a caustic damage that's happening". I think that's absolutely right. The more I think about it – I'm thinking about for example, on our stem cells, we have genes that are not expressed in our stem cells for a reason.

They're methylated. One certain gene called ARF is methylated. The reason –.

Tim Ferriss: ARF?

Rhonda Patrick: It's called ARF, yeah, like a dog. The reason why it's not expressed is because when it gets expressed, it causes senescence; it causes a cell to stop dividing. You don't your stem cells to stop doing that because you need your stem cells to replenish all the other cellular populations in that tissue.

Tim Ferriss: Yeah.

Rhonda Patrick: What they found is that this specific gene, when we're younger, we don't express it in our stem cells, and as we get older, we start to express this gene.

Tim Ferriss: I understand. The ARF gene.

Rhonda Patrick: The ARF gene in our stem cells. Then, our stem cells start to die off. What they found was that there's a de-methylize, so there's an enzyme that takes that methyl group off that gets activated by something called NF Kappa B, which is an inflammatory. It's activated with inflammation. Inflammation activates –.

Tim Ferriss: You hit a critical mass of inflammation at a certain age, and that de-methylates ARF?

Rhonda Patrick: I think what's happening – I think it's a quantic signal. This has to be tested. They've shown NF Kappa B activates this group of de-methylases called the Jumanji de-methylases.

Tim Ferriss: That's great.

Rhonda Patrick: Jumanji –.

Tim Ferriss: Isn't that a movie with Robin Williams?

Rhonda Patrick: Yeah.

Tim Ferriss: No, I'm only kidding.

Rhonda Patrick: These Jumanji de-methylases get activated, and pulls off these methyl groups. What I think is going on is there's a quantic signal with age, and I think it's inflammation that's activating these de-

methylases, and it's changing the genetic pattern. I think there's a connection.

Tim Ferriss: Do you think that could be reversible?

Rhonda Patrick: I do.

Tim Ferriss: Okay.

Rhonda Patrick: I really think we're figuring out – first of all, we're figuring out how to reprogram our stem cells; now, we can do that.

Tim Ferriss: Stem cells, let's talk about it. I've been interested, and I just feel like the clock is ticking, and now, I'm getting to a point where my stem cells are no longer as good as they used to be. The idea of banking stem cells, and harvesting stem cells from whether it's bone marrow or elsewhere, so that you can use them later to –.

Rhonda Patrick: That's one thing. Actually, I just recently banked some stem cells of my own.

Tim Ferriss: You did?

Rhonda Patrick: Yeah.

Tim Ferriss: How old are you? If you don't mind me asking.

Rhonda Patrick: Thanks for doing it publicly. I'm 35.

Tim Ferriss: Alright, so I'm 36, I think I've done a lot more damage to myself. You look a lot younger.

Rhonda Patrick: Thank you.

Tim Ferriss: You're welcome. I look exactly my age or older. I felt like – I guess, there has to be a benefit to doing it to compare to – what better time than now, I guess. It would've been better – I assume – if I had done it some time ago. How did you bank your stem cells?

Rhonda Patrick: There's a variety of different ways you can bank your stem cells: cord blood is one, which I didn't – that was up to my parents. They didn't do that when that happened, so I'm screwed there.

Tim Ferriss: I would've been really impressed if they pulled that off.

Rhonda Patrick: I would've been really impressed. I would've been really impressed.

Tim Ferriss: Out of their time.

Rhonda Patrick: Yeah. Wisdom teeth have – so I had two – I had impacted wisdom teeth.

Tim Ferriss: What does impacted mean?

Rhonda Patrick: When they're coming in crooked, and –.

Tim Ferriss: Right.

Rhonda Patrick: I had to have them removed. There's – I was doing this reading. I was like, "If I have to get these – removed, there's got to be some positive thing to it". I started reading, and I found out that there's stem – dental pulp stem cells in the teeth.

Tim Ferriss: I have all my stems – I have all my stem cells. I have all my wisdom teeth.

Rhonda Patrick: Do you?

Tim Ferriss: Yes.

Rhonda Patrick: Let me continue.

Tim Ferriss: Yeah.

Rhonda Patrick: There's dental pulp stem cells –.

Tim Ferriss: This is crazy.

Rhonda Patrick: I'm on top of it. Yeah. There's dental pulp stem cells in your wisdom teeth that can – because they're from a mesenchymal origin, which means they can form bone, they can form cartilage, and they can form teeth, eventually –.

They can also be coerced, if you have the right stromal cells, and stuff around to neuro-type populations. I found studies where they took human wisdom – so they extracted wisdom teeth from humans, took out the dental pulp stem cells, and then they did – mice, where they had spinal cord damage. They transplanted the dental pulp stem cells from the humans, into the spinal cords of these mice, along with a variety of growth factors, and –.

Tim Ferriss: Cocktail of –.

Rhonda Patrick: Yeah, the cocktail of things. It replaced their damaged motor neurons.

Tim Ferriss: That's crazy. From humans.

Rhonda Patrick: From humans.

Tim Ferriss: Is there no risk of host rejection in that type of thing?

Rhonda Patrick: Yeah, there is. They do a lot of things where they'll irradiate the bone marrow, and make the immune system so it doesn't respond to the foreign stuff. There's all these crazy things they do for that.

Tim Ferriss: Wow.

Rhonda Patrick: The other cool thing is that in Italy, they did the first clinical trial where they took the dental pulp stem cells from the extracted tooth, and they regenerated bone in the person. These studies that have been coming out, they're relatively new. I was like – I'm all about it. Then, I looked up companies that potentially could bank my teeth. I found a couple of companies that I thought were pretty trustworthy.

Tim Ferriss: That had a sign of intersection like, "Call now, banking…"

Rhonda Patrick: Most of them were like – they had already been doing the cord blood, so it's like the cord blood, and they've been doing it for like 40 years, and are also now doing the teeth. What they do is they'll send your oral surgeon a kit, which is essentially like a balanced saline solution. The oral surgeon will take out your wisdom teeth, and put it in this saline solution, send it back to them, and then they will cryopreserve the tooth in liquid nitrogen. They do a little bit of manipulation, but not much. They don't want to take out the stem cells until you actually need them.

It's good. I did all this reading on the procedure. "Let me talk to your cell biologist. I want to see what you're procedure is" and I figured out these guys are doing it right because I looked through the way it's supposed to be done. It was about $625.00 for the whole thing.

Tim Ferriss: That's nothing.

Rhonda Patrick: Yeah, and then, it's $125.00 a year. My husband got – he had to have one of his wisdom teeth removed, so he banked his. Primary teeth are a really great source. Kids have even more dental pulps themselves in their teeth that they just throw away.

Tim Ferriss: Wow. If your kids have wisdom teeth, parents, get yourselves a balanced saline solution so it won't –. What'd you say?

Rhonda Patrick: Stem Save is one of the companies, and then, there's National Dental Pulp Laboratory.

Tim Ferriss: Stem Save is more memorable. What was the other one?

Rhonda Patrick: National Pulp Dental Laboratory. I actually went with them just because I spoke to their sub-biologist, and went through the whole – I went through the whole – I'm sure they were irritated with me.

Tim Ferriss: Where are they based?

Rhonda Patrick: They're in New England area.

Tim Ferriss: It makes sense, doesn't it?

Rhonda Patrick: It does.

Tim Ferriss: Yeah. In Boston, somewhere?

Rhonda Patrick: Yeah. Cool stuff. Right?

Tim Ferriss: Yeah.

Rhonda Patrick: The other cool thing is the reprogramming thing, what I was talking about, where they can take your skin cells – they can even take –.

Tim Ferriss: What is the difference –? Sorry –.

Rhonda Patrick: Yeah.

Tim Ferriss: Between the modifier mesenchymal, and the modifier pluripotent? They seem to indicate the same thing. Are they different?

Rhonda Patrick: Mesenchymal is the part of this origin of a cell where it came from. Pluripotent means like, for example, if you have a bone marrow cell.

Tim Ferriss: Yeah.

Rhonda Patrick: Bone marrow can form like blood cells. It can form your red blood cells, white blood cells; they have this distinct limit to the type of cells they can form.

Tim Ferriss: I see.

Rhonda Patrick: A multi-potent means you can actually form multiple different types of cells, so you can take a multi-potent stem cell, and you can form heart cells, you can form liver cells, you can form blood cells.

Tim Ferriss: Got it.

Rhonda Patrick: Totipotent means – I'm a Wikipedia people –.

Tim Ferriss: Right.

Rhonda Patrick: Anyways, the cool thing is –.

Tim Ferriss: The mesenchymal.

Rhonda Patrick: The mesenchymal just means the type of tissue where it came from. The origin –.

Tim Ferriss: People use mesenchymal and pluripotent interchangeably, which is why I'm trying to figure –.

Rhonda Patrick: No.

Tim Ferriss: They do not.

Rhonda Patrick: No, I don't think they do.

Tim Ferriss: Okay.

Rhonda Patrick: Mesenchymal –.

Tim Ferriss: I'm not saying people don't know what they're talking about, though.

Rhonda Patrick: Oh, you're saying you've heard people?

Tim Ferriss: I've heard people use –.

Rhonda Patrick: No, that's not interchangeable.

Tim Ferriss: Alright, got it.

Rhonda Patrick: Yeah.

Tim Ferriss: Good to know.

Rhonda Patrick: Yeah, they're wrong.

Tim Ferriss: Got it.

Rhonda Patrick: You brought up a good question with the pluripotent, multipotent because actually, what's really cool now, is that we can take a cell, a skin cell that's terminally differentiated – fibroblast, they're not stem cells. People have figured out – actually, I think his name is Shinya Yamanaka.

Tim Ferriss: He sounds Japanese.

Rhonda Patrick: Japanese. He was in Kyoto, Japan when he first made this discovery, in 2006. It was a freaking game changer; a super goal.

Tim Ferriss: I'm guessing most [inaudible] outside the U.S. are far beyond us in research –.

Rhonda Patrick: The –.

Tim Ferriss: Legislative, and the [inaudible] that lead then, to your funding issues.

Rhonda Patrick: Right. Absolutely, in the work ethic, I think a lot of Japanese –.

Tim Ferriss: Yeah, they're hard workers.

Rhonda Patrick: They're hard workers. I knew one that had a cot, and would sleep in the lab.

Tim Ferriss: Yeah, well, they have – they have a term for death overwork there. "Kodoshi".

Rhonda Patrick: Do they?

Tim Ferriss: Yeah.

Rhonda Patrick: I'm not surprised.

Tim Ferriss: "Ko" is too much, "Do" is like working, and then "Shi" is death. "Shi" also means – "Yol" or "Shi" is four, which is why a lot of Japanese and Chinese are superstitious about the No. 4. If people ever wonder – they think that's weird, it's kind of like 13 for a lot of Western cultures. That's why they don't like the No. 4. Shinya Yama – what was it?

Rhonda Patrick: Yamanaka. I think. I hope I didn't –.

Tim Ferriss: It's alright. Yamanaka is like Jones. It's one of those common names.

Rhonda Patrick: Is it? I'm probably right.

Tim Ferriss: Yaman, Guchiyama – really, really common.

Rhonda Patrick: He figured out – he had looked at these patterns of gene expression, and stem cells, and he figured out by looking at a variety of different ones, which ones are really important for the stem cells that could be multi-potent, could form multiple tissues. What he found was that there's four different transcription factors; those genes that activate a variety of different genes. When I was talking about that FOXO was one of them.

Tim Ferriss: Yeah.

Rhonda Patrick: He found four of them that were required for a stem cell to be multi-potent. What he did was he took like fibroblast cells – first, he started out with mice, and then, they've done it in humans. The first study was in mice, where they took fibroblast cells.

Tim Ferriss: What is a fibroblast cell?

Rhonda Patrick: Skin.

Tim Ferriss: Got it.

Rhonda Patrick: Yeah.

Tim Ferriss: Blast with all those –.

Rhonda Patrick: Blast with those four – the way we can do it is we can put it in a virus, in a viral background, and the virus will then incorporate retrovirus –.

Tim Ferriss: That's the viral vector?

Rhonda Patrick: Yeah, exactly, it's a vector. Right. You can put –.

Tim Ferriss: That's how they do gene therapy.

Rhonda Patrick: Exactly. That's exactly what they're doing there.

Tim Ferriss: You've got to be careful with that stuff.

Rhonda Patrick: You do.

Well, in this case, they're using a retroviral background, which means that this virus –.

Tim Ferriss: Not virus – the retrovirus.

Rhonda Patrick: Yeah, it'll incorporate, it'll use it's RNA transcriptase to make DNA, and it'll incorporate to random places in the chromosomes, so it can be going anywhere. The potential harm in that is that you can actually get it in a place where it's like an oncogene, or it can cause cancer because you're screwing up stuff.

Tim Ferriss: You avoid that.

Rhonda Patrick: Avoid that. Instead, you make this freaking skin cell, a multi-potent stem cell, where now, they're able to make it turn into a neuron, and they can make it turn into a kidney cell, and they can make it turn into a liver cell.

Tim Ferriss: In which case you don't have to worry about banking your stem cells.

Rhonda Patrick: In which case, you don't have to worry about banking your stem cells because now, you can just take your skin cells. They've even been able to – they've done it from the urine – the renal fibroblast cells that you excrete in urine – those cells.

Tim Ferriss: Wow.

Rhonda Patrick: Urine, which is non-invasive. You pee, and they can isolate these cells, add these four transcription factors –.

Tim Ferriss: Wow. You can be like, "Too bad I drank like an alcoholic for 20 years, but that liver stress is – whatever.

Let me just grab my Mormon neighbor's pee, and make some stem cells".

Rhonda Patrick: We are heading there. We are heading there. Right now, we can do this, low efficiency. They are now working on finding – the problem is, is that some of these transcription factors, like semic, which is one of the ones that is required, is also cancer –.

Tim Ferriss: Right.

Rhonda Patrick: They found that if you're doing some mice, 20 per cent of the mice will get cancer. They're trying to figure out the subtleties –. My – I don't know, I could be totally just making – I like to make connections and come up with new possibilities. I'm thinking this new way they can do gene therapy with this targeted –. I didn't read the paper. It came out recently, this new technique that they can do. I think they use [inaudible] or something where they can actually target a gene, put an exact locus where it's supposed to be instead of randomly incorporating –.

Tim Ferriss: Instead of shotgunning it.

Rhonda Patrick: Exactly.

If I were working on that, I would take advantage of that system, and try to see if that – if you now use that system to deliver it to this fibroblast cell, getting it in the right spot.

Tim Ferriss: How far away do you think that is from consumer use? Of course, people could hold out – we were talking about autodriving – in a self-driving –.

Rhonda Patrick: Right.

Tim Ferriss: I think it's going to happen a lot faster than people expect, but it's still going to be a few years. In the meantime, you should learn how to drive. Would you recommend that people hold off for that, or do you think that banking stem cells is a good insurance policy?

Rhonda Patrick: I think banking yourselves now, if you – for example, if your kids are losing their teeth, or you've got a couple of wisdom teeth –.

Tim Ferriss: What if you don't have any wisdom teeth? What would your second choice be for banking?

Rhonda Patrick: Obviously, if you're a female, and you're going to have a child, something that's really cool that came out – I don't know, four or five years ago, I think, where they found the placenta – the placenta is like a really rich source of multi-potent stem cells.

I haven't actually done any investigating yet, on whether or not there's companies banking that. I would be shocked if there weren't.

Tim Ferriss: Yeah.

Rhonda Patrick: That's another really good source. Cord blood, stem cells, and teeth. Males, teeth –.

Tim Ferriss: Males are just –.

Rhonda Patrick: I think – well, the bone marrow –.

Tim Ferriss: A dearth of opportunities.

Rhonda Patrick: Invasive, and –.

Tim Ferriss: Yeah. There's a buddy of mine, also, a fascinating guy you might enjoy meeting at some point. Maybe you've met him, Daniel Kraft. Have you met –?

Rhonda Patrick: No.

Tim Ferriss: He's an MD, very fascinating guy.

Rhonda Patrick: He is in the Bay area?

Tim Ferriss: Yeah, he's in the Bay area. I got to know him through Singularity University. I was an advising faculty member at NASA Ames, where they were running Singularity University. I think they still are. We got to know each other because he develops, process in technology for bone marrow harvesting. I've been meaning to reach out to him.

Rhonda Patrick: Right.

Tim Ferriss: Invasive is kind of an understatement.

Rhonda Patrick: I don't think it's very – I think it's painful, basically.

Tim Ferriss: Yeah, I think there are less painful ways to do it. Given all this crap I've done to myself, I'm sure it would be just another –.

Rhonda Patrick: Although, getting your teeth yanked out –.

Tim Ferriss: Not exactly a walk in the park, either.

Rhonda Patrick: It wasn't painful, it like psychologically screwed me up because I was like twilight. I was calm, but –.

Tim Ferriss: Twilight, like the werewolf Twilight?

Rhonda Patrick: The twilight like – you know –. I thought they were going to put me under. I was like, "Yeah, just put me under".

Tim Ferriss: They didn't? They were just like, "No, just hold still".

Rhonda Patrick: They put me – it was like I was like relaxed and calm.

Tim Ferriss: They're like, "Here, have a martini. Ready?"

Rhonda Patrick: Yeah, I'm still awake. This is really – pulling your teeth –. It wasn't pleasant, but I got my teeth cryopreserved, they're in New England now in liquid nitrogen.

Tim Ferriss: Besides the dental pulp stem cell storage, what other types of things are you doing to potentially extend a healthful life span? What are the other – kind of low hanging – what other things are you thinking of?

Rhonda Patrick: Well, long hanging is what we started this conversation with, micronutrients.

Tim Ferriss: Yes, fix your diet.

Rhonda Patrick: I really – and not just yet – really focus on these micronutrients. You've got hundreds and hundreds of enzymes in your body that require these minerals and vitamins as cofactors to function, Do you know what? You're not going to notice these things not functioning right. You're not going to notice it when you look in the mirror. Taking care of those micronutrient inadequacies really is the low hanging fruit. It's work, I guess, but it's a lot easier than –.

Tim Ferriss: It's also routine, though. It's a habit that you get into.

Rhonda Patrick: Right.

Tim Ferriss: Just like anything else.

Rhonda Patrick: That's why the Vitamix, for me, it makes it so much easier because while I do also eat salads, and I also cook my vegetables, too, getting that broad spectrum, I think there's micronutrients in there we probably haven't even discovered.

Tim Ferriss: I'm sure.

Rhonda Patrick: Absolutely. I am too. I'm convinced.

Tim Ferriss: Definitely.

Rhonda Patrick: Not only that, biology is so complex. There is nothing more complex than biology. No technology will ever, ever compare. We don't even understand how everything is working. Making sure –.

Tim Ferriss: I would imagine 20 years from now, we're going to look back at the state of the art today, and it's going to look like leeches in bloodletting in [inaudible]. It's going to be like holy – I can't believe we used to do that.

Rhonda Patrick: I think the stem cell reprogramming is –.

Tim Ferriss: Huge.

Rhonda Patrick: It's huge like, I'm shocked I don't hear more people talking about it. In the next ten years –.

Tim Ferriss: I think there's such an unwanted stigma associated with stem cells because of the religious furor over embryonic stem cell use.

Rhonda Patrick: Maybe you're right.

Tim Ferriss: It's just – completely through the scientific research, sort of to the side of the road, in the last administration –. It's really unfortunate that mass misinterpretation of the options led to this lack of funding. Your day job is researcher. Right?

Rhonda Patrick: Right.

Tim Ferriss: You're working within institutions, and it's like if something politically falls out of favor, and people are – and other people are interested in getting tenure, or whatever the – they might be, or

remaining on the board of – of the general "A", "B', and "C' funding is just not going to –.

Rhonda Patrick: It's not going to appear.

Tim Ferriss: It's not going to happen. It doesn't materialize –.

Rhonda Patrick: Exactly.

Tim Ferriss: To your point, though, I think that we were chatting about this before we started how when it comes to diet, there's such a focus on what not to eat. Right? "Don't do this. Don't do this. Don't do this", and that's the extent of the guidelines for a lot of folks. Now, I do think there's a benefit there like, "Don't eat refined carbohydrates". Fantastic. The absence of bad things does not guarantee the presence of necessary things.

Rhonda Patrick: It doesn't.

Tim Ferriss: What I try to do very often with people who are 200 pounds overweight, 100 pounds overweight, or whatever it might be.

I've met many, many readers who've now lost over 150, or 200 pounds; amazing amounts of weight. I've personally met at least a dozen. There are many, many others. The way that I have people like that start – because, it's too overwhelming to give them 100 rules, it's too restrictive and unrealistic given their current set of behaviors to say, "Change these – you can no longer do these 12 things". I'll say, "Alright, we're going to start with what to add first.

You need 30 grams of protein within 30 minutes of waking up. You need a fist-sized serving of green on any plate that you eat off of. That's it. Those are the two things you're going to do", or like, "Start drinking water. How about that? No more drinking calories". It was like one tiny thing with the additive stuff would be – it's so beneficial. So the way that I generally interact with those folks is I'll say, "You can eat – you have to eat the following things.

After that, if you're still hungry – you can have like 15 liters of ice cream. I don't care. But you have to get these – cover these bare necessities, these bases first". I think that's such a – for whatever reason, an uncommon approach in the U.S., where it's usually sort of a "No smoking" sign that gets placed on a handful of things, and that's the extent of the guidance.

Rhonda Patrick: It makes sense. Your body is designed – is very resilient. We can deal with stress. We have a whole host of enzymes in our body, and proteins that deal with crap, but those things need cofactors to do that. It's like you said – I wouldn't say 15 gallons of ice cream, but the point is –.

Tim Ferriss: Liters – liters. Let's not go crazy.

Rhonda Patrick: Yeah. Give your body what it needs.

Tim Ferriss: Well, here's the thing, I can say that understanding fully well that they will not eat the 15 liters of ice cream.

If they're getting enough – if they're getting the enzymes, if they're consuming fibrous greens – people are constantly amazed. I'm just like, "Look, you don't have to eat…" this is part of the reason why, for instance, I'm a proponent often times, of legumes and beans, and whatnot – somewhat hilariously controversial among the paleo community – because, they help to control glycemic response, and the fiber content, and the duration of digestion prevents overeating.

Rhonda Patrick: I personally like consuming legumes, and I love lentils, I love eating –.

Tim Ferriss: Lentils are the bomb.

Rhonda Patrick: Yes because, these fibrous – the fiber in them gets broken down into short chain fatty acids, and this is great for your gut. Keeping your gut happy is so important in so many ways. That would be like a whole other topic –.

Tim Ferriss: Gut health.

Rhonda Patrick: Pretty much, yeah. It's kind of weird how the paleo community was against that. I don't know who started that meme –.

Tim Ferriss: Well, it comes down to a lot of the stuff that we were talking about, the anti-nutrients.

Rhonda Patrick: Right.

Tim Ferriss: It's related to that.

Rhonda Patrick: The lectins, but lectins get heated and activated.

Tim Ferriss: Well, that's –.

Rhonda Patrick: That's awesome.

Tim Ferriss: This is a whole separate story. The lectins and saponins in all of this, in my experience, typically get either inactivated or removed with conventional preparation, or cooking.

Rhonda Patrick: The thing is – I think it comes back to this focusing on – not focusing on what not to eat, not focusing on –. Plants have a whole host of genes in them, and proteins in them that are – insecticides, and pesticides that are being produced to keep bugs away themselves, without us putting any. It's like you can focus on every little bad thing that's in something. There is – you'll find it in everything – in everything.

Tim Ferriss: Right.

Rhonda Patrick: I think a better approach, rather than focusing on these little minute possible bad things that may or may not do something, is focusing on what our body needs to function properly indefinitely. You need to make sure that you are getting the things that you need for your body to deal with stress. You need to make sure that you're getting the things you need to make sure your body can deal with DNA damage, that you can deal with all the crap of normal living metabolism, immune function. These things produce inflammatory molecules, also reactive nitrogen species, or [inaudible] species, just from normal living.

Tim Ferriss: Yeah, agreed. I'm getting – you're making me gems for a – Jake Shields green drink. That is a local MMA fighter, and there's a place called Sidewalk Café down in the mission that serves freshly blended greens.

Rhonda Patrick: Awesome.

Tim Ferriss: I think that is probably going to be my next stop. We can talk about tons of things for hours, and hours, and hours. I'm sure we'll do a Round 2.

In the meantime, obviously, during the days, you're still working in the labs, but where can people find more about you, and follow you online?

Rhonda Patrick: They can find me at foundmyfitness.com. That is my Twitter name as well, FoundMyFitness, and my Facebook name, and that's the name of my platform where I break this all down for people.

Tim Ferriss: Cool. Awesome. This is super fun stuff; very important stuff. To be continued… Thanks very much for making the time.

Rhonda Patrick: Awesome. It was a blast.

Tim Ferriss: Yeah, it was a nice chat. Thank you.

Rhonda Patrick: Cool.