How To Boost Brain Energy & Stop MS Progression Transcript

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Introduction and Guest Credentials

Welcome to another episode of the Missing Autoimmune Summit. I'm Doctor Charles, your host, and we're going to be interviewing, Doctor David Perlmutter, who is a board certified neurologist, a fellow in the American College of Neurology and certified in integrative medicine.

He is a six time New York Times bestselling author. He serves on the board of directors and is a fellow of the American College of Nutrition, and currently serves as the Director of Neuroscience Research at Bryan Therapeutics.

He received his M. D. degree from the University of Miami School of Medicine, and he received the Leonard G. Rowntree Research Award. He's a member of the editorial board for the Journal of Alzheimer's Disease, and has published extensively in peer reviewed scientific journals, including the Archives of Neurology, neurosurgery, and the Journal of Applied Nutrition.

In addition, he is a frequent lecturer at symposia sponsored by the institutions such as the world Bank, the IMF, Columbia University, Scripps Institute, New York University, Harvard University, and serves as an associate professor at the University of Miami.

His books have been published in 32 languages and include the number one New York Times bestseller, Green Brain The Surprising Truth About Wheat, Carbs and Sugar.

With over 1 million copies in print. Other. The New York Times best source include Brain Maker, The Grain Brain Cookbook, The Grain Brain, Whole Life Plan, brainwash, co-written with David Perlmutter, MD, he's editor of The Microbiome and the brain, authored by top experts in the field.

Published in December 2019 by the CRC press, his latest New York Times bestselling book, Drop Acid, focuses on the pivotal role of uric acid in metabolic diseases and was published in February of 2022.

Welcome, David. Let's get right to it. So, David, what I'd like to do is first begin with what are the most interesting things that you're seeing right now as it relates to people with Hamas?

What I'm seeing right now, is, is a real shift in, emphasis. You know, for so long we have looked at, the immune system being activated, unusually, in an autoimmune fashion, activating various cells, in the brain.

That would then, lead to destabilization of myelin. And that was sort of the cornerstone of what was looked at in multiple sclerosis. I mean, you know, we've been doing this work for an awful long time, recognizing that primarily this is an immune issue.

And early in, in my career, you know, our approaches were just to suppress the entire immune system, just wipe it out. And and then we went from immunosuppression to this notion of immuno modulating.

And there were trying to be quite, specific about how we tinkered with the immune system, both the T cells in the B cells and where the B cells would go or not.

Microglia and the New View of MS

And, you know, I think more recently, in fact, quite recently, we've begun to focus on a different population of immune cells in the brain is playing a very, very important role.

And these are our immune cells that don't get a lot of attention in the multiple sclerosis world, and that is the micro

glial cells. We're beginning to recognize that really upstream of the significant immune dysregulation that goes on within the brain, are changes in the activity of a unique population of not the adaptive immune system, but the innate immune system, in this case, the micro glial cells within the brain.

And with our focus on these cells and, you know, sort of taking us away from the notion of, activation and overactivity of the adaptive immune system, I think it's really, a breath of fresh air because it's really giving us a lot of new territory to explore.

And I think it also tends to allow us to understand how energy based approaches to brain functionality, can be interpreted through the lens of Ms.. To understand what may be going on aside from our, you know, narrow minded.

If I may say, focus on the adaptive immune cells, the T and B cells. So as we look at now, these interesting cells in the brain, the micro glial cells, we look at them in terms of their metabolic function, determining how they act.

We know that these cells and micro glial cells are very supportive for the brain. They're very supportive for the individual neuron. They nurture the neurons. They nurture the synapses.

They nurture the myelin. They nurture the blood brain barrier. They foster the growth of new brain cells, neurogenesis. They foster the growth of new synapses.

And who wouldn't want that? But the very same micro glial cell can turn its back on us, can become the evil twin. And as such, can foster the degeneration of brain cells, the loss of brain cell function, the loss of synapses, the the decline in the, the, patency of the blood brain barrier.

So what lights my fire right now? To answer the question is the focus on these micro glial cells that have taken on a real, spotlight in terms of Ms..

Research and, the creation of new approaches to regulating whether these micro glial cells are in their M2 configuration, where they're nurturing us, loving our brain cells, or they're they're in their M1 phenotype, in which case they are absolutely threatening for the brain.

And I think when we focus on these micro glial cells, we begin to understand, and get a really good sense as to this notion of Ms. is more than just the number of plaques on an MRI scan.

And let me unpack that for just a moment. And this is a long winded answer to your question, but for so very long, the the standard by which Ms. interventions like pharmaceutical interventions have been judged was basically serial MRI scans and counting the number of plaques.

And you know better than anyone that patients can decline. And in fact do decline even when they're aren't developing more and more plaques within the brain.

You know, it's a similar situation with the targeting of beta amyloid and Alzheimer's disease. We know that plenty of people have no amyloid and yet have Alzheimer's.

And plenty of people will have a head of, brain full of beta amyloid in her cognitively intact. And I think that in Ms. research, clearly, so much focus has been on these plaques on the number of plaques in the brain.

Clearly, they're not normal, but we see instances where people don't change the number of plaques that they have in their brains and yet continue to decline in various aspects of their functionality, like motor functionality, for example.

So we know that there's a much bigger issue going on in the brain. And and clearly what's happening is that there's a change in the brain's metabolism.

There's a change overall in the brain's, mitochondrial function, the brain's energetics. And the reason I say that you should know this more than anybody, and you do, because it really then helps us understand why doctor walls diet, which targets mitochondrial function, has been so effective in helping people with Ms..

And you know, so much gratitude from me to you for for getting the word out about the fact that when we target mitochondrial function, when we target brain energetics, it allows patients to do better because we are targeting brain metabolism.

Now we know I'm going to close the circle that when we target brain metabolism, we are able to shift those micro glial cells away from being threatening to being supportive.

And that's very exciting because there's a lot of work being done, in Ms. research, indicating that this is really upstream of what is going on immunologically that makes a good brain go bad.

So with this understanding of the role of these micro glial cells, we understand why the ketogenic diet, for example, is so effective because it's changing the metabolism not just of the neuron, but what controls the fate of the of the neuron, which in this case, are the micro glial cells.

You know, for those listeners, when we're talking about metabolism, this this makes me think about, the, the growing body of research, of the harm of the ultra processed foods, that is, the foods with high and added sugars, the liquid beverages that we drink and are marketed heavily to our children, in the sugar sweetened, white flour based cereals, breads, pastas, that so many children and young and young people are eating like 70% of the calories.

Can you talk to us a little bit about what that diet, that kind of diet does to our microglia? Certainly. Well, we're in a in a time now that we're embracing, an understanding of something called immuno metabolism and what immuno metabolism is all about is the fact that our metabolic health, which used to be the province, I guess, of the endocrinologist, that our metabolic health is, having a significant effect in terms of what's going on in the brain through the immunological part, the connection them with metabolism and immune, immuno immunity in the brain.

Ultra-Processed Foods and Brain Metabolism

And we recognize that a central player in that are these micro glial cells. Those are the brains innate. They make up the brain's innate immune system and can, you know, are making up around 10% of the cells within the brain.

So much of the research has been not just in mice, but in all neurodegenerative conditions, has been on the neuron focusing on the neuron. Is the neuron going to become de myelinated?

In other words, will the where there is there a threat to the myelin as we would see in demyelinating disease like like Ms.. You know that's interesting.

But it turns out that metabolism in the body is reflected in the metabolism of the brain and the metabolism in the body. Controlling metabolism in the brain ultimately manifests as changes in the function of the immune system, imbalances the immune system in the brain.

So where do these metabolic threats come from? And as you so correctly identified, the big inroad to threatening our metabolism are the foods that we eat.

And as you correctly identified, 70% of the caloric intake in the American adult and similar number, in children comes from these ultra processed read, metabolism threatening foods.

Think about it. These are foods that are so processed that they immediately raise our blood sugars dramatically. And as a response, our pancreas tries to help us and pumps out as much insulin as possible and ultimately can't do it anymore.

And the insulin that it pumps out is less and less effective. We become insulin resistant. And guess what? That's a central issue in what makes a good brain go bad.

The fact that insulin is no longer doing its job. It's not that there's not enough glucose around. For example, in the Alzheimer's brain, there's actually more glucose then in comparison to controls.

But the brain is less able to utilize that glucose because it is metabolically compromised. So all the cells of the brain feel the pinch, including these micro glial cells.

When the micro glial cells are threatened in terms of their ability to use glucose, their mitochondria don't work as well as they should. Then they shift, they turn their backs, and they become, as I mentioned earlier, the evil twin.

So the question then becomes, well, in confrontation to this incredibly threatening dietary, choice that people have adopted globally. We used to call it the standard American diet.

Then it was the Western diet. Now it's let's call it like it is. It's the global diet. What we can do to challenge that is say, you know, this is a diet that threatens brain energetics.

This is a diet that is destabilizing to the mitochondria within. Yes, the neuron, but the mitochondria within the brain's immune cells as well. What can we do to fix it?

You've been talking about the value of ketogenic diet for an awful long time, and that is job one is to reestablish mitochondrial health. When we do that, it becomes a powerful therapeutic tool for multiple sclerosis, for Parkinson's, for Alzheimer's, for autism, for a lot of these issues that have, as at their core, mitochondrial dysfunction, I've been calling these diseases and others acquired mitochondrial these because they're basically mitochondrial dysfunction brought on in this case by what you mentioned, lifestyle choices.

But there are a lot of things that can threaten mitochondrial function, like, for example, Covid infection, powerful threat to the mitochondria, Lyme exposure, mold, head trauma, various things, inflammation.

As a matter of fact, anywhere in the body, can amplify the inflammation in the brain, which threatens mitochondrial function in these cells, the micro glial cells.

And it's another mechanism by which these ultra processed foods ultimately threaten the brain. How so? If inflammation anywhere in the body can threaten the brain, how might the ultra processed food threaten inflammation?

We talked about raising blood glucose and making our brains insulin resistant. The other thing that these types of foods do, not just because of how they threaten us with higher levels of glucose, but by and large, they are made with oils that are also pro-inflammatory.

But what both of these pathways do is they threaten the diversity and the function of the organisms living within the gut. What does that do? Well, a lot of things.

But one thing that happens is the gut becomes more permeable, and when the gut lining becomes more permeable, then we we challenge our immune systems, with, through, various types of pathways, including how these 17 cells that line the gut are challenged and upregulated to ultimately produce more inflammatory chemicals that make their way to the brain and threaten the brain's immune system.

So, it's a clear and present danger in these foods that are so pervasive, through multiple channels are threatening the brain and altering immune function within the brain.

Now, everyone who's listening, to this interview, keep in mind the reason we are over consuming the added sugars, the white flour based products, is that the food industry, which was, largely purchased by the tobacco industry, hired food scientist to design the food to be hyper palatable, extremely tasty, to create cravings, and, symptoms.

If we tried to decrease our consumption of these foods. And so if you're thinking like, well, you know, I've tried, you know, implementing the walls diet, but, you know, I got headaches, I felt terrible, I just I just couldn't do it.

And I went back to my, previous diet. So, David, do you have any tips for people, as they're like, okay, I really should work on having fewer carbs, and I should think about that ketogenic stuff.

But every time I try, it's a big struggle. I would say, you know, your comments about, the food industry, the whole notion of food industry is interesting, but, our, you know, are extremely important, valid.

I think the main reason that people eat these foods is because we like them. Everybody likes them because they're sweet, salty, and they have lots of fat.

And that those taste are hardwired into our, brain stems such that we seek those foods out. Because those are the foods that traditionally, during our hunter gatherer times, were the foods that allowed us to survive.

So, you know, we were selected for having that desire in our brain stems. That's why they're so hard to avoid. You know, I've often asked the lecture during my lectures, how many people here think you have a sweet tooth?

Don't raise your hand because the answer is everyone. We all love sweet because sweet tells our physiology that that food is safe, and that that food is going to cause us to make more fat so we can survive during times of food.

Caloric scarcity. Call it what it is. So what are the tips then? The tips are to realize that there are two ways that we make our decisions. The child in the room or the adults in the room.

The child in the room says, I want sweet, I want salt, I want fat, I want it right now. I want a big bag of that. I'm going to park myself in front of the TV and stay up late.

Ketogenic Diet Tips and Early Challenges

The adult in the room says, I just heard a podcast and I've heard about this stuff for quite some time, that these ultra processed foods are not good for your brain.

They're not good for your heart. Your immune system, your bones, your risk for cancer, you risk for cardiovascular disease, you name it. And therefore if I cut back or stop eating them, that's going to be a good thing for my health in the long run.

The real question comes down to belief. Do people believe the media that says, you know, eat these foods? They're good. They're enriched with vitamins.

You should be eating your bowl of cereal each morning. Or do they believe what people like Doctor Terry Walls are messaging? And that is if these foods are basically going to kill you, they're going to, aggressively challenge your immune system.

They're related to risk for neurodegenerative conditions like Alzheimer's and the whole list that I just enumerated. And it's a question of belief. You know, we are led to believe that we can live our lives however we choose.

And come what may, they'll be a drug to fix our Alzheimer's or miss what have you. Let's be clear we don't have any drug right now to treat metabolic issues like diabetes or hypertension.

None whatsoever. That's going to raise eyebrows because people say, well, I'm taking medicine for my blood pressure and my diabetes. No, you're taking medicines to treat the symptoms of your diabetes, the elevated blood sugar.

Stop the medicine. And a couple days later, guess what? You still have your diabetes because your blood sugar is going to go through the roof. So you're treating the smoke and ignoring the fire.

But we know that we can indeed reverse diabetes and get people off of medication. Doctor Sarah Hallberg made that very clear that who knew a ketogenic diet?

Reestablishes immuno metabolic health. And as such, that's treatment for the disease, not just treating the symptoms of the disease. And so it is, with neurodegenerative conditions as well.

We don't have any meaningful treatment for Alzheimer's. We look at the drugs that, are listed in the journals that you and I read, and it's pretty much for symptom management, isn't it?

There are drugs now release that target beta amyloid that can slow the decline in Alzheimer's. But you know what? At 15 months, Alzheimer's patients taking the drugs and those on the placebo are falling off a cliff.

They basically don't work, and they are riddled with potential side effects that can be life threatening. The the approach to Ms. is quite similar. There are disease modifying treatments that are out there, but by and large, we need to focus on what is upstream of the immune regulation problems.

And what it is, clearly is the energetics in the brain. The Mito control function. It's why we look at things that improve mitochondrial function, like time restricted eating and the ketogenic diet and, enhancing, mitochondrial biogenesis, the growth of new mitochondria.

Why things like coenzyme Q10 and hyperbaric oxygen really have roles to play here, why people are looking at drugs like metformin in conjunction with alpha lipoic acid because they're targeting mitochondrial function.

That's where the money is. That's where the relief comes, and that's where reestablishing brain health will be realized. You know, again, for those of you who are sort of struggling with, you know, how do I begin making, diet changes in my experience?

And I'm going to ask you to comment about yours. We've seen this in my clinical practice, in our clinical trials, that the first two weeks are the most difficult, where we have, a lot of craving, you know, having people take some B vitamins in a multivitamin can be very helpful.

Family support. Peer support can be very helpful. We acknowledge that you're going to have craving. You may have headaches. Typically, we see it markedly reduced by the end of the first week.

Reduces further by the second week. It's very rare that that's still going on at the fourth week. Very, very rare. What are you seeing? David? Well, same.

And I agree with you that, you know, that's the time those first couple of weeks where people need tools. And, you know, I find that a very effective tool is to ask individuals to look themselves in the face, in the mirror and, and repeat something I often use, I'm doing this for my health, and it really reinforces the fact that we're connected here, that I, you know, I'm not distant from my health and myself.

And, you know, the notion that, you're going to get through it, I think, is really very important to keep encouraging people. So, you know, I think that also you mentioned B vitamins, very important.

I also feel that one of the issues that really missed a lot in people going on keto, and I think, you know, we sort of like induce to Genesis at the, at the part of the, first part of the program, is fiber, dietary fiber.

And I think people get mixed messages. Well, that's a carbohydrate meant was a cup my carbs? No. We really want non digestible fiber. It's not going to be a dietary carb that's going to raise your, blood glucose.

And I think, you know, encouraging dietary fiber is helpful because it leads to feeling fullness. It allows people to really, jumpstart their microbiome and also gives them a sense of, you know, that they're nutritionally more complete y because they're having better bowel movements, because a lot of people jump on a full ketogenic diet in the first thing you know, this is, you know, I haven't pooped for a couple of days.

So I think dietary fiber turns out to be healthier. And, you know, you know, very, very important. I do, I've learned to caution my patients that when you go into ketosis, you may lose more, sodium, potassium and magnesium.

And so if you find that you're having more muscle cramps, then, taking more sodium, potassium, and magnesium salts. And so I have people use light salt and we talk about, I particularly like magnesium three and eight.

Sometimes they use topical magnesium oils, to massage into the legs. What are your strategies, David, to deal with the muscles a little bit. I do it, for everybody, on the front end.

I don't wait for there to be manifestations of, you know, electrolyte issues. Muscle cramp. Magnesium would be, you know, probably constipation and headache and fatigue.

So I, I tell everybody, you know, a good, complete magnesium supplement, I use one called element. Element, and that's become very popular and just put it in a glass of water.

So, respectfully, I'm a bit more preemptive as to that because I think it's really it's very, very common. In fact, element was actually created. And there are others out there created exactly for this application.

CGMs, Supplements, and Nrf2 Activation

That is people getting into ketosis. I also find that one thing that encourages people is to wear a continuous glucose monitor. Why? Because when they start out, prior to engaging, ketogenic diet, you know, the blood sugar make, you know, it may need some work.

And I think, that is one of the metrics that is really encouraging for people. Gosh, you know, I started out I was getting my fasting, blood sugar was whatever it was, 118, you know, and that seemed like it was okay.

We know that's not okay. And I've been spiking during the day with meals. All of a sudden your blood sugars come under much better control. That's a pat on the back.

And I think, you know, any pat on the back during induction in first couple of weeks is good. And even if it continues. So I'm very bullish on CGM continuous glucose monitors as a way of really keeping people involved.

Yeah, I think that is a super helpful tool now. So our listeners who are thinking like, okay, that sounds like something I'd like to do, how could our listeners get a continuous glucose monitor?

Well, here's the good news. And that is, until quite recently, that had to be done, through a prescription from your doctor. Nowadays, you can get them there various places online.

There's a place called Levels Health. I'm on their scientific advisory board. And they actually have an app. You can go to Levels Health and get a CGM.

I don't think they're very expensive. The good news is you can get it without a prescription anyway. But if you're pre-diabetic or diabetic, then by all means, run that one through your doctor.

A doctor can write a prescription. You can just go to your local pharmacy and pick it up. And these, CGM come with, instructions that tell you how to download an app.

Like Dexcom G6. D7 is what I'm using right now that comes with an app. And you download the app and immediately you know your blood glucose by looking at your smartphone.

So, you know, and this has become very, very commonplace. There's actually a ring now that is reported to be able to show your blood sugar. I want to caution people that to my understanding, what I've read about it is it's not very accurate.

However, you know, these, continuous glucose monitors like the Dick's Dexcom are exceedingly accurate because, you know, they were developed for people with type one diabetes who were taking insulin.

And people are adjusting their insulin dosages based upon the readings from these CGM. So you can be sure they're very, very accurate. Yeah. So I've used CGM as well.

And it's certainly, was remarkably, useful and very, very interesting. So, you know, again, thinking about, the, the excitement that we, that you and I have for the microglia, what I find super interesting when I talk to my conventional neurology colleagues, they're still sort of baffled, like, well, how how can we calm down the microglia?

We really need some drugs that can target microglia. And they have them. They absolutely have no tech. De Farah is one of the most commonly prescribed drugs for a multiple sclerosis.

Is it, was it approved in March of 2013? So, you know, that's a long time ago. And this is a drug that works via activation of a specific, pathway called the Nrf2 pathway.

And what does that do in Nrf2 activation? Ultimately makes it's, through what's called the keep protein makes its way into the nucleus of the cell and then allows the production of chemicals that do many things, improve mitochondrial function, reduce inflammation, and increase the body's ability to deal with reactive oxygen species or, more broadly, what are called free radicals.

So this drug tech to Fara is actually very much targeting brain energetics and very much targeting the reversion of these micro glial cells from being the evil twin back to being the healthy twin, the helpful twin, the nurturing twin.

So, you know, that's been around a long time. And, you know, we've been interested in activating this Nrf2 pathway for a lot longer than just since tech.

The Pharah came on the market. And we've been talking about this for for decades, because we know that there are a lot of natural ways that we activate this Nrf2 pathway.

We know that cruciferous vegetables, for example, and even more importantly, something called sulforaphane, which is found in cruciferous vegetables, that's available as a nutritional supplement at the health food store.

But, you know, I think the a better way of getting sulforaphane into your body is to buy broccoli sprouts and chew them. You know, chew a couple of tablespoons of broccoli sprouts every day.

Broccoli sprouts are rich in something called glucose. And why is that important? Because when we chew broccoli sprouts, we break open the cells and it releases releases.

Maybe it's too technical, but who knows? Okay, this is an enzyme called My Raisins, and that converts this glucose into sulforaphane. And what we don't convert into sulforaphane can be converted to sulforaphane by virtue of our gut bacteria.

Who knew this? Sulforaphane is nature's Nrf2 activator. It acts in the exact same well way as tech to Fara. So that's a really important tip. I believe that, you know, things like the cruciferous vegetables and the sprouts of them far more concentrated are wonderful natural ways of utilizing this pathway that is used for a pharmaceutical drug to do.

Exactly. To respond to your question, to activate brain energetics and to increase mitochondrial functionality and to reprogram these microglia back to being supportive, within our brains.

And it probably has fewer side effects. Who knew? But I will add to the list of natural Nrf2 activators. Turmeric, chocolate. And, certainly coffee. Coffee is absolutely on the list.

So, you know, just things to think about there. There are a variety of, natural products available and that would be

helpful for that are nature's Nrf2 activators.

How about green tea matcha green tea I think EGCg as well. Yeah. And interestingly, there's a real big, push these days to, to look at pharmaceutical ways of reverting the microglia from M1 being the damaging, threatening twin back to the M2 configuration where they're nurturing, recognizing these is, as in right now happening, how important that is in terms of the overriding control over the immune system within the brain, which is really, you know, been the central focus of mass therapy for as long as we've really known about the disease.

And there's something called a Bruton's. BTK, Bruton's tyrosine kinase inhibitors. There are drugs that are bt, K inhibitors that specifically act to revert these micro glitches back to being, the helpful, type to microglia.

But we do know that, these drugs that also target the Nrf2 pathway could do this, that there are a variety of natural products that can revert these microglia back.

So I think it's really something that we should be thinking about because these, these products actually do exist. We know that, curcumin can do it. Resveratrol can do it.

Sulforaphane can do it again. Another, push for so, so for fane, quercetin spice of 10 or 15%. And I think anybody's really settled on the, the pronunciation of Sisseton.

Natural and Pharmaceutical Ways to Calm Microglia

But that's also being talked about, interestingly, in the context of being a way to rid our bodies of senescent cells or cells that are, that are alive, but are not really functioning and are kind of threatening to neighboring cells as well.

So, again, EKGs, you mentioned that before. Green tea, is another one of nature's ways of acting like this, BTK inhibitor, which is the central, a central focus of multiple sclerosis research right now.

In fact, several drugs have been developed and have entered phase two clinical trial from the pharmaceutical perspective. But, unfortunately, it seems that these pharmaceutical BTK inhibitors, of which there are natural analogs, the pharmaceutical ones have been, causing significant liver disease and therefore haven't made their way to the market, which is, you know, certainly a good thing.

Yeah. I don't think any of these are commercially available at present. That's correct. Yeah. Whereas natural ways safe ways of inhibiting, a Bruton's a tyrosine kinase enzyme.

Not that that's going to be in the quest, but here it's just, my. Yeah. Can we run through that list again for our listeners or their variety? We know that EGCg, which is why we drink green tea, is one, resveratrol.

Sulforaphane, that's for sure. So there are a variety of them out there. But, turmeric also acts in that way. By 10 or 15. Again, I don't know how you pronounce it, but that's certainly on the list.

And, quercetin a really important supplement. Not just because of how it acts, in this regard, but it also acts as an Nrf2 activator. And quercetin also acts to reduce something called uric acid.

And uric acid is important because it threatens mitochondrial function directly when it's elevated. So that's yet another, call to action in terms of, wanting to be wanting to be involved in lifestyle choices, in this case, nutritional supplements that are good for the mitochondria.

Now, again, research being done with drugs, that are approved for other treatments like for diabetes, metformin and is another way to target the mitochondria and may actually, as such, help revert these bad these, M1 micro glial cells or the, the evil twin back to being supportive of the brain.

So for a moment, let me just digress, because downstream of the microglia, when they're functioning well is support for astrocytes, neurons, and also a cell called the oligodendrocyte.

And that is something very important as we talk about multiple sclerosis, because it's the oligodendrocyte that is involved in the production and maintenance of the myelin.

We're talking about a deep myelin native disease. We certainly want to be, doing everything we can to foster the health and function of those cells, the Alagoas.

Okay. Well, David. Well, I could talk, for hours. We should wrap this up. So could you tell our listeners how they can find you? I am available at, Dr.

perlmutter.com doctor perlmutter.com. And let me encourage your viewers to go there because, I write, a lot, and we post, my blogs there. You can sign up for my email.

Put your email in, sign up for our newsletter. But we've also created a really robust, searchable database for people to look at. What are what is peer reviewed science, saying about not just the development of drugs, but the other things that we're talking about.

You know, the idea of activating our microglia to go back to being helpful and and loving in our brains. There's a lot of research being done from a pharmaceutical surgical perspective as well.

And, you know, from a, nutritional supplement perspective as well. And it's so valuable to know that we've been publishing quite a bit at in terms of how effective your diet, you know, the walls, diet, walls protocol, is in terms of really targeting brain energetics.

That's a good thing from an energy perspective in general. But, you know, getting back to the very first question that you asked me, what am I interested right now?

And that is the role of brain energetics in determining brain immunologic function. Again, this whole notion of immuno metabolism, metabolism deals with the energetics part of the equation.

And the immuno deals with what's going on with respect to these micro glial cells. So, I encourage people to go there, I think on Instagram and Twitter and or X it is, David Perlmutter or at David Perlmutter.

There you go. Okay. Great. Thank you so much, David. It's always a pleasure. Thank you. Doctor. Was.