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Hey, everyone. Today, we're going to talk about the blood brain barrier and what we call leaky brain. When you look at healthcare and you look at the physiological pathways, you can have different barriers break down. You can have the gut barrier break down. That's called leaky gut. You can have the blood brain barrier break down. People are using the slang term leaky brain. You can have the lung epithelium break down. Some people use the term leaky lung. We're going to be going over each of these different barrier system breakdowns with these talks that we do every week.

Today's talk is really, really about the blood brain barrier and the so-called concept of leaky brain. Now, when people hear the word leaky brain, it sounds funny. It sounds weird. It's the same thing that happen when people started to use the term leaky gut. For the most part, when we use the term leaky brain, what we're referring to is that the blood brain barrier has become permeable. This is a physiological response that can happen.

It's really an established mechanism in the fields of neuroimmunology of how infections get into the brain and how different pathogen and environmental triggers can activate neuroinflammation, neurodegeneration in the brain. What I want to do before I take questions is in the first 15 to 20 minutes, I want to explain to you what is the blood brain barrier. What are the symptoms that take place when the blood brain barrier breaks down? What lab tests are used to determine breakdown of the blood brain barrier.

What are mechanisms that can cause the blood brain barrier to break down from lifestyle, from environmental factors, from disease processes? What are some nutraceuticals and lifestyle factors you can do to improve the blood brain barrier. They also talk a lot about the blood brain barrier in my book called *Why Isn't My Brain Working?* Have some information about the blood brain barrier and neuroinflammation or autoimmunity on my website called Dr. K News. D-R-K-N-E-W-S.com. Let's first talk about what blood brain barrier is.

For the most part, the blood brain barrier is simply blood vessels and cells called astrocytes that create a barrier to basically keep things from blood, from systemic circulation away from the brain. This blood brain barrier has little transport mechanisms for certain chemicals and different compound and cell messengers to cross that can cross through a passive and an active transport system. There are times when this blood brain barrier opens up and really sets up the stage for different environmental triggers.

For example, if you have different chemicals in your blood stream, they can start to get into the brain. If you have certain pathogens, they can get into the brain. If you have any



circulating antibodies, they can then cross the brain. The blood brain barrier get into the brain and then activate immune cells in the brain called microglia, which then sets up the stage for significant brain inflammation and neurodegeneration and so forth.

When we look at the healthcare system, there's a small imperative time where people started to understand and accept that the gut barrier can become permeable.

I think we're at the point now that we have several thousand papers published in the peer-reviewed literature of intestinal permeability and then able to show causes of disease development with intestinal permeability like autoimmune diseases and chronic inflammation and lots of papers on what's called endotoxemia that can cause dysfunction throughout the body including the brain, the cardiovascular system, organ systems with leaky gut. The blood brain barrier model is also starting to get more attention over time.

I think it will just be a matter of time where people start using the term leaky brain as well. Now, with leaky gut syndrome, we know when people start to have an intestinal tight junctions break up, they get reactions to food proteins. They start to get inflammation and swelling and different symptoms throughout their body. One of the key things is that when the blood brain barrier breaks down, the key thing that happens and the key symptom people start to develop are symptoms associated with brain inflammation and neuroinflammation.

Let's talk about that for a second. When you look at neuroinflammation, neuroinflammation basically means the cells in the brain that launch the immune responses are overactivated. These cells in the brain, they're called microglia. If the blood brain barrier becomes permeable, then protein then triggers for this immune system. Whether they're food proteins, whether they're pathogens, whether they're other inflammatory mediators and blood circulation all start to activate the brain. The brain basically becomes more inflamed.

There are more inflammatory mediators circulating around neurons and synapses when there's a neuroinflammatory state. When this happens, one of the main symptoms that takes place is most people start to complain of what they call brain fog. What that means basically is there's something interfering with normal and ideal synapses. That's really what's happening when people are trying to get to a thought or to an action and they just can't do it.

They're trying to do some motor coordination activity like hitting a tennis ball or whatever they may be doing and they just find it difficult to do more than usual. The key thing about neuroinflammation, one of the key things that it does is that it interferes with ideal synaptic activity. It slows down what's called nerve conduction speed. How fast neuron synapse. What people typically notice when their brains are inflamed is that everything



just becomes less efficient. They can still do things but motor tasks become less efficient.

Coordinated activities, using your muscles and cognitive tasks become less efficient. That's the key feature of imperative nerve conductance. Now, the other part of this is that when there's inflammation in the brain, the inflammatory response uncouples cells in the brain called mitochondria. That impacts brain endurance. Other key feature that happens when there's lots of inflammation in the brain is the brain just gets really fatigued really quickly. The person starts to have increased expressions of neuroinflammation.

What they may notice is that they can't read as long as they used to. They can't drive as long as they used to. Their overall capacity to do tasks and the time and endurance they have is just diminished. Those are the key features of neuroinflammation. Everything slows down. Everything becomes less efficient. Their brain fatigues really quickly. With neuroinflammation, another key feature is that it comes and goes. Some days, it's worse. Some days, it's better. It's not always there all the time.

Whenever I hear a history of someone telling me that they have brain fog, they can't think, they can't focus. They have episodes of depression that comes and goes. Some days are better than others. They don't really have any signs of a clear neurological disease, then they really start to consider that their blood brain barrier may be permeable. Now, are there lab tests you can run to determine if someone has blood brain barrier permeability? The answer is yes. The most published and well-known lab test or lab marker is a lab marker called S100B.

S100B can be measured as a level or it can be measured as an antibody. Elevation of S100B is associated with blood brain barrier permeability and breakdown. You can also measure blood brain barrier protein antibodies. Cyrex Laboratories does this for example. In a clinical scenario, when I suspect someone may have so-called blood brain barrier permeability, I'd like to run those markers.

Now also, if someone is suffering from a neurological autoimmune disease like multiple sclerosis for example, it's really important to also measure blood brain barrier antibodies to determine if there's any blood brain barrier permeability. Because circulating antibodies can't really cross the brain until this blood brain barrier breaks down. This is also a major concern for people that have gluten sensitivity or celiac disease.

Gluten for example is a protein that many people that seem to have reactions against especially what we call modern wheat. Now, if someone's sensitive to gluten, they make antibodies. Those antibodies technically can't get into the brain if the blood brain barrier is healthy. If the blood brain barrier is permeable, then these antibodies can cross. Why gluten is a concern for that is because gluten has been shown to bind to areas of the brain called the cerebellum because of the mechanism called molecular mimicry.



That means that the antibodies produced against gluten can also bind to a structural area of the brain called the cerebellum. Because the protein structure amino acid sequence of gluten is very similar to protein structures of different regions of the brain specifically to astrocytes in the cerebellum and also to neurofilament proteins. Here's a scenario. If someone has gluten sensitivity, they have antibodies to gluten. It doesn't really cause any brain issues but then they have other factors that then start to break down their blood brain barrier.

Once their blood brain barrier breaks down, now these antibodies can cross and have an impact on the brain. This is a clinical scenario where the blood brain barrier becomes really important. Now, you can also have people that have let's say high levels of environmental toxic chemicals or toxins in their body for whatever the reason is may be. Technically, the blood brain barrier is intact. They can't cross into the brain. If the blood brain barrier becomes permeable, then let's say aluminum in your blood stream. That aluminum can cross into the brain.

Aluminum can then bind and attach to proteins in the brain. This is a mechanism where environmental compounds may promote neurodegenerative diseases and be a factor in things like dementia and Alzheimer's. We know that the blood brain barrier is really, really important. Now, the question comes up is what can cause the blood brain barrier to break down? Let me give you a list of things.

For the most part, anything that impacts healthy blood vessel function to the brain or anything that causes chronic inflammation to the brain can cause the blood brain barrier to break down. Remember, the blood brain barrier is basically blood cells, endothelial cells, vascular endothelial cells and astroglial cells, which are these different immune cells of the brain. These cells are very, very prone to be compromised in chronic states of inflammation.

For the most part, chronic inflammatory responses, like a chronic inflammatory disease of like lupus or chronic inflammatory disease like systemic rheumatoid disease or anything like that has a potential to break down all barriers of the body including the gut barrier, lung barrier and the blood brain barrier. In that, chronic inflammation is a major factor. There's very clear evidence that traumatic brain injuries break down the blood brain barrier. When the brain gets injured, neurons get shared.

The sharing of neurons causes a release of a thing called heat shock protein, which opens up the blood brain barrier intentionally to allow the immune cells to come in to get rid of the injuries in your brain neurons but they don't always heal. Some patients had a traumatic brain injury or a car accident. They notice the brain declines over time and over time because their blood brain barrier never really heals. Yeah. The brain injuries can cause it.



We also know that inflammatory bowel diseases, chronic inflammation in the gut can actually open up the blood brain barrier. Dr. Vojdani and I, we published a few studies on this. We published one study in the World Journal of Gastroenterology where we showed that when people have intestinal permeability with celiac disease, they have increased levels of zonulin. Zonulin opens up the blood brain barrier proteins.

We found high degrees of association with leaky gut, zonulin markers and what are called Aquaporin-4, which are blood brain permeability markers and glial fibrillary protein, which also open up the blood brain barrier. We also published a paper. The paper was called Correlation between Antibodies to Bacterial Lipopolysaccharides and Barrier Proteins in Sera Positive for ASCA and ANCA patients. It's a long title. In that paper, we showed people that inflammatory bowel diseases have significantly increased odds for having blood brain barrier permeability.

We check forwarded subjects with that study. We know that when the gut's inflamed that the brain is inflamed. We also know that when there's a leaky gut, there's a very, very high chance that there's also a leaky brain. Because they share some of the similar protein agents like zonulin, which opens up the blood brain barrier. Chronic gut inflammation can lead to chronic brain inflammation. Intestinal permeability can lead to blood brain barrier permeability. Past head traumas, chronic inflammation, chronic infections.

Someone who gets to their antioxidant levels depleted can really have all these factors add up to cause their blood brain barrier to break down. Once your blood brain barrier breaks down, there is an increased activated inflammatory state of the brain, which then causes decrease in brain function, slowness of the brain and decreased brain endurance. If this continues on, then a person can start to develop neurodegenerative diseases. Now, there are some also lifestyle factors that have been shown to cause blood brain barrier permeability.

Alcohol abuse unfortunately has been shown to cause blood brain barrier permeability. Sedentary lifestyles have been shown to increase risk for permeability of the blood brain barrier. Because when you are sedentary, you could decrease the circulation, decrease blood flow. You get decreased release of healthy growth factors in your blood vessels to keep your blood brain barrier healthy. When someone combines things like lack of exercise with an inflammatory diet and alcohol, it's very easy for the blood brain barrier to break down.

Chronic sleep disruption has been shown to cause blood brain barrier permeability issues as well. Those are the main lifestyle factors. Now, at the end of the day, when you're looking at a person who has chronic neuroinflammation and they're dealing with depression and brain fatigue issues and just inability to finish their task and cognitive delays. They have for example, let's say lab tests that show blood brain barrier



permeability, the goal is how do you treat that? What do you do? You got to look at the lifestyle factors first.

Make sure they're not abusing alcohol. Make sure they're on an anti-inflammatory diet. Make sure that you identify underlying issues. Whether it's chronic inflammatory disease or rheumatoid disease and try to implement strategies to reduce that inflammation. There are some nutraceuticals that have been published in the peer-reviewed literature that have been shown to really help the blood brain barrier. The nutraceuticals with the most evidence so far are number one, fish oils. Fish oils have been shown to help the blood brain barrier.

Ginkgo biloba has been shown to help the blood brain barrier heal. Many of these are animal studies. They can actually look at the blood brain barrier post mortem and see that they've healed. Vinpocetine is another botanical that helps increase blood flow to the brain and protects the vascular system of the brain. That's been shown to help the blood brain barrier heal. Alpha lipoic acid and glutathione and resveratrol. Those are the main cocktails of different flavonoids and compounds that have been really shown to impact the blood brain barrier.

As a summary before we take some questions here is what is the blood brain barrier? The blood brain barrier is basically a barrier to keep pollutants, toxins, circulating antibodies, dietary proteins away from the brain. When the blood brain barrier becomes compromised, the symptoms are decreased neuron speed, decreased nerve conduction. Mental slowness, motor coordination slowness and then increased fatigue of the brain. The way you can measure blood brain barrier permeability is blood brain permeability antibodies or S100B levels or S100B antibodies.

These are routine lab tests. Things that cause the blood brain barrier to break down could be things like traumatic brain injury, long use of corticosteroids, significant infection, significant inflammation. The lifestyle factors are alcohol abuse, lack of exercise, sedentary lifestyle and chronic sleep deprivation. Nutraceuticals again, fish oils, ginkgo, Vinpocetine, alpha lipoic acid, glutathione. Those are all the main things that can really impact the blood brain barrier. Let me get into some questions here. I think we got some here. Okay.

Thank you, everyone for joining me here by the way from different places. Okay. My wife's going to help me here. **One of the questions I have here is if a person is Transglutaminase 2, will they have leaky gut barriers all over in the body as well? Lung barrier, gut barrier, addition to small intestines?** Transglutaminase 2, TG2 is an antibody for intestinal permeability for celiac disease. There's a high correlation of intestinal permeability up to let's say 90% with people that have Transglutaminase 2.

We would suspect that if someone has TG2 antibodies that there's a very high risk for them to also have blood brain barrier permeability. Since we know that



Transglutaminase 2 is strongly associated with intestinal permeability. This is also a concern because if you do have Transglutaminase 2 antibodies, a laboratory marker for celiac disease, then if the blood brain barrier is breached, then those gluten antibodies can also then cross the brain. If gluten antibodies cross the brain, there is that potential for gluten to bind to proteins in the brain and cause some neuroinflammation, neurodegeneration. There are multiple studies that had correlated gluten sensitivity not even celiac disease but just gluten sensitivity with different types of neurodegenerative and neurological diseases and chronic neuroinflammation. TG2, celiac disease, gluten sensitivity, you're really concerned for blood brain barrier integrity as well as leaky gut.

Okay. Evelyn said ... Wait a minute. Can someone type those nutraceuticals you just mentioned? Can you repeat them? The nutraceuticals you just mentioned?

Nutraceuticals?

Yeah.

Fish oils, ginkgo, Vinpocetine spelled V-I-N-P-O-C-E-T-I-N-E. Alpha lipoic acid, glutathione and resveratrol.

Okay. Did you say Quercetin?

No. I did not say Quercetin.

Okay.

Quercetin may have an effect but I'm not sure if there's any published studies on that. The ones I mentioned on that list are clearly shown in studies to have an effect on the blood brain barrier. That's why I mentioned them.

Okay.

Of course, for the most part, lots of anti-inflammatories, lots of antioxidants may have some benefits as well. Those are the ones that actually have research published on them.

Okay. Shelby asks, "Can anxiety be associated with blood brain barrier permeability like depression?"

Can anxiety be? The thing with anxiety is that there's so many different mechanisms for anxiety. Blood brain barrier permeability isn't directly associated with causing anxiety. However, there could be inflammatory responses from blood brain barrier permeability that can promote the mechanism of someone's underlying anxiety. I wouldn't say that you would go from anxiety directly to blood brain barrier permeability. It's not that direct.

Okay. Sorry. How does MTHFR affect this?



That's a good question. Thank you. How does MTHFR affect this? MTHFR is Methylene tetrahydrofolate reductase polymorphism. It's a genetic uniqueness that 25% of population have where they can't metabolize homocysteine through B12 very effectively, their folate very effectively. There is some research on this. What they found is that if a person has high homocysteine and these people that have this genetic uniqueness typically do that elevated homocysteine levels can cause increased breakdown of the blood brain barriers. I didn't mention about that.

Thank you for asking that question. If you ever got your lab test done, it's really common these days to have your doctor measure something called homocysteine. It's typically done to look at cardiovascular risk because elevated homocysteine destroys blood vessels. Don't forget. The blood brain barrier is also primarily blood vessels and astrocytes.

There has been clear findings that elevated homocysteine levels, which is part of our sometimes routine cardiovascular workup is also associated not only with cardiovascular disease but breakdown of the blood brain barrier. You may have to get your homocysteine levels down. Typically, that's done by taking B vitamins, specifically folate and B12.

Okay. Dana asks, "Can a blood brain barrier with supplements be repaired?"

Yes. The blood brain barrier can be repaired. Because the blood brain barrier's dynamic, it breaks down and repairs. It breaks down and repairs just like the gut barrier. You could have lots of alcohol, lots of inflammatory foods, lots of stress. Your gut barrier can thin and break down. As you eat healthier foods and take that inflammatory load off your gut, it could heal. The blood brain barrier's dynamic works in the same way as well. There's people that have chronic leaky gut for many, many years.

There's people that have chronic leaky brains for many, many years. The point is that if the ongoing inflammatory cascade that's going to break down is continued, then it can't heal. If you remove those factors and provide high amounts of anti-inflammatories and antioxidant properties to support the barriers, then they can heal.

Okay. Meredith asks, "Can leaky brain cause sleep disorders?"

When you think about specific conditions with leaky gut, whether it's sleep disorders or anxiety, there isn't a direct relation to any disease or specific brain symptom other than brain endurance issues and fatigue issues. However, inflammation adds to the fire. Most mechanisms that cause disease to the brain are dysfunction to the brain. Neuroinflammation is going to promote the mechanisms of all neurodegenerative diseases, which are really an inflammatory cascade.

Some sleep disturbances can be associated with abnormal nerve signaling conduction pathways in parts of the brain and the pineal system. Inflammation can absolutely



disrupt those mechanisms. It's a very general mechanism. However, it can disrupt the whole list of physiological pathways in the brain that can cause a whole host of symptoms. It's not necessarily specific for any single condition like anxiety or sleep disorders.

Okay. Richard asks, "Can food sensitivity cause inflammation in the internal and external carotid arteries or any arteries?" Food sensitivity.

Food sensitivities can cause systemic inflammation. Systemic inflammation can definitely cause inflammation everywhere including blood vessels and the gut barrier, the lung barrier. It has some impact. How significant of an impact it has may vary from person to person. It probably by itself won't be enough to cause all these systems to break down. Usually, when people start to develop food sensitivities, they really lost something called immune tolerance. There's already significant degree in their immune system integrity and their health.

It can be part of a contributing factor to the overall inflammatory load.

Okay. Sharon's asking what about Huperzine A?

Huperzine A is a very powerful botanical that has been shown to be a natural cholinesterase inhibitor, which is great to activate acetylcholine and is the main neurotransmitter from memory pathways and helps with things like dementia and Alzheimer's disease. There has been some studies that show Huperzine A can slow down beta-am plaque development, which is a key feature of Alzheimer's disease development.

Huperzine A does not directly have any benefit that I know of to the blood brain barrier. Because it's working more of an acetylcholine pathway. In blood brain barrier mechanisms, there are nutraceuticals that help the blood brain barrier that typically help work on improving vascular inflammation or basic systemic neuroinflammatory responses. Huperzine doesn't seem to have that showing an effect on those pathways.

Okay. Steve asks, "Does the elevated homocysteine act directly to break down the blood brain barrier? Could there be a comorbidity factor that causes both? Elevated homocysteine and break down of blood brain barrier?"

There could be other factors associated with why someone has methylation defects causing the blood brain barrier to break down. I think those probably do exist to some degree. Homocysteine itself is very inflammatory. When they've done animal studies and just inject homocysteine into healthy animals, initially, they did it with pigs. First, the line studies and once these pigs got injected with homocysteine, their whole vascular system became inflamed and basically destroyed.

These animals got strokes immediately. Unrelated to methylation defects, homocysteine itself is very inflammatory to blood vessels. Blood vessels include the blood brain



barrier. I think there could be some methylation defects that are part of things that can impact blood brain barrier integrity. We know we need methylation to help support myelin regeneration. Methylation is important for astroglial cell function. There could be a part of the methylation part of it, which is this transfer of one carbon groups.

If homocysteine's high, homocysteine itself is very inflammatory. That's why if you get your lab work done, if your doctor has measured homocysteine or if you're getting your blood work, ask your doctor to measure homocysteine. If those levels are elevated, then you could have some break down with the blood brain barrier. Now, let me also share some things about the homocysteine levels. When you get your homocysteine levels measured, the laboratory range will usually have levels. Below 15 is normal.

Research is showing that levels even as they start to get above seven and definitely, as they get into above 10 start to cause significant injury to neurons and potentially even to the blood brain barrier. You really want to make sure at the very least if your homocysteine levels are normal, meaning less than the laboratory range of 15, just make sure they're not above 10.

Because if you're in the 10 to 15 range, you still could have some risk for inflammation even though your lab test may be within that normal reference range of less than 15. 10 and above, be concerned. You may want to take some extra antioxidants, nutraceuticals to support yourself.

Okay. Jonathan asks, "How does insulin resistance relate to neuroinflammation and blood brain barrier permeability?"

That's another great question.

Good job, Jonathan.

Insulin resistance can definitely be a factor in blood brain barrier permeability and brain inflammation itself. Insulin resistance leads to glucose not being able to get into the cell. When glucose can get into the cell, one of the things that can happen is glucose could get glycated, which means that the attachment of a protein to a sugar and this becomes very inflammatory. This become glycation end products. Glycation end products can cause the blood brain barrier to also break down. I didn't mention earlier so thanks for bringing that up.

If you ever have your blood work done especially if you have pre-diabetes, risk for diabetes, there's a measurement that's called HbA1c, which is glycated hemoglobin. If your glycated hemoglobin levels are elevated, those same mechanisms can definitely break down the blood brain barrier. When you look at HbA1c levels, they look at a certain percentage number and usually want that in the low 6% number below. Below 6% would be ideal.



Once people start to get their HbA1c above 6.8, 7% or higher, then there's going to be some significant inflammatory mechanism through glycation that can definitely break down the blood brain barrier.

Okay. Jeffry asks, "Brain fog is often said to be a symptom of Hashimoto's thyroiditis. If one has Hashimoto's thyroiditis, does that mean they have a leaky brain as well?"

Brain fog itself is most likely due to the neuroinflammation that Hashimoto's patients have. Many patients of Hashimoto's have intestinal permeability and absolutely have blood brain barrier permeability. Trust me. As a practitioner who's worked a lot with patients suffering from Hashimoto's and who routinely measures intestinal barrier proteins and blood brain barrier proteins, I can tell you that there's a large percentage of patients that have Hashimoto's that do have blood brain barrier permeability.

They also have high risk for gluten sensitivity because of their gene type for Hashimoto's. It's this HLA DQ gene type. You'll see many Hashimoto's patients that have gluten sensitivity, gluten antibodies, intestinal permeability and blood brain barrier permeability. They just can't get their brain fog and their depression under control until they can actually heal their barriers.

Okay. Rose says, "Hi"

Hi.

Wondering if there's a way the brain can flesh out the impurities on its own.

The brain is actually constantly detoxifying itself through its own lymphatic and vascular system. The best way to get the brain to do that is to actually just move and exercise. Movement and exercise impacts brain circulation and brain lymphatic pathways. The ways that the brain clears those toxins is really through vascular mechanisms. If you can move and exercise to any degree, that really helps your brain's ability to support a synthetic and vascular flushing systems.

Okay. This is a question from Steve but it's been asked a lot. The RepairVite product doesn't seem to have fish oils, ginkgo, that kind of stuff recommended for improving the blood brain barrier. Is there a repair formula that will come out soon? I think they're confusing blood brain barrier to leaky gut.

Yeah. There's a product called RepairVite, which is that nutraceutical that has things to help leaky gut. It's really designed for a leaky gut product. The things in there, your typical compounds for the gut like glutamine for example to help the gut heal, that doesn't directly impact the blood brain barrier. Things that impact the blood brain barrier would be more things like resveratrol, glutathione, alpha lipoic acid, Vinpocetine.



I like to take a product called NeuroFlam that has all those things in there. Any one of those nutraceuticals alone has the potential to support the blood brain barrier.

Okay.

Eric Cohen asked about NeuroFlam, yeah. NeuroFlam was one of the things, some product that has the key nutraceuticals in there. The key nutraceuticals we've already talked about. Resveratrol, glutathione, alpha lipoic acid, ginkgo, Vinpocetine.

Okay. Laurie. "I gave up gluten and it completely reversed my brain fog. I was a patient of someone who took your courses, Dr. Geronimo."

Yeah.

"It was a game changer."

Great.

"Thanks."

Thank you for sharing that. Yeah. Some people, they have gluten sensitivity. They eat gluten. They get zonulin released. They get an inflammatory gut. The blood brain barrier opens. Sometimes, just being gluten-free completely reverses all of it. There's other people who for example, may have the same mechanism. They have a significant reaction to gluten. They eat it. They get leaky gut. They get leaky brain. They just try to take ginkgo or alpha lipoic acid. It doesn't really work. Nothing's going to really work until they remove the trigger.

You got to be aware of that, too. A lot of times, you're not going to be able to just heal the blood brain barrier, take nutraceuticals. You're going to have to treat the underlying mechanisms. Thank you for sharing your story with gluten. I think that is really common. Gluten, dairy, corn, egg protein, soy protein are the most common food sensitivities out there. For some people, those inflammatory food reactions, if they continue to eat them, they can get brain fog. I have friends that note that testing that comes back that shows they're sensitive to milk.

They get bloating and distension. They even get brain fog. They still question if they can eat milk because the bloating isn't so bad. They can deal with it. It has an impact. A lot of times, taking nutraceutical won't be enough. You'll actually have to remove the trigger and milk, dairy, egg, protein, soy are the most common and corn.

Okay. Speaking of that, Lauren asks, "What are your thoughts on the use of kefir to restore gut integrity thus helping the blood brain barrier? 99% of the lactose will be removed but it still has whey and casein. Does that override the benefits of the probiotics?"



Right. Kefir is fantastic for supporting the gut microbiome for many people. However, there are people that are extremely sensitive to casein. For them, the benefits don't outweigh the inflammatory response. For people that are extremely sensitive to milk protein, whey, they probably won't be able to get away with kefir. For those that don't have those extreme reactions, it could provide some benefits. There has to be some individuality in some respect to how sensitive they are to casein if they can tolerate kefir.

Okay. Deirdre says, "Is ataxia caused by leaky brain?"

Is ataxia caused by leaky brain? There's different causes of ataxia. Best way to simplify it is that your balance is off. We're talking about truncal ataxia. A truncal ataxia means you don't have good balance. You have dizziness and hard time going downstairs. Ataxia can be caused by any injury to an area of the brain called the cerebellum. Whether it's stroke, whether it's brain injury, whether it's neurodegeneration but there is a condition that's called gluten ataxia.

This is specifically where people that are gluten sensitive have gluten antibodies bind to that area of the brain, which is called molecular mimicry. For those people and there's a subset of those people out there in the population. For those people, they have extreme sensitivity to gluten and the same genotype of gluten ataxia is found with Hashimoto's people.

I can tell you a lot of people that have thyroid disease, Hashimoto's have the same genotype and risk factors for gluten then causing gluten ataxia and then having this whole neuroinflammatory and even eventually, neuro autoimmune response and blood brain barrier break down as a vicious cascade.

Okay. This is a couple of people asking this. They're asking about the proteins, soy, egg, whatever. They're saying, "Even the organic is pro inflammatory?"

Yes.

Not just GMO but the actual protein itself? People are thinking that it's-

Yeah. When you look at proteins and immune reactions, whether it's organic or not, it doesn't matter.

Yeah.

Organic foods, they have technically less pesticides, which is great. You don't want as many pesticides in your foods. The structure of the food protein, whether it's organic or not is going to determine the immune response. In our family, we try to have everything organic. It doesn't mean we can have organic wheat and be okay if we're sensitive to gluten or organic corn or so forth, whatever the protein may be.

The only thing you're really getting with organic is you're getting less pesticide exposure. The dietary protein is still the same. It could still cause a trigger.



Okay. I don't know if you answered this or not. Carol. "If a person has tTG2, Tissue transglutaminase 2 antibodies, will they have leaky barriers all over their body?" Did you answer that?

People that's tissue transglutaminase, they have leaky barriers all over their body. We mentioned transglutaminase 2. There's transglutaminase 6 also, which is specific to brain inflammation. Technically, if you have TG2, transglutaminase 2 or transglutaminase 6 antibodies, you have a higher risk for blood brain barrier permeability. Some of that TG2 stuff is in the literature. TG6 is not in the literature yet. I've done some in-house testing for a research study.

We haven't published but we did find high degrees of correlation between transglutaminase 6 and the S110B blood brain barrier permeability antibodies.

Okay. Genevieve asks, "What would be a good differential diagnosis from brain fog from leaky gut than other sources?" How do you differentially diagnose if it's from leaky gut?

Right. If someone has brain fog, the symptoms are just having slow brain activity, slow motor activity, poor brain endurance. It just lets you know that there could be neuroinflammation but it doesn't tell you where it's from. That's the key thing. Clinically, just first go, is there brain fog? If there's brain fog, you expect that there's blood brain barrier permeability. Quite honestly, if they go through history and take some steps and do some trial there and dig to figure out what the cause may be.

Definitely starting with the gut, gut permeability is a good place since there's a high degree of well-established association with leaky gut and leaky brain. For the most part, chronic inflammation, anything that drives the inflammatory response that impacts circulation are all clinical mechanisms that can lead to blood brain barrier permeability and neuroinflammation.

Okay. "Does the Epstein-Barr virus' chronic activity affect blood brain barrier negatively?" Alexander is saying.

If you have chronic Epstein-Barr virus, the key thing is has it become reactivated? If it becomes reactivated, the white blood cells are really, really high. Monocytes may be really high. That's an inflammatory cascade. All inflammatory cascades have the potential to break down all barriers of the body whether it's a gut barrier, lung barrier or blood brain barrier. A lot of people just have chronic Epstein-Barr but the virus itself has not been reactivated.

In a clinical setting, there's actually a profile called the Epstein-Barr virus profile where they measure different proteins of Epstein-Barr to determine if it's been reactivated or if it has not been. That would really be the test to determine if the virus has been reactivated. If that's the case, then at least you know there's some inflammation. Now,



inflammation itself can also even across the blood brain barrier from viral infection even if the blood brain barrier is intact and just cause brain fog and is a dysfunction.

I think most people when they get influenza or the common cold or common flu, they notice that the brain's not working well. They can't think. They can't focus. They can't concentrate. They're actually having brain inflammation at some degree. In those cases, they may have an intact blood brain barrier. Not all inflammation is caused by the blood brain barrier breaking down. There are still inflammatory mediators that can cross a healthy blood brain barrier and cause brain inflammation.

Whether it's Epstein-Barr virus or another virus that causes someone to not think or focus or concentrate, that doesn't necessarily mean that the blood brain barrier is broken down.

Okay. This is a couple of people asking. I'm going to combine them. What are your protocols for lupus, RA, cystic fibrosis?

Yeah. I know there's people asking questions about what are your protocols for lupus or RA or cystic fibrosis.

Just a bunch, yeah. MS.

MS.

Yeah.

We don't have protocols. Protocols are an inefficient way. Protocol for a disease doesn't work clinically. Yet that protocols for specific mechanisms. For example, the person has MS that has blood brain barrier permeability and someone who doesn't have blood brain barrier. He could have Bristol's MS who has cross reactivity with a certain pathogen. For example, Hepatitis C can cross react with myelin. That's a major trigger for MS and someone who doesn't. Sometimes, you can't even plan the mechanism. The mind to the protocol for disease is inefficient.

This is how functional medicine differs from the world of just nutrition and botanicals. In the field of herbology of a disease, depression and then you go right to St. John's Wart. In the field of functional medicine, you don't do that. You have depression then you go, what's the mechanism of their depression? Maybe their mechanism of depression is neuroinflammation. Maybe their mechanism of depression is poor blood flow to the brain. Maybe their mechanism of depression is really brain degeneration.

It doesn't necessarily to a treatment protocol. It's impossible to give you treatment protocols. Like Facebook, which in a real clinical setting for a disease process because the disease itself doesn't dictate treatment. You have to figure out what mechanisms are involved and what lifestyle factors evolve in and this is the basic concept of personalized lifestyle medicine. In chronic diseases, in progressive diseases, really



need to have that individualized approach to try to improve health and function and recovery in those instances.

Okay. Stephanie says, "You do an amazing job of taking intricate concepts and explaining them in such a clear way."

Thank you. Thank you, Stephanie. That was nice.

That was very nice. I think, yeah. Okay. Can thyroid or other hormonal imbalances lead to blood brain barrier permeability?

Yes. I didn't mean to stop you there.

I know, yeah.

No one knows the answers. We're taking a [inaudible 00:45:50] bend.

It's a lot to talk about.

Yeah. Yes. Hormone deficiencies can impact permeability of the blood brain barrier and of the gut. Thyroid hormones is absolutely one of them. If someone is for example, truly hypothyroid and they actually have high TSH, that can impact permeability of the gut barrier, the lung barrier, the blood brain barrier. Hormones like testosterone for men, estrogen for women, progesterone, thyroid hormones, if they become depleted, they can slow down how cells regenerate.

Barrier cells of the gut, the brain, the lungs all benefit from hormones that cause an anabolic effect or tissue regeneration effect. They can be a player as well.

Okay. Elizabeth. She's asking what are the zonulin markers? Is it lymphocytes?

Zonulin is a protein. It's actually haptoglobin, too. It's a protein that can be measured in blood. Blood levels of zonulin tend to fluctuate all over the place. Zonulin antibodies are a very good marker to determine permeability of the gut brain barrier, the gut barrier and also even potentially the blood brain barrier. It's just a routine laboratory marker that can be measured. The main blood brain barrier proteins are S100B, aquaporin antibodies especially the aquaporin-4 and even just what we call blood brain barrier protein antibody.

There's also a high association with antibody to gliofibrillary acetic protein, which involves basically the astrocytes. If it's elevated, it can indicate the blood brain barrier's breaking down. Those are all individual lab tests that can be ordered in a clinical setting and have been used in research settings to determine the breakdown of the blood brain barrier.

Okay. People are asking are there certain foods to avoid in general that cross react with the blood brain barrier and cause a break down?



There's no foods specifically that we know about cross react directly with the blood brain barrier. The concern is that the blood brain barrier breaks down and then if food proteins cross into the brain and then what you're concerned about are food proteins that cross react with actual neurons. I got to tell you that the two big ones are milk protein and wheat.

Say it again.

Casein milk protein, casein and gluten have potential to cross react. There's a study that we published in the journal of nutrients where we looked at 400 healthy blood donors. We checked their reactions to milk and wheat proteins. We wanted to see how many of them had neuroinflammatory reactions specifically to myelin by measuring myelin basic protein myelin and lymphocytic protein. We found a very, very high degree of association between people that had reaction to milk and wheat proteins to brain inflammation proteins like myelin basic protein.

We published that in the journal of nutrients. If you go to pubmed.gov, which is the national library of medicine, you type in my name, you'll see some of these papers that I've published. The one that is published in the journal of nutrients, we find that those two proteins are significantly inflammatory for the brain.

Okay. Genevieve and a few other people are saying, "Will you please do a talk on how to treat these chronic viral infections? Epstein-Barr, Hep C, etc."

Sure. We can put that on the list.

Yeah.

Yeah.

Okay. Elizabeth says, "Is there a celiac profile like the Epstein-Barr profile?"

The best laboratory marker for looking at gluten sensitivity and celiac is without question, Cyrex Array 3. What Cyrex Array 3 does is that it breaks down the transglutaminase proteins. It's TG2. Add in TG3 and TG6, which are all important to understanding where the gluten sensitivity or autoimmune response is against. Also, when you look at gluten, gluten has different branches like alpha gliadin and gamma gliadin and different variations of those and gluteomorphin and so forth. The absolute best laboratory marker to determine reactivities to gluten is Cyrex Array 3. There's no substitute.

Okay. Besides that, Sharon asks, "How do we know if we have a reaction to gluten or casein?" How do you know if you have a reaction-

How do you know if you have reaction to gluten or casein? You measure the antibody. You have to do a lab test, an antibody test, ELISA test. Most people would just reduce their food sensitivity test to determine if those reactions are there. I would caution



against staying away from finger spot testing. Those are not as accurate. A really good blood draw by accredited laboratory would be to go ... Let me make the analogy for blood spot testing. People listen to the radio and you're not really tuned in to the radio station. You can't pick up every word.

You can't pick up everything that's said. You can pick up a few of those things. That's how spot testing is. To pick up a few things but you don't really get a clear message of the testing of the proteins. You get a full solid blood draw done by CLIA established laboratory. You have tuned in to the radio station. Perfect sound and you can hear every single word and hear the message. When you do some of these spot testing, the methodology is not as clean. You won't get as clear of the reactions to food proteins.

Okay. This is people thanking you. Sorry.

Thank you.

Very, very kind.

Thank you.

Thank you. Do elevated alpha beta tubulin antibodies had anything to do with leaky gut?

Alpha beta tubulin antibodies are specifically associated with neurological autoimmune reactivity. Alpha beta tubulin is a protein in the structure of neurons. There's antibodies against it. That means there is neurological autoimmunity. It's not specific for anything to do with leaky gut. It's very specific for just neurological autoimmunity. If you have neurological autoimmunity or if someone has alpha beta tubulin antibodies, you definitely want to make sure the gut barrier's intact and the blood brain barrier is intact.

You might want to look at zonulin including antibodies for the gut. You want to look at blood brain barrier protein antibodies for the brain. Make sure that those are not abnormal. If they are, then figure out how to fix those.

Okay. This is a little off. Paige is saying, "I had a test for Hashimoto's that tested antibodies. What other antibody tests can be given to determine if you have an autoimmune disease? Why would you test it?"

Wait. If you have Hashimoto's and you've been tested and if you have antibodies for the thyroid, for me in my practice, that's only I can really comment on, I like to use a panel from a lab called Cyrex called Array 5. What it does is it screens for tissue antibodies to 20 other different tissues. It checks for antibodies to the gut, to the adrenal glands, to the pancreas, to the brain, to the joints. It lets me know if there's any other autoimmune reactivities going there.

My routine step in my practice is if someone walks into my office that has for example, Hashimoto's or any other autoimmune disease, is then to have them to Cyrex Array 5.



Then I can see if there's any other autoimmune reactions anywhere else. That's how I have been doing it.

Steve is quoting some of your books. Answering questions and this is funny. Sorry. Thank you, Steve for using your books to-

Thank you.

... Yeah. That's funny. Do you think evaluation of a blood brain barrier should be done always in the initial workup of patients' neurodegenerative disease? That's from Sebastian.

Sebastian, should you always do a blood brain barrier workup on neurodegenerative diseases? Ideally, yes. Realistically, no. Ideally, yes because you like to have the information. Realistically, no is because there's always the factor of expense. You can't test every single marker with every single patient. Sometimes, you have to pick and choose what are the most appropriate ones or have a budget and a process step by step of how you go through things. Technically, yes.

If you have anyone that has any neuroinflammation, neurodegenerative disease, traumatic brain injury, brain fog, it would always be nice to check for blood brain barrier permeability and determine if that's a factor in their health.

Okay. Satiny, I think. Is intermittent fasting on thyroid patients okay?

Yes. Intermittent fasting on thyroid patients should be okay as long as they can physiologically not completely fall apart while they do the intermittent fasting phase of it. They can do intermittent fasting. Intermittent fasting can get a person to ketosis. Ketosis can actually also help heal the blood brain barrier. Ketosis creates an anti-inflammatory effect and dampens neuroglial inflammation and drops insulin levels significantly. Both those mechanisms can have a dramatic impact in helping heal blood brain barrier and brain inflammation also.

That's another good strategy that can be used that wasn't mentioned.

Okay. A couple more. Any connection with autism and blood brain barrier?

Any connection with autism and blood brain barrier. Yes. There's definitely a factor of brain inflammation, neuroinflammation with the pathophysiology of autism. Obviously, autism is multi-factor, multiple variants that evolve. At the end of the day, there is a central theme of neuroinflammation there. Blood brain barrier permeability does play a role in some models of autism.

Okay. Valerie's asking, "Is there somewhere you've summarized your list on where the blood tests one should have at the minimum done every year?" Meaning from their doctor.



That's really good.

When Hashimoto's patients have been on thyroid meds and also for someone with Hashimoto's but not thyroid meds. Just general what you should be running every year.

What you should be running every year. Yeah.

When you go to your physician and you tell them, "I need this done." Maybe you write that down.

Yeah. That's a good article to write. Thank you for sharing that. We can write that article at Dr. K News, Valerie. I can just tell you at the very least, routine blood work with that question is something that gets overlooked all the time isn't done. Getting what's called a chemistry profile where they just look at BUN and creatinine and your electrolytes, phosphorus, neutrophils, SAT but a chemistry profile, chemistry panel. Chem 24, complete blood count, basic thyroid panel, lipid panel, those are all just routine exams and is so important.

Blood pressure measurement is so important. You can go deeper and check immune markers and get into the gut and check a gut barrier profile and microbiome testing. It really comes to the budget of what's involved. I can tell you for me in my practice and for myself and for my family, we at least do routine lab work every year. That just includes the markers that I stated to you. It also includes an immune profile, a T and B-cell breakdown. Because you really want to see if there's any underlying immune activation triggers and looking at individual T and B-cell profiles can give you clues for early malignancy or early autoimmune diseases. I think you've brought up a really good question that we'll probably need to write an article on. We do write articles all the time. If you go to Dr. K News, D-R-K-N-E-W-S.com on our website-

Say that again.

Dr. K News? D-R-K-N-E-W-S.com.

Because people ask so they can understand.

I know. I just slur words. I speak fast. I apologize. Give us a little bit of time and we will organize that or maybe we'll do a talk on that.

That's a great ... Yeah.

Next week, we're going to do a talk on the lung barrier, I believe and then the gut barrier and go over some more of the research between those other barriers as well. Thank you.

I have one more question.

Last question.



Yeah.

Okay.

It's interesting. From Deirdre.

Okay.

Okay. What difference does it make in treatment if you already have Hashimoto's and you find other autoimmune conditions after doing the Cyrex Array 5? Why would you-

Right. The question that's being asked is you have Hashimoto's and then you find other antibodies.

That's exactly it.

Yeah. How does that actually change your treatment? In some sense, you're right. At the end of the day, you have to keep your autoimmunity under control. The way it technically changes your treatment is there could be other cross reactive food proteins and pathogens with different target proteins. For example, if you have myelin or ASCA antibodies or tropomyosin, for example, if you have tropomyosin antibodies, which is a marker for intestinal autoimmune disease, they found a shrimp proteins directly cross react.

You could have significant inflammatory reactions with specific cross check to foods like shrimp protein if you have that antibody. Also, it gives you a clue to determine what symptoms you may have may actually be autoimmunity. If you have Hashimoto's and you also have lots of brain symptoms and your brain's impaired, you actually have autoimmunity as part of that mechanism or if you have Hashimoto's and you have chronic blood sugar issues and hypoglycemia, you actually have some subtle adrenal autoimmunity.

It gives you some clue to what the big picture is and what the complexity of symptoms are involved and how to also monitor the progression of autoimmune diseases.

Because they start in with cell and antibodies and they become autoreactive and then eventually, they destroy the tissue. You want to get the big picture assessment as well. I hope that helps. Thank you all for joining us for leaky brain. I hope you found some of the information useful. Thank you for your time.