Introduction and Guest Background

Welcome. Welcome to another edition of Mycotoxins in Chronic Illness 2.0. And it is really a pleasure today to talk to Doctor Felix Schultz. He is a gentleman that I have known, gotten to know quite well over the last two years.

He he's been, he's a president of Efecto Lab of America, and this is a lab that I have, found very helpful as I've been trying to, sort through who has what or at what stage of illness.

And, Doctor Schultz is an immunologist and, he really thinks so. We have a I have a very good time because I'm always learning something. And hopefully, we're going to have a chance today to share in his knowledge.

We will start off, I think, Felix, with maybe just talking about what brought you to the field of, you know, immunology and chronic infections. How did you wind up here? Well, yeah.

Thanks. First, for for having me and having this conversation. I'm. I'm. It's a pleasure for me and an honor. Thank you. And. Yeah, I started out with basic research, in in, in in neuroscience, actually, but insects and then, I moved on to make a PhD in the topic of the PhD ventured often innate, responses in skin and, skin inflammation and proteases.

And, then basically the journey took us and the next, part of my research life, I ended up at the center of immunology in, Minnesota. And, there is where the research shifted, towards T cells and, skin inflammation, T cell responses, antigens.

Yeah. That's how I ended up, at least, in that part of the research, further down the road. Then I switched gears from academia, into industry. And, because of the background, then with the T cells and antigens, I developed, laboratory tests, that involved, immune cells.

So T cells and also basal foods for allergy. And that's how I ended up, basically in the realm of infectious diseases. Lab test. Yeah. But if you saw a immunology has been the field that that's occupied you and that's and we really appreciate that because, for those of us who are treating and those of us who've been trying to read about it, immunology seems to be, how do you say probably one of the more confusing areas in medicine is until you really understand it.

So I'm looking forward to you giving us a little overview today of how to understand T cells and chronic illnesses. You know, we've during this series, we talked a lot about mycotoxins and a lot about Lyme.

And today we're going to talk a lot about tick borne diseases, but also the chronic viral infections. You know, because I know that it's been an area that you have, developed quite a bit of expertise in, and bringing us tests that we didn't have before that weren't really available in America.

How T Cells Are Activated and Specialized

So, you know, so can you just start off and tell us a little bit about, you know, how you look at T cells and, you know, and because a lot of us, I'm just going to set you up with the idea that a lot of us have heard about 1 or 2, even 17, and all the chemicals they release.

But, I don't think we understand, how they, the subtleties and the complexities of them. So just give us a little bit of a deep dive, okay? Yes. So, the T cells, that, develop during and infections, are of different types of nature, meaning, the immune system, gets certain signals while generating the antigen specific T cells.

So during an infection, antigen gets shuttled into the lymph node. And in the lymph node, it screens this reaction to find T cells that recognize these specific antigens.

And once they log in they get a lot of information. So the antigen has information that the antigen presenting said has information there. Like, these chemicals you refer to as cytokines that are exchanged and called stimulatory sectors.

And that will determine, basically the subtype of T. So this antigen specific T-cell will become and then it will just multiply. And it is a very specific system.

So each of these T sets has a specific role and even learns, in that that communication, for example, an infection is located and can only enter that very tissue, for example.

Oh, okay. So we can get to t t cells. That only can home to the skin and has the receptor make up that it cannot leave the blood at any other side than skin.

Like if you have a skin infection, for example. So, that, that, T cell has that information and basically imprinted if you so will go into the skin and site.

And that is what each one T cells do. They don't necessarily, kill bacteria or viruses themselves, but they orchestrate, other lymphocytes to come into the tissue and basically, get the job done if you so.

Well. And then the role of the t t helper subsets is, the head T cell head, and they do that in the lymph node a little bit for the conversion of antibodies.

And they also do it, in the skin by orchestrating other cells to accomplish, the fighting. And, there's different subsets of, of these like of, yeah. T helper cells that can be made, as you mentioned, like 22 to 17 for most infectious diseases, the TH1T cells are the important ones.

They they play a critical role. And the other ones are not necessarily of importance to understand, and for treating a disease, I would say or, because they're just right.

The other ones start coming in when we start running into autoimmune diseases and, yeah, and allergy type systems. But today we're talking more about the, just chronic, persistent, bacterial infections and viral infections where the TH1 and and just to to recap, the antigen is the chemical that the foreign bug or protein will will the our body will see.

And everybody today with Covid has been thinking mostly about, at least in the beginning, a lot about the B cells and the immunoglobulins and the T cells now we're realizing, are probably giving us very important immune memory that lasts quite a bit.

I don't want to change subjects, but you want to say a word about T-cell memory, because I think that's important. Is that what the testing you do? And also the Covid?

So the broad concept of, of, T-cell, memory is that, once infection is under control or improves or is cleared, the, the, the same antigen, for example, that, let's say a week ago was responsible for creating T1T cells that site.

But now antigen is very limited. So not as abundance in the lymph node anymore because, let's say the bacterium has died off in the, in the body. And it's that antigen now is seen the information that is conveyed to the T, so switches and educates the T cell, to become, a memory.

T said it has everything with T cells. There's not only one type of memory T cells, there's multiple ones. And they all have specific roles and that sometimes temporary, sometimes more long term.

And then, you can measure in the blood for example, so called central memory T cells, they get made usually at the tail end of an infection. And then they circle around the body.

And they can be measured in the blood for, depending on the disease and the antigen, that's always the limiting

factor. We have to keep in mind. For, for between like 6 to 8 weeks or for other diseases or antigens, maybe even sometimes up to six months.

You can see these T cells in the blood. So, but the, the in context with Covid, people are often talking about and think or not, I don't know if they talk about it, but they think about what they mean is the tissue resident memory T so that is one, really hard to find in the blood because the majority of these T cells are pro definition or, but by the name tissue resident.

So you don't find them floating around in the blood. So they, they sit, in the skin or in the lung and also again, like the, the inflammation where to go is given to them the moment they see the antigen and then they home into the tissue and they stay so now, T cells have a limited lifetime or so tissue resident memory T cells.

It's not like you have an immortal cell that doesn't exist. So now a disease is clear and you don't have antigens. So now you can ask the question, how come the against some diseases B has these memory T cells for quite some time.

Right. The answer to that is there's a system in place, for a certain tissue resident memory T cells that, makes them proliferate like spawn offspring, if you so within the tissue that doesn't require antigen to be present.

Because otherwise we wouldn't have long term immunity. Otherwise. We have 6 to 8 weeks this sitting there, no new antigen after disease has gone.

T-Cell Memory and What Blood Tests Can Measure

No memory. Right. So so that that is a system that is there. And that again depends on what type of disease it is. And how long these T cells can perpetuate that.

It's also a limited lifespan of or a limited amount of proliferation or something like that. So, for some diseases we may have these tissue resident memory T cells for a few months for another disease.

We have it maybe for a couple of years and for another one we maybe have some even longer. But for for Covid, obviously, as this is still a new disease.

I mean, it's. Yeah, around for two years now. We don't know that yet. And, I think the indication is that they also not going to stay there forever. So it's not like you had Covid and you have, immune memory T cells, for the rest of your life.

That's a misconception. Like, coronaviruses are not known, to, to generate, long term memory effects and, so our test is really good at checking, for, for, for, T-cell activity that is currently going on.

So we check often for the 20 cells and also for the central memory T cells. So with these two subsets you have a nice system where you can look at the specific disease.

And you will find, the TH1T cells. At the beginning, of a disease, quite solid and especially in viral infections, we find a lot of T cells often, and, that indicates like a high burden or high disease activity.

So once the immune system starts controlling the viral replication and the as I mentioned, the antigens go down. And then we see usually the central memory T cells come up for for a brief period of time.

And so, so and if you see these T cells, you can assume that you will also have down the road tissue memory, tissue resident memory T cells as well. Okay.

Because that's the, the logical consequence of that. But, vis a vis an L is not how we do. You can measure that because, again, tissue resident memory T cells are not found in the blood, or if so, only for a brief period of time and very rare.

So for that, if you want to check for those or measure those, you would need to go like, go classic, like, go, a tuberculosis classic, right. Take the antigen, and make a skin prick test and wait 48 hours if you have then, eczema on that.

You know, you had memory T cells and. Right. Because the they reside in the skin, not in the not so so just to to clarify because, you know, it's funny, I've been listening to this story for, for two years now, and it's amazing how, it sounds simple, but it's easy from still for me to get confused with it.

If you could, because you, you really do see different, you know, responses. So you have like some of the things like Lyme and, you know, Borrelia, Bartonella.

But because we tend to have, as you say, you know, it seems like smaller responses than we see with the viral infections and, and, and you say sometimes, like when, when you see a T-cell response to a virus to, let's say, to line, let's say to earlier, so you would expect to see one, if somebody that has had the disease for a long time, but they still having symptoms, you sometimes will still see the, that, that, that first, interferon gamma response and probably talk a little bit about the interferon gamma response that you get from the, th one, the T cell.

Okay. So yeah, so one thing is, you cannot well, as you mentioned, different diseases and result is, it's hard to cross compare, the tests we do from disease to this, this disease for multiple reasons.

One, each antigen, has intrinsic or not intrinsic, but the specific maximum, immune response it can induce. And that may vary greatly just because of the antigen, meaning one antigen can spawn, let's say, 10,000 antigen specific T cells, another antigen only 100.

Wow. Okay. So then we do. Yes. And that is, partially due to the signals in the lymph node. Plus, also sometimes there's also nice experience experiments done and show that, that, specific antigens have in mice at least the capacity only to spawn this many T-cells.

And that's the antigen. The antigen specific T cells can only do that. And so that's why cross comparing T-cell frequencies across diseases is is hot and challenging.

And I wouldn't recommend that. Yeah I wonder if that might have something to do with why we see, you know, such persistent you know, because bacterial infections in and when we think about them, we usually don't think of bacterial infections persisting.

You know, we we kind of understand. And we'll talk a little bit about why some viruses tend to persist. But those are ones that if you can correct me, but I believe are mostly DNA viruses that will actually they can get into our DNA, so to speak.

Where you know, like the RNA viruses don't tend to persist as far as the depends rate for the first, there's also persistent infections from from bacteria like tuberculosis can persist.

I think, Listeria can persist. So there are some diseases that are few, but I'm saying but most like. Yeah, brucellosis, Listeria. I mean, there are a few, but these are the infections that we are dealing with that mainstream medicine doesn't often think about other than TB.

Right. And in America they don't even think about that enough. But yeah. So I think that's how let me just go there for a minute, because that's I think an area that a lot of listeners, and I know doctors get confused with is that big difference between the body's response to when you have like a streptococcus section, you know, or a staph infection.

And when you have a Borrelia infection, you know, like, like especially after that first week, what's, what's happened. Because most of the time if you have a staff or a strep, if it's really infection and not just colonization, you're either going to beat it or die.

Yeah. Yeah. So so, yeah, I can comment a little bit like on the Borrelia infections that start with that. So, as I mentioned, the T-cell frequencies that we see for, for Borrelia are often very low.

And, that that has multiple reasons. 1st May be that the, the antigens we use don't have the, high T-cell frequency. That's that's could be one reason.

The other reason, maybe, in the biology of Borrelia itself, Borrelia is a very slow dividing buck, right? The bacterium has, like, division time of up to 48 hours, 24 to 48 hours for bacterium that that's like, very slow.

Right. So, and if you think about it, what that means is that, it also means that you have slow antigen available because if you have only a few bacteria around, there's only limited capacity that they will do a specific protein that ends up to be an antigen.

It makes sense that if you have a low bacterial burden, you have low antigenic burden. And again, that may be reflected in the low T-cell frequencies in addition.

So and then it depends also how, the acute response or the acute infection rate. A lot of people that get bitten by a tick and get Borrelia are fine. They will be able to find an awesome. Yeah.

Then we have cases where that is not the case where Borrelia actually disseminates. It's what it's called when it leaves the skin to go into other body parts and infects others.

Other tissues, like the heart muscle can be infected or, the nervous system can be affected. Right. And then we we come into a territory where it's, it's harder to to fend off.

Borrelia, Chronic Infection, and Immune Evasion

And, then you have like, multiple reasons why the immune system struggles with with fighting it also. So there's the low antigenic burden that you find, is may play a role.

And others is, for example, that there are more studies that show that, that, the, the bacterium can, be in mice, at least invade into the lymph node and, slow down, and make it inefficient.

The, the so-called class which to IgG to antibodies. So basically the bacteria in the human response. So there's multiple factors that slow down the defense and the fight against Borrelia that it can become like like chronic.

And that's something that I think doctors sometimes forget more than patients is how these bugs are. Each one of them has different set of skills in order to modulate and affect the immune response.

You know, it's not just so simple that they come in and they all do the same. Stereotypical dance with the immune system that each bug has its own way to evade the immune system, and Borrelia does it very well. And that is the challenging part of the people that acquire, like, a chronic infection.

Right. And that that moon system is not able to clear it. And, that, also, well, what I just mentioned is the reason why it's so hard to detect in lab tests.

It's not that that the lab tests are that by design, they're not. The issue is that, let's stick with what I mentioned about the antibody measurements.

Like in if there's no class, which there's no IgG. So the test designed to measure IgG, cannot help you there. So the biology is, is of the bacterium is in the way of, of of having really good accurate lab tests.

And it's unfortunate that many, you know, medicine is often 20 years or 30 years behind, the, the knowledge base, you know, the immunology, you know, what doctors do and many infectious diseases, infectious disease specialists, and especially most doctors still believe the dogma that, you know, you automatically within three

months you switch to IgG response.

And that fits really well with most of the with many of the viruses. But it doesn't always fit with Borrelia, that's for sure. We I mean, that is specific for Borrelia.

Yeah. And there's like studies I think a really good study that compared their ology and PCR tests on Borrelia came out in January 2020. And they showed, I think that, they only got they compared acute and chronic Lyme patients and they found only like half being positive for sure for their IgG.

There was a lot positive for them. And that's. Yeah. And again like that's not because the lab tests are not functioning well. That's because if there's no IgG to measure there's not a degree to measure.

And that's so just I mean I want this for patients, but there's a lot of clinicians who are listening and and want them to help understand when they see, you know, your tests and you're not the only one to some other labs were doing, T-cell testing to understand that the response with, just as we said, is that because there's so little antigen, even the T-cell response that you're measuring and, when you measure it, you the numbers seem small compared to the response that you often see when you when you use when you're looking at viral responses with the same technology.

I think that's really important. So, back for a minute. And so sort of from the beginning, is that just to make it into one, you know, one of the problems of me interviewing is that I know, I know parts of the story, and I always want to hear from you in another detail, because I keep learning.

And, so I want to make sure that people get the whole overview, before I keep breaking you up into little pieces. So, basically, you're your the T-cell testing involves two types of cells. And, how do they work? Just just from the top?

Because you know, people. But I want to make sure you tell it in one fell swoop. Yes. Okay. I can try to be brief on this. It's not technology. It's so called Elizabeth technology that comes from immunology research from the 80s.

And, if you. So will we simulate a lymph node in a cell culture dish, so we receive the patient's blood, isolate, the, the white blood cells or the lymphocytes out of it.

And, as you mentioned, we have everything that's required, for antigen presentation in there. So then, after we have isolated them, we play them, in the medium that has some magic in it.

Basically, it is full of nutrients and vitamins for, for the immune cells so that they are happy and, and then we, we add on, to, well, to multiple cells, specific antigens, for, for, for specific diseases.

And now what happens, overnight, we give them 20 hours to do the magic, the T cells. And, is that, antigen presenting cells? We take the antigen and throw it around the circle dish.

And if there's a antigen specific T cell that has been formed in the last 6 to 8 weeks. Okay, that's a requirement, then that he said, we'll see the antigen, the, the antigen, it recognizes and will produce interferon gamma.

That's the signature cytokine of 20. So it will produce that if it sees the antigen okay. So and we measure that in from from gamma is a spot. And in each of those spots I refer to one T cells.

So that's why we can back calculate if it's so well that the T cell frequency to a specific antigen and, we do that also for a second T cell subset, the central memory T cells.

And for that we measure IO release and again with these two T cells, you can see during treatment or during disease progression what happens to the immune system in a disease like, if you like, when we pick up T-cell frequencies, with chronic Lyme patients, for example, you know, you see very few T cells in those cases for the reasons that I just mentioned, that there's not a lot of bacteria often around to to introduce a solid response.

And, so if people then get treated, usually with a few weeks delay, we see it's usually a spike. And the reason for that is that the treatment affects or kills the bacteria.

Like if you wait, that's what you need. We need to give something that kills bacteria. And, if you now have cell death of the Borrelia site, suddenly you have antigen available.

The immune system sees it and makes it makes, makes, makes a spike in interferon gamma producing T-cells. And then the antigenic burden goes down once that is over and then you see the I2T sets the central memory T-cells come up, come up.

And that's why these two T cells are giving you information to guide through treatment. You will see. Oh is can I stop treating or can I shift treating or whatever else.

And, now getting the topic back to the viral stuff. Oh, actually, before we go to the virus, I want to go to, I just want to mention one thing that you've emphasized to me many times is that the interferon gamma that you're measuring and the IL two that you're measuring, are in the plate and specific to the stimulating those cells.

But those cells make up a very tiny amount of the cells circulating in the blood. So testing that you would you know, that they're hard to find. And so they don't really reflect if people go out and get what we call cytokine panels, which people are doing right now, especially with post Covid, the interferon gamma numbers that we see on those cells has no quarter on those tests, has no correlation to what you're seeing in the in the lab because they're coming from different types of immune cells, correct? Yes.

Because also, the antigen specific T cells don't have a role in the bloodstream. That's just their, transportation system to work if you're so.

How the T-Cell Assay Works

Well, so producing like, nitrogen specific T cells traveling from the lymph node into the site of infection is quite right. There's no point for the T cell to produce interferon gamma because A a different gamma is not required in the blood in that case.

Right. So it's required once the antigens specific T cells, is in the tissue and gets re exposure to the antigen again, then it will produce interferon gamma which is a proton therapy, a signal and recruits other cells on site to to fight off.

And that's what's in the tissue. And so the the interferon gamma of these T cells is not produced in the blood. So if you measure a cytokine component is what you find.

There's often, interferon gamma released in the periphery into the blood. Right. But it doesn't by other, by other cells, or you will never be able to figure out which cell produce these interferon gamma most of the time, innate lymphocytes that produce interferon gamma, like IAC once are known, in infections to be responsible for a big chunk of the different gamma production.

So it's not necessarily from antigen specific T cells. If you just look at the blood for these cytokines. Yeah. Then just an echo of the inflammation you have in the tissue.

Right. I guess that that's what what what's difficult. What I just want to emphasize to people is because, how we use these words, you know, T1T cells and, and interferon gamma.

And yet they, they have specific meanings, but they really reflect very, very different, concentrations and, and origins when you are using them in your testimony, when we're just talking about them globally in the body for like, like if, for example, you think about it, if, generic T cells would produce interferon gamma, our test wouldn't work because then the whole plate would light up like, the plate, like, sorry.

Like on average, 40% of the white blood cells are CD4, T cells, which are can be or cannot be like T is one T cells, depending on what they become. Most of them are naive T cells.

So those are the cells that just circling the body waiting for the one day that they find in the lymph node, the antigen, most of them will never find the antigen.

Right. The lifetime of a human body. And then we have the subset of the just recently activated T cells that are just on the way to the job, right. And again, like all these T cells don't produce any cytokines, unless they get stimulated specifically with a specific antigen.

And that's what we do, in, in the Ili spot. And the, the beauty of that is that, antigen specific T cells, they're genetically not. Yeah. Like, the, restricted in based on their identity, what cytokines they can do, like a 2 to 1 T cell.

We don't produce isoform. Right. So it's one T cell. We always do interferon gamma. So that's why, you know, that that if you find a spot out from gamma T, so it was, is from a 27.

And we we're very certain on that. And the same with Io2 O2 in the blood is only produced by antigen specific central number T cells, you know. Oh so there's a requirement that they have been established in the last 6 to 8 weeks.

Right. And that's and the thing is, is that you are isolating the T cells right before you plate them. Yeah. We we isolate the, the the whole slew of lymphocytes, lymphocytes.

If you not only have T cells in there, there's also other lymphocytes in. Right. But the only ones that respond to antigen specific, T cells. So why we can ignore the other cells that are in there because none of them produces cytokines.

By default. Okay. Okay. So then that soon now we can I think we've got that one straight. It's just important to people understand the specificity of this test and not to confuse it because I said we, you know, the world of, what about functional medicine?

I guess we'll call it has been bandied about. It one, two dichotomy. As you know, for so long that people tend to forget how many cells, different cell types we're talking about and actually probably what every six months do you find or probably every two months, maybe there's another T, another T cell subset found?

I have no idea. But it seems this keeps multiplying. Yeah, it's a but because it's a very specific system like each subset has a specific role and yeah.

So so and that's the beauty of it. Right. And and yeah. So yeah it's confusing when we, when we, when we dive down to five, which we won't do today. Yeah.

So, so, so what do I always think of I think what, what people should think of also before ordering lab tests is what you mentioned. Specifics. Right.

With the cytokines and, and immune cells, really everything has a very specific role. And one cannot necessarily extrapolate from scenario A to scenario B, then that's often not a good idea.

It's like one has to be very specific. Like again, what we said earlier, the T cell frequencies are very specific for certain antigens and certain diseases.

Right. You cannot extrapolate. Oh I see this many T cells and this is a an exemplar to disease B that's that's not how it can be applied. So let's let's switch and just go and continue with the same major topic of T cells and T cells testing.

But let's talk about the viruses. Because chronic viruses has been something that I mean, I know I have been

chasing for 30 years now or probably longer.

And, you know, we, we know that for most people, these very elevated Epstein-Barr and cytomegalovirus, it has six, titers. When we measure antibodies to them, we know that they don't represent in most people, active infection, you know, active replicating virus.

But it it's hard to discriminate between this few people who that actually has an inactive replicating virus and the people who have virus that has now become part of their B cells.

So can you just talk a little bit about them about that, especially with the EBV, CMV? Yes. Okay. So so that is a basically a type of viruses that belong to or to the herpes family viruses.

Right. So Epstein-Barr and cytomegalovirus V6 are human herpes viruses.

Using T-Cell Testing to Track Lyme Treatment

And they are this they are known to, integrate into the DNA of, of often immune cells. Not always like depends on which virus we're talking about. Like they all do different hosts if you so and the interesting thing about these viruses, they have, an a primary infection like EBV especially is known as being very exhausting.

Right. Like, it's causing mono. Yeah. My nose is, that the people are very tired, exhausted and so on. But then, after the initial infection is over, they're fine.

So what's happening in these diseases is that, the virus, switches life cycle. So you're kind of thinking of, like, there's an on and an off switch, but you're always with the virus.

The virus will never leave your body, right? Because it's persistent. Chronic controlled infection is the term for that. And what that means is you have, the virus integrated and then in some cases, they're completely quiescent in the DNA.

In others you have specific viral particles that are made, but they, they don't do anything right. And, I mean, it depends on, on which virus it is. And, then then in most cases, you have a role like, especially in EBV and CMV, you have a requirement of the immune system, to recognize the virus and, to keep the virus basically in the control and infectious stage.

And, that's why, makes for us. Is the lab possible? And what we have is specific antigens, for, the so-called latent, that's a chronic controlled infection stage for the latent cycle.

And so the duty cycle politics cycle is when these viruses shift gears and become new, meaning basically, they start doing slightly different viral particle that pumps the, the cell, and then they can infect the new cell.

Right. So that's what we call that the the lytic phase. Yeah. Exactly. And that's and that's often when the people feel symptoms again, like, like, for different herpes virus would be shingles, right.

When people get the infected and slammed into the blisters, or if you think of, of of, one or herpes two with cold sores. Yeah. The cold sores. So, the the difference between EBV and seeing these activations is they do not have these visible symptoms necessarily.

I think in some reactivation you can get skin rashes, but it's not like a given. Like like, this is other herpes virus. That's where you clearly see the blisters and you know, it is.

Right. And what's going on. So that makes it often so hard to see if somebody has a reactivation because the people are just more tired and exhausted.

And then, I mean, personally it's really hard to differentiate that. Right? Is it just daily life and chronic stress and

work. You know, or, or just, you know, like the, the ins and outs?

I mean, we know exactly. But once they especially once they reach what we call that chronic fatigue stage, that any kind of, you know, you don't know, is it because they did a little more for two days that they're crashing, or is it just that the virus is now coming out and and, you know, in a reproductive phase, that lytic phase again.

And we this was the two different subsets of antigens that target like the lytic and the latent. You can actually, fairly good. I think it's very accurate.

It was the T cells measure the responses because, if you have the latent states, you most often find T cells against the latent stage. CMV for sure, because there's a requirement to have CD4 T cells to, to keep CMB at bay.

With EBV, it can be varying so that you can find sometimes lower titers of antigen specific T cells or sometimes even on but once, the virus is bothersome again, you'll find for sure against the lytic variant.

Right. Because the lytic particles are only made when they are losing. And, it's a flare. So then you'll find, the T cells because the antigen is required.

Right. So, so that each one T cells during that lytic phase, you would expect to see again those T cells, they would last about the same time 6 to 8 weeks generally.

Yeah. It's I think it's a good estimate. It's just estimates. Right. But I think so that's a good estimate. And then you can also see once the let's say once the virus quiets down again and goes into the late stage, you will see that the T cell frequencies go down, in conjunction with, antigenic burden, like with the viral load, like the lytic viral particles go away.

And over time, the one t sets go away. And then you see, sometimes the, the I2T cells. So the memory T sets up and yeah. So that's the beauty of this test because it's, fairly quick moving along with what's happening with the virus in the body.

And if you look at, antibody titers, it's a little harder because IgG titers for example, are often slower moving. They move along a little bit too, but, not as quick as T cells.

So you will find, it's things improve quicker improvement in the T test than in the antibody test. Yeah. Or the antibody tests I can tell you from years of doing them are are not much help once you get you know above you know, the normal background level.

You know almost everyone has had EBV or CMV sometime in their life, especially usually when you're young. So the background antibody level for Epstein-Barr, you know, I always feel once it gets a few times normal, you know, especially we see these people who, like, are greater than 600 or greater than whatever, like, you know, about ten times their upper limit of, like, what you would expect to see when the acute infection.

They have, you know, it's really hard to interpret the antibodies at that point because they often stay. I mean, and, you know, we look at the different subsets, whether it's the nuclear antigen or the viral capsid.

But even so, it's difficult to, parse that. Well. And, you know, the the T cell test gives us a better idea what I haven't done.

Why Blood Cytokines Do Not Match the Assay

And I wonder if you've had reports of people who have done and I should do this, is looking to see if we get a response, a quicker response when we use antivirals as far as reducing the lytic phase and inducing more of the latent or the IL, the IL two response.

And you should, see that. Yes. Yeah. Treatment, reduces the viral particle numbers, the T cells to each one T cells.

Yeah. We should see especially since we go up.

Yeah. The EBV is a little easier to treat. So that would be an interesting. Yes. I mean which I, I'm surprised we haven't done that. We should be doing that.

Embarrassing moments okay. So yeah. So I mean basically we we we kind of covered one thing. Can you talk a little bit about, you know, cytomegalovirus is one of those things that many people get, you know, upset about because we don't like to have it.

But we do see that it goes up in many people. The serology makes the antibodies go up with aging as people age. And actually some people in the anti-aging community consider it a sign of, an aging immune system.

As the CMV titers get higher as we age. I think that's a little bit inaccurate view of of of it. So you have, because, you have multiple things going on with CMV and aging and the immune system over time.

So CMV is it's a a little bit in immune immunology, oddity. By the way, that's cytomegalovirus. But I always yes, just for, it does things that are surprising, like, so you always have latent virus around, and that means you always have T cells against it.

So, it does, antigenic conversion, if you're so well meaning, it has multiple antigens on the surface, but, the older you are, the less T-cell repertoire recognize is the virus.

It's a very specific antigen. And, that T-cell that is specific for that very antigen also dominates, like the, the T-cell compartment later on in life.

So that's what I meant with conversion. And there's, really interesting research out on it. Actually, that shows like, in younger age, this, T-cell, is cross protective against other diseases, but unfortunately, it loses that quality down the road in life for whatever reason.

So, and one of the known downsides, of having CMV, I mean, CMV stays with you for the rest of your life, right? You can. Okay. But and, I think there are studies from the heart associations, that show that that people with, like, 70 over age, ten years of age, 75 years of age that have had CMV since young, are more prone for heart disease, cardiovascular disease.

So I think that's where the anti-aging community comes probably in or where that makes sense in a bit because, if you have, more and more heart disease and, high blood pressure, that's probably, not a great thing to have.

And, so, so, that's immunologic wise is this oddity of, of this conversion to what's one T cell epitope? Okay. So, so it's, so you start off with multiple T-cell epitopes with C and D.

And over time you wind up with just one I think one dominant one. Yes. One. I think it's almost like and I could have this wrong, but I think there's a belief that it's almost like your immune system is, losing some flexibility when it has when, when it starts to dominate and also just the amount many times of the antibody.

But I could be wrong. Yeah. That's something we're going to. I have a, I have someone who's made a study of this, who's going to be on one of our, one of our next, so, so in general, to, to do this called immune senescence.

But there is a bit of scene B, right? Immune senescence just means that, that, you have less naive antigen specific T cells. And, hence over time, your chances of having the appropriate antigen specific T cells for disease, you acquire, is lower.

Or let's say if you if you let's, let's say if you acquire at age of 30 disease a and you have, like ten T cell epitopes against the disease and you fight it off, fine.

But now you're 75, you acquire the same disease, and now you only have by chance size antigens, specific T-cell

epitopes that you can recognize. And hence you drink on the cold or whatever disease it is following.

Right. As the system gets us, a little bit. Yeah. Yeah. Less vigorous. Yes. Yeah, I get that. That's, that's, that's that's a common effect.

Chronic Viral Infections: EBV and CMV

And that unfortunately happens to, to most of us. Right. Okay. I think yeah, that's what they're probably looking at that increasing as we age it gets less and less.

And I think I don't know how solid the research is on that, but, the there's at least some speculation that people with CV, the immune senescence is a little bit enhanced because of this dominance of this one, epitope.

But, I'm not certain. It's been a while since I read that stuff, so I'm not certain how that actually worked in in theory. Right, right, right, right.

But, but but just getting back. So the this the ability to use T cells, I mean, the thing I want people will say is that this is for the clinician, for those of us who are treating patients, this has been a revolutionary step, okay.

Because up until up until recently, we only had B cells to look at, only these immunoglobulins to look at. And the immune globulin also lasts from 3 to 6 months.

But sometimes they seem to last a lot. I mean, everything's like, you know, the herpes family virus. Since we never get rid of them, there's always low levels persisting.

And so it made it a little harder to know who was who was actively ill and who was just having a slow, I guess, or who's having a B-cell that was just showing that antibody now and then, you know, presenting an antibody and then getting your whole immune system triggered, so, so at this point when you use, so just one more time, so what the T-cell testing does for us is to and let you just one more time, because I know I keep going off on some tangents that that intrigued me.

And I want to make sure people I suggested why this is so important. Yeah. So I would say the importance is not necessarily in detecting if a disease is present.

The importance is in if you have a patient that has a certain disease and you see T cells, that you that gives you a tool at hand where you can monitor disease progression or a treatment of efficacy.

Right. So you will see changes, if you start treating and that also gives you the opportunity, if you chosen the right approach to stop treating in time, or if you choose the wrong approach to, to contact and say, okay, it's not really working.

Let's, let's try a different role. Right. So, so that's, that's the beauty of this test that the T-cell frequencies in a given patient will tell you over time what the immune system is doing.

Are they in fighting mode? Are they preparing for future with this generating memory T cells like the central memory T cells that we can measure. Right.

So so that that is the strength of this test that that is very intrinsic to a specific disease. If a patient has these T cells then you can utilize it.

During treatment. Yeah. No, I think I just want to emphasize that again is that it gives you two pieces of very important information. One is the disease present.

We can assume that if the T cells aren't reactive at all, then at this moment, that disease, you know, especially with Borrelia, yes, it could be hiding still.

So I mean, that's why I would say that if it's if you have a very high clinical suspicion, it's probably worth repeating or then get a Western blot to see if there was any evidence and wait till symptoms flare, or you treat and see if you get a T-cell response.

Yeah, I think that's a, I mean, something we've done in the past, using, you know, with, with Borrelia is sometimes treating and then checking because the very nature of the bug, because there's so few of them and just remember, I think, you know, I think staph or strep reproduce like every 20 minutes or something, just to give people an idea of the different rates of rate of reproduction between, you know, once every 48 hours versus once every 20 minutes.

To give you an idea just a lot more quickly, you know, I mean, that old pain doubling, doubling, you know, have you getting a penny and doubling it every day, you know, gets you a few million dollars by the end of the month?

Well, imagine the difference between if you doubled it every 20 minutes or every, you know, two years, but it's usually different. So, yeah. So no, I think so.

In fact, the lab really I mean, like, Doctor Carruthers, we need, you know, who, who I think really helped bring this bring this test to the Lyme community, you know, from Germany.

And I think bringing it to America really made a difference, because those of us who try to use it when we had to ship to Germany realize that T cells don't live long and and it's it's really important.

And that's the beauty of having you in America that we can get those tests to you overnight and really have. Right. That's, that's, that's of very high importance, like, as we mentioned earlier, we, we, we look at a fraction of the T cells that are in the blood.

And, if you look at shipping for multiple days, like each day, you lose, a boatload of T cells, so you lose a lot of sensitivity in the test. If you only look at the a few antigen specific T cells.

So, the short at the time between the blood draw and the lab processing it, the better it is for the quality of the test and also the reliability. And at the end of the day. Right. Yeah. Yeah.

And just to remind people is that we're looking at live cells when you when we do serology tests, which means looking at antibodies, we're looking at proteins that reproduce.

And yes, they can degrade but they're they last quite a while. You know in blood samples as well. You know, T cells, especially ones that are live and we're looking for a very few of them.

We need them live and healthy. So they need to be fresh. Okay. Well, really, Felix, thank you so much. I said, I, talking with you. I always want to answer my questions.

Which keep getting bigger and bigger. But we have that. But I think the basic information is just so important that, you know, we have a technology here that can really diminish the length of time we need to treat people.

Because sometimes when people are having symptoms from multiple infections or for multiple reasons because we I so this is a mycotoxins summit. And so you all will know that sometimes you can be treating and you get an exposure and the symptoms can also mimic each other.

So it's nice to know that even though you thought your mycotoxins were gone and now we're treating your line, we have a way of checking whether the Lyme is still causing the problem.

So anyway, so again, he looks. Thank you so much for your time. I really appreciate you and all the work you do and the fact that you keep, you know, trying to, you know, just always improve the tests and give us some more, give us some more things to do that will improve our patient care.

So thanks again. Yeah. Thank you for for having me. Thank you very much. My pleasure.