The role of hyperbaric oxygen therapy (HBOT) in regenerative medicine

Dr. Joseph M. Raffaele, M.D.
Jason Sonners, DC, DIBAK, DCBCN, CCWP

Dr. Joseph M. Raffaele, M.D.
Fascinated with human biology and performance, Jason Sonners, DC, DIBAK, DCBCN, CCWP is always working to integrate new knowledge and practical experience. In addition to his doctor of chiropractic, he earned his Diplomat of the Chiropractic Board of Clinical Nutrition and his Diplomat of the International Board of Applied Physiology. He is currently enrolled at the University of Miami School of Medicine, earning his PhD in molecular biology with a concentration in regenerative medicine. Dr. Saunders published an Amazon bestselling book in 2020 entitled Oxygen Under Pressure, describing the science and benefits of using hyperbarics for a variety of indications, longevity, and performance enhancements. He is also on the board and faculty of the International Hyperbaric Association and the International Board of Undersea Medicine, lecturing at functional medicine conferences all over the country and certifying doctors and technicians in hyperbaric medicine. Dr. Saunders and his wife, Dr. Melissa Saunders, are co-owners of Core Therapies Family Wellness Center, a multidisciplinary clinic in Northern New Jersey. They're also the owners of two hyperbaric clinics, New Jersey HBOT, PAHBOT, as well as HBOT USA, a business designed to help practitioners obtain hyperbaric equipment, provide education, develop their business protocols, and earn their HBOT certification.

Dr. Joseph M. Raffaele, M.D.
Welcome to another episode of the Telomere Summit. I'm your host, Dr. Joseph Raffaele. I'm very pleased today to have with us Jason Sonners, DC, DIBAK, DCBCN, CCWP, to talk about hyperbaric oxygen therapy, a really interesting modality affecting multiple medical conditions, as well as perhaps the aging process, which we'll talk about and a little bit about how it has been shown in the study to improve telomere length and senescent cells. Welcome Dr. Sonners.

Jason Sonners, DC, DIBAK, DCBCN, CCWP
Thank you. Yeah, it's really great to be here and I love any opportunity I have to share some information on this topic. So thanks for having me.

Dr. Joseph M. Raffaele, M.D.
You're welcome, yeah. So why don't we start just a little bit about how you got into your interest in hyperbaric oxygen therapy. I always like to hear the story of how people get to where... And I know, you're passionate about it, just talking to you a little bit before the interview, so I'd love to hear about it.

Jason Sonners, DC, DIBAK, DCBCN, CCWP
Yeah, so I mean, the short story is, I was a few years into practice and I was working on flipping a house actually as like a side project nights and weekends, and I was putting a new roof on the house and I herniated a disc in my lower back which led to a full neuropathy, a full drop foot in my right foot.

Dr. Joseph M. Raffaele, M.D.
Well.

Jason Sonners, DC, DIBAK, DCBCN, CCWP
And so I was out of practice for a good few weeks, my wife happens to be a chiropractor, so she was working on me, treating me, most of the back issues had gotten better within about three or four weeks, and I was back to work, but I still had a full drop foot left to my right foot, and a year later, it still never changed, and 18 months later, it never improved. And so I was about 25 at the time and I just sort of assumed that was my life, and I was learning how to cope and deal with it. It was pretty devastating, 'cause some of my background is exercise physiology. I'm a chiropractor, I do a lot of clinical nutrition, I thought I knew all the things I needed to know to help somebody like myself, and I just couldn't figure it out. Fast forward, about that 18-month time period, I was at a show and they had a big vendor hall and they had these hyperbaric chambers, I had no clue what it was. It looked interesting and they were doing demos, so I asked the guy if I can try it, so I went in, I did about a 30-minute session. It was interesting, I didn't really notice much, and then I got out, I started walking around the vendor hall, and in about 15 minutes, I started getting like pins and needles on my foot. And that was the first time I had felt my foot in literally 18 months at that point. So I started to think like, "Wow, am I feeling my foot because of this, this chamber?" So I went and I spoke to the rep for a little while, of course, he said, "Oh, yeah, of course. That's what it does." And I'm like, yeah, right. I'm from Jersey, I'm skeptical of everybody, so. Anyway, so he agreed to treat me, so I did about eight

hours worth of sessions in 30 minute increments over the course of four days, and I left with about 15, 20% improvement in my foot.

Dr. Joseph M. Raffaele, M.D.
Wow.

Jason Sonners, DC, DIBAK, DCBCN, CCWP
So I bought the chamber, I had no intention of ever using it in practice honestly, I just I bought it for myself, I treated myself for a couple months at home and I had 100% full recovery in my foot. From there, my stepfather had recently been diagnosed with Primary Progressive MS.

Dr. Joseph M. Raffaele, M.D.
Oh.

Jason Sonners, DC, DIBAK, DCBCN, CCWP
And he was starting to go downhill pretty quickly. And we were already starting to do a bunch of things like nutrition, in addition to some traditional therapies, but nothing was really making a difference, and I thought to myself, I said this is just pressure and it's oxygen, couldn't possibly hurt. I had a neuropathy, he has a neuropathy, they're completely different mechanisms, but maybe, this is about 15 years ago, so there's not a whole lot of research today, there was even less than, and so there wasn't much to support the concept, but I just thought, hey, let's just give it a shot. So we did a very aggressive basically 40 90-minute dives, 40 days in a row, it's what we did.

Dr. Joseph M. Raffaele, M.D.
I like how you call it, dives, is that what they do?

Jason Sonners, DC, DIBAK, DCBCN, CCWP
Yeah, 'cause they came about because of recompression chambers for the men for scuba, yeah, so we still refer to it as a dive, but-

Dr. Joseph M. Raffaele, M.D.
Now I know the lingo, that's cool.

Jason Sonners, DC, DIBAK, DCBCN, CCWP
Yeah, it's . He had an amazing change. He had his gait narrowed, his balance improved, the swelling in his feet reduced, he started getting feeling back in his feet, he started walking stairs again.

Dr. Joseph M. Raffaele, M.D.
Wow.

Jason Sonners, DC, DIBAK, DCBCN, CCWP
They had to change his diagnosis to relapse and remitting just due to the fact that he started having all these improvements.

Dr. Joseph M. Raffaele, M.D.
Sure.

Jason Sonners, DC, DIBAK, DCBCN, CCWP
And now, it's 15 years later, he still uses the chambers and he's doing better today than he was even then. So at that moment, I said, we're missing something 'cause again, my issue was very unique, his issue was unique, but somehow it helped both of us, and there wasn't enough data to support either one of those stories. And so that's when I really got interested in the science and the research and kinda building it out from there.

Dr. Joseph M. Raffaele, M.D.
Absolutely fascinating. So that if that doesn't interest you in learning more about hyperbaric oxygen therapy, I don't know what's going to. So let's dive into, so to speak, a sort of basic explanation of what it is and what are the physiological principles behind it, and then after that, maybe we can talk about some of the primary indications for it, and then we'll go from there.

Jason Sonners, DC, DIBAK, DCBCN, CCWP
Yeah, so the sort of the easiest way to explain it, I think is right now, there's an atmosphere around us. I mean, I live in Jersey, I'm in Florida right now, so I'm at sea level. So our atmosphere has a pressure, at sea level, we call it one atmosphere. So at one atmosphere of pressure, there's just enough pressure to allow my body to absorb oxygen and saturate my red blood cells virtually 100%, let's just say, 98, 99% saturation, right? What we know is if we go to altitude, let's say I went to Denver, all of a sudden, we say there's less oxygen at elevation, and really, air is 21% oxygen, no matter where you are, even at the top of Mt. Everest, air is 21%, or sorry, oxygen is 21% of the air that we're breathing, but there's less pressure. So as you get away from the Earth's surface, there's less and less pressure, which means every time I take a breath in, there's less molecules of oxygen being brought into my lungs and then there's less of a driving force driving that oxygen into my plasma for the red blood cells to pick up. So most of us know this, we have an adaptation to that, the adaptation is ultimately if I can't saturate my red blood cells

enough, my body will start to make more red blood cells. Now, I have more taxicabs to deliver all the oxygen my body's trying to deliver. So that's as we go up above sea level. As we go below sea level, which is really what we're trying to create in hyperbarics, the exact opposite is true. As we start to go below sea level, we're increasing the pressure of the air or the oxygen that we're breathing, and ultimately, if you remember, I don't know, fifth or sixth grade chemistry or biology, molecules move from high concentration to low concentration, so as you can create a larger concentration of molecules in your lungs, there's a larger driving force to move oxygen from your alveoli inside your lungs into circulation. Normally, when we talk about oxygen delivery, we talk about red blood cell saturation, and ultimately, what hyperbaric is really doing is saturating the red blood cells, sure, but really, it's super saturating the plasma. So under normal circumstances, our plasma carries very little oxygen, literally about .3 milliliters per 100 milliliters of blood, but under hyperbaric conditions, we can increase that 15, 20-fold, depending on how much pressure we're using and what percentage of oxygen we're breathing, and as a result, the plasma, which is typically carrying such a little amount of oxygen becomes almost an unlimited reservoir, able to hold on to all this extra oxygen while you're inside the chamber. And so that becomes important for three reasons. One is, in a lot of cases where there's trauma or inflammation, whether that's post-surgical or chronic illness or post-stroke, or so many of these conditions, there's a breakdown in the micro circulation.

And so when there's a breakdown in the micro circulation, the red blood cells can't get from point A to point B. And so the other side of that obstruction becomes hypoxic. Well, if you're dissolving oxygen in the plasma of the blood and bypassing red blood cells, you actually you don't need them to carry it anymore, all of a sudden, as long as the fluid can get through those areas, oxygen can now get to those areas, and so we're able to oxygenate that tissue because of that. The other thing that it does is that because it's saturating inside of our blood, when we get out of the chamber, it literally starts trying to come out of solution, it literally will bubble up. So there's a certain distance that oxygen can normally travel away from a capillary to interact with either some cell or some tissue. When you get out of a hyperbaric chamber, that distance increases by about four times greater. So again, when you have either these barriers of perfusion blockage or damaged circulation or basically tissue hypoxia, when you could have the oxygen travel further distances, you can really impact that hypoxic tissue and start really waking it up and start regenerating that tissue. That's kinda like HBA 101, if you will, in terms of mechanism.

Dr. Joseph M. Raffaele, M.D.
Sounds great. Yeah, so that's obviously why one of its primary uses is in wound healing. There's that blockage to and it's particularly diabetic wounds and things with this poor circulation. So in terms of the... We've talked about the pressures changing, it gets a little fancier in terms of

the protocols, are there different protocols for different indications? Let's talk about some of the basic ones. We've all heard about the wound healing ones, but now we're hearing that people can do it for just general health, they can do it for particularly cognitive function, I've heard, it can be beneficial for. And what's the mechanism behind that?

Jason Sonners, DC, DIBAK, DCBCN, CCWP
Yeah, so I mean, there's a lot to that. One is, I would say, traditionally, we use hyperbarics, let's say, insurance-based indications in a hospital setting. We're talking about things like gangrene, osteonecrosis, radiation damage, necrotizing fasciitis, basically, we're talking, in most cases with carbon monoxide poisoning, we're talking about literally life or death or life and limb-threatening conditions. And in most of those cases, hyperbaric is the last resort before, either someone's about to die or an amputation.

Dr. Joseph M. Raffaele, M.D.
Right.

Jason Sonners, DC, DIBAK, DCBCN, CCWP
And in a lot of those cases, even being the last resort of these terrible conditions, it seems to have an amazing impact on a lot of these patients. So, but the mechanisms that it helps with those conditions, and the mechanisms of all the things, I don't treat any of those conditions in my clinic, if I have a patient in need in that scenario, we happily send them to wound care clinics, to the hospital, we're not equipped for wound debridement, or other things like that in our clinics, if you can get it covered, that's great, and I'm just as happy to send people into those clinics for that purpose. But what's really happening is you're reestablishing the oxygen gradient, a lot of wounds, because of poor circulation, because of diabetes, or just these chronic non-healing wounds, there's this breakdown of the oxygen gradient, that's what I was talking about with the pressure, and so when you can reestablish an appropriate gradient, or even a larger than normal gradient, and all of a sudden, drive oxygen into that tissue, it's gonna stimulate almost all of the same pathways, and and hyperbaric happens to be very, what I would consider to be anabolic. It stimulates collagen and fibroblast proliferation, it stimulates stem cell proliferation, it stimulates brain-derived growth factors, platelet-derived growth factors. So a lot of these growth factors, collagen, stem cells, it's very tissue regenerating, tissue repair and inflammatory control. So when you start looking down all of the cascades of cellular signaling that occur with hyperbarics, whether it's osteonecrosis and gangrene, or it's, we'll talk later telomere length, MS or post-stroke, the mechanisms of what we're trying to stimulate are virtually the same. And what I would say is probably one of the biggest differences is somebody with carbon monoxide poisoning or gangrene, we are taking oxygen, literally to human tolerance. In other words, hyperbaric is a great tool, oxygen is very healing, but you could take it

too far, and there's consequences oxygen toxicity, central nervous system, oxygen toxicity, pulmonary oxygen toxicity. So when we're treating these life and limb-threatening illnesses, we are taking people often very close to human tolerance of oxygen, because that's what's required in those moments. And what I would argue and we haven't been able to prove this exactly yet, but I think one of the things that I would argue is we have a tool that has a very large range of pressures, with a large range of percentages of oxygen that we can use, and perhaps the the tool is consistently the same, but we should maybe consider matching the severity and the intensity, right? Here's the severity and the acuteness of the condition, here's the intensity of the therapy. An these very severe and very acute conditions, we wanna be very intense. And these more chronic and sort of chronic illnesses that are plaguing so many Americans between autoimmunity, neurodegenerative so many of these conditions, we probably don't need to take them that far in order to get the same result, and as opposed to a lot of acute and severe conditions where we're only treating maybe six times or 10 or 12 times, these chronic illnesses probably require less intensity, but longer durations of care to really start changing their pathways and they're signaling on a more long-term basis. As I mentioned, my stepdad's been doing hyperbaric for like 15 years, MS isn't something that we have figured out how to get rid of.

Dr. Joseph M. Raffaele, M.D.
Right.

Jason Sonners, DC, DIBAK, DCBCN, CCWP
It's a way that we're managing it, right? But we're managing it along with other things too, of course, but we're managing it pretty successfully using that as a tool. So that's kind of a breakdown in my mind of how we can start thinking about some of these.

Dr. Joseph M. Raffaele, M.D.
Yeah, that's very helpful. In terms of the signaling, you mentioned earlier when you were talking off camera about Hypoxia-inducible factor-1, alpha, I guess, HIF-1 alpha is the terminology for it, that's one of the main things that's induced. How does that work, and what are the other signaling pathways? 'Cause I think about oxygen also as being... If you're talking about the extremes of oxygen as being a free radical generated rush to your body, and if Earth was 30%, oxygen, we'd all be in a world of hurt, but you're talking about transient levels of that, and that's the difference 'cause it turns on a signaling pathway and then we remove the oxygen, how does that work? And how does that... How does that feed into the kinds of conditions that you treat? And let's talk a little bit about what those conditions are.

Jason Sonners, DC, DIBAK, DCBCN, CCWP
Sure. So I would say that, in the reading that I've been doing, especially the research curve for hyperbaric was flat for about 100 years, and we're finally starting to make this turn, and there's a few groups that have played enormous roles in that. There's a group out of Israel that's definitely played one of the largest roles in our understanding of hyperbaric for these types of issues, primarily, and we'll talk more about them and some of the research but one of the things that we can say is that there's an actual physical amount of oxygen that people get. So what pressure were they at? What percentage of oxygen were they breathing? And how many minutes were they in the chamber? And we can multiply those out and create a concept around a dosage of oxygen per session or per protocol, per treatment protocol. And that's a dosage of oxygen, and the primary in my mind, when we're hyper-oxygenated, some of the things that seem to be most stimulated from that would be mitochondrial function, upregulation of ATP, ATP efficiency, upregulation of fat burning or even ketosis, if somebody is kinda shifting in that direction, eliminating the rate limiting steps in ATP production. CoQ10 would be one of those, Cytochrome C could be one of those, but oxygen is one of those rate limiting steps of ATP production. When we upregulate oxygen inside the body, we could really start turning the crank on ATP production, that's where we're gonna get cellular energy from so, and that's systemic. It's not like I can give that to your liver or your heart or your brain, you have to breathe this in for this to work, and it has to go everywhere when it does that.

And so any cells that are exposed to that upregulation of oxygen could start to have upregulation ATP production, therefore upregulation of tissue and cell function because of that. And we see that showing up in liver function, in brain function and in performance in general. So I call that the mechanical side, right, that's a dosage of oxygen and the machinery that's affected by the dosage of oxygen. On the other side is this cell signaling component, and the cell signaling component is much less well understood at this time, although we're starting to be able to look at it from a cascade of events. Probably at this point, what I would say, and this has even changed for me over the last couple of years, but I would say that reactive oxygen species is probably the most important cell signaling cascade that we have when it comes to hyperbaric and HIF-1 alpha. And if you look at the pathways of what happens, reactive oxygen species has gotten a very bad rap in functional medicine and from what the things that I've learned and the different things that I've treated patients for, especially with chronic illness and other things like this. And again, I can't completely prove this, but there's a great paper by Angela Poff and Dominic D'Agostino. I think it came out in 2020, in comprehensive biology maybe, I could link it to this conversation after the fact, but they talk a lot about the reactive oxygen species. So there's exogenous reactive oxygen species, right? EMFs, radiation, smoking, drinking, stress in my life, all the things that are acting on me from the outside world, right?

And I would agree that those are things that are gonna pretty well, they cause lipid peroxidation, so they're gonna destroy our cell membranes, our mitochondrial membranes, our nuclear membranes, they're gonna create epigenetic and genetic damage, these are terrible things. So I'm not saying that they're not terrible.

Dr. Joseph M. Raffaele, M.D.
Right.

Jason Sonners, DC, DIBAK, DCBCN, CCWP
It seems to be different when the reactive oxygen species is a normal release of mitochondrial ATP production. And so as your ATP get upregulated or your mitochondria get upregulated, therefore ATP increases, we also get an increase in reactive oxygen species, but when it's endogenous, in other words, it's because the body is making it, one of the benefits to that is it seems to massively upregulate our own endogenous antioxidants. Specifically superoxide dismutase goes up from hyperbaric oxygen, catalase and glutathione peroxidase, So we start getting an increase in endogenous antioxidants to deal with the increase in reactive oxygen species so that not only could that be improving how well we tolerate it from a hyperbaric standpoint, but my argument would be, I think that there's evidence now to say that it's actually gonna also help you deal with your external environment because your body is now learning how to tolerate and upregulate its its own defense mechanisms against that oxidation.

Dr. Joseph M. Raffaele, M.D.
So it's like a hormetic effect, almost like exercise in some ways-

Jason Sonners, DC, DIBAK, DCBCN, CCWP
100%, I look at hyperbarics... I'm sure a lot of the people that you're interviewing, we're all very interested in longevity and improving performance, just not athletic performance, like life performance.

Dr. Joseph M. Raffaele, M.D.
Sure.

Jason Sonners, DC, DIBAK, DCBCN, CCWP
Maximizing human performance in whatever endeavors we have, there's no doubt that that's the best word for it probably, is this hormetic effect where we can challenge and stress the body on a regular basis in different modalities enough to get a stimulus, enough to get change, enough to get improved strength and resilience to the outside world, and not so much that breaks us down faster than we can recover, right? Exercise is great, you could also do too much

of it, right? So if you're not getting enough or if you're doing too much, that's not gonna serve you, there's this happy place, and the more of it we do, the more of it we can handle. And the more of it we do and the more of it we can handle, the more we can start to tolerate the rest of our environment more effectively. And I look at hyperbaric identically to that, the same way I would with fasting or other dietary challenges, or temperature like sauna and ice baths and all the different modalities, I use them all in my life personally, as well as recommend them to patients. So I think hyperbaric fits that model really, really well when it comes to this.

Dr. Joseph M. Raffaele, M.D.
So that is very important that you have the right protocol for the right patient.

Jason Sonners, DC, DIBAK, DCBCN, CCWP
100%, right? 'Cause if you have someone who's very sensitive, right, and we have, I'm sure you do, we have these very over oxidized, very delicate, sensitive patients and we go and blast them in the chamber at high pressure, could they have a negative response? Absolutely. Could we expose them to more mild exposures of oxygen and then just build that up as their tolerance increases? I mean, that's our approach. That's a lot of what we do in our clinic with regard to hyperbarics, especially for those patients. So and then lastly, is that sort of the HIF-1 alpha, and there's so much that it does, but I think the best way to explain this is, we know that there are many anabolic benefits to hypoxia and there are modalities that help us, whether that's living in altitude so that we're creating a hypoxic environment or we're artificially creating a hypoxic environment through other tools and modalities that are out there. What that seems to do is that seems to stimulate HIF-1 as well, it seems to stimulate VEGF, so we get a lot of the angiogenesis and the rebuilding of the microcirculation, which is great. It also seems to stimulate other stem cell releases and growth factor releases.

It's trying to improve our body's ability to heal, recover and prepare for this lack of oxygen and to be prepared for when oxygen increases again, and we can start a big cascade of recovery and regeneration. In one of the studies done, I think it was in 2019, it was called the "Hyperoxic-Hypoxic Paradox", it was that done by that same group of Efrati out of Israel, and what they were looking at was the differences between hypoxia and what's considered to be hyperoxia with intermittent hypoxia, but when you use hyperbaric, there's never actually hypoxia, it's all relative. So in the chamber, you're hyperoxic, you're getting more oxygen than normal, when you get out of the chamber, you're just going back to normal, like sea level oxygen, but because you were hyperoxic and the chamber was driving that oxygen into your body, when you got out of the chamber, that oxygen wants to get out. It's like shaking a can of Seltzer and opening, the bubbles have to come out, right? But when oxygen comes out of our body, it doesn't just bubble up it actually interacts with our body and stimulates it. But when

oxygen's rushing out of your circulation, it seems to stimulate either most but potentially all of the same cell signaling cascades as hypoxia. Here's the difference. With chronic hypoxic exposures, you get the VEGF, you get the HIF-1, you get the stem cells, you get the growth factors, you get a lot of that anabolic stimulation, however, it appears to have a reduction in sirtuin activity and a reduction in mitochondrial activity.

Dr. Joseph M. Raffaele, M.D.
Well, yeah, that makes sense.

Jason Sonners, DC, DIBAK, DCBCN, CCWP
When you get this... Right, right, 'cause it's for the same reason that the increased oxygen increases mitochondria so that as there's less oxygen, mitochondria down-regulate. When you're getting this hyperoxia hypoxia from intermittent hyperbaric use, you still get all of the same HIF-1, VEGF, stem cells, growth factors, all the same anabolic and regenerative qualities. However, you also seem to get an increase in sirtuins and an increase in mitochondrial, not only efficiency in terms of how much oxygen you can make, we get an increase in mitochondrial density. If you have enough repetitive exposure to hyperbaric, your body will literally replicate your mitochondria, thereby having more mitochondria to process that oxygen to make even more ATP, and so there's an enormous mitochondrial benefit to repetitive exposures to hyperbaric.

Dr. Joseph M. Raffaele, M.D.
So you're an exercise physiologist, you said you sort of started out with that, right? I was just thinking about that when cyclists are training, particularly Tour de France-type cyclists, they have the beginning of their season is all base training, Zone 2-type stuff where they're trying to build up mitochondria and get more mitochondrial biogenesis, are you saying that this kind of therapy could potentially be as effective as that or-

Jason Sonners, DC, DIBAK, DCBCN, CCWP
So I would say, when I look at nowadays, when I look at performance that way, 'cause you'll see people do a lot of breath work or breath holds, or carbon dioxide management as well, right? So, I think all of these things become important, and so in my own performance, I've done a lot of work, trying to improve my tolerance for carbon dioxide, right? So I'll do certain work under more hypoxic conditions because that improves our ability to deliver oxygen, right? Under normal circumstances, resting circumstances, you and I right now, we only utilize like 25% of our oxygen carrying capacity inside the red blood cells.

Dr. Joseph M. Raffaele, M.D.
Right.

Jason Sonners, DC, DIBAK, DCBCN, CCWP
Moderate exercise, we'll look at maybe 1/2, extreme exercise, we're looking at maybe 80% of that oxygen. So how well do we get the oxygen when red blood cells get back to our lungs? How efficiently or how effectively can we deliver that oxygen to the working tissues and the working cells? And we can train that through hypoxia, we can train that through intense interval-type training, we can train that through working at different elevations and altitudes. But could we also become hyperoxic, right, and continue to improve our ability to collect that oxygen and deliver that oxygen and improve our mitochondrial biogenesis and density? So not any one of these, in my opinion, and for athletes that we work with, not any one of these is like the one. People compare, let's say, I don't know if you're familiar with EWOT exercise, with oxygen therapy, right? So usually high intensity, it's usually on a cycle, and you're...

Dr. Joseph M. Raffaele, M.D.
Let's just tell us, for our listeners what it is just briefly.

Jason Sonners, DC, DIBAK, DCBCN, CCWP
Yeah, so it's exercise with oxygen therapy, and so what you're doing is you're usually using a bike, but it could be any aerobic-type exercise, and ultimately, what you're doing is you're going through different bouts of, again, hyperoxia. So you'll be breathing through a mask of oxygen, getting a lot of oxygen at certain times.

Dr. Joseph M. Raffaele, M.D.
What percent?

Jason Sonners, DC, DIBAK, DCBCN, CCWP
And then... What's that?

Dr. Joseph M. Raffaele, M.D.
What percent-

Jason Sonners, DC, DIBAK, DCBCN, CCWP
Usually, like 94%, it's usually very hot, and then you'll cycle through different intensities of exercise and you'll cycle through different percentages of oxygen. So you'll have this relative hyperoxia, hypoxia on the oxygen delivery side and then you'll have this increase intensity on

the interval side, and what you're doing is you're playing with supply and demand, is really what you're doing, and you're teaching the body how to extract as much oxygen in from the environment as possible and deliver as efficiently as you can. And so the things you can do with EWOT, I love EWOT, it's not hyperbaric, it's EWOT. It has a great place, it has an absolute value and in performance, it's an amazing tool, and that's a very different thing than hyperbaric, which is saturating your plasma far beyond what red blood cells can carry. In other words, with EWOT, you still need your red blood cells primarily to be the oxygen delivery and carrying source, hyperbaric is literally free floating oxygen. There was a study in 1948, I'm sure they'll never be able to do it again, but they basically took pigs. They drained all of their red blood cells, they replaced their entire blood volume with like a saline solution and put them at three atmospheres in the hyperbaric chamber, and they lived perfectly.

Dr. Joseph M. Raffaele, M.D.
Well, yeah, and so I was thinking about people, during cardiac surgery or any major surgery, they get pump head, because they don't get enough , they gotta run the low blood pressure, and that's just not enough with the atherosclerosis in the carotids and the rest of the brain, if they did those surgeries in a hyperbaric chamber, that probably wouldn't happen.

Jason Sonners, DC, DIBAK, DCBCN, CCWP
So there was a moment, I think it was in the 50s, there was a moment where they were starting to do more of these open heart surgeries in a pressurized surgical suite, and it was just too expensive, and they moved on pretty quickly, but to your point, I think that that's a great point, I think that that would improve the condition, certainly, for the patient, and then, I mean, honestly, I would imagine it would improve the conditions for the workers- Keeping everybody more alert and focused and...

Dr. Joseph M. Raffaele, M.D.
Pretty cool. So what kinds of conditions and what do you specialize in treating in your multiple centers practice?

Jason Sonners, DC, DIBAK, DCBCN, CCWP
So I mean, we started, because a lot of my patients initially were more musculoskeletal-type patients, I got into this because of a neuropathy from a disc injury, so naturally, I just, I started seeing those types of folks a little bit more in the beginning. With our clinics now and in the clinics when I help another practitioner, start a hyperbaric center, let's say inside their existing clinic, I really try to get people not to specialize. In other words, if you get really good at the tool, you can really help so many different people with so many different conditions, and it's not like hyperbaric... It gets a bit of a bad name, almost like it's a cure-all, I will be the first one to tell you,

I mean, I've studied this inside out, upside down, I live it, I breathe it, I teach it, this does not cure anything. That's not the point. It's not a cure for any of the things that we treat. Oxygen is just such a foundational, the way I view it, because of my background, maybe in nutrition, it's a new nutrient, it's a co-factor.

Dr. Joseph M. Raffaele, M.D.
The nutrient.

Jason Sonners, DC, DIBAK, DCBCN, CCWP
It's cells require oxygen for function and for a variety of reasons, call it chronic inflammation, or toxicity or injury or whatever, there are times in our body where we're relatively hypoxic in certain tissues or cell types, and if we can stimulate this upregulation of oxygen into the body, it's safe. It's very non-invasive, and it can make the difference between turning a patient from going down this chronic, inflamed road and just start to shift that momentum back in their favor. So, again, it's not gonna cure it, but it's such an important piece to the management of and the repair and the regeneration of tissue of all types, that it allows us to really not focus and to help so many people. So we see a lot of neurosensory hearing loss, we see a lot of radiation burns from, let's say, radiation from cancer treatment, but they're not bad enough to be covered by insurance. Neuropathies of all kinds, from diabetes to disc herniations, to carpal tunnel or other neuropathic conditions. Neurodegenerative people do very well, so the MS, the Alzheimer's, the vascular dementia, these people, especially if you catch them early, these people respond very quickly. Lyme disease, C. diff H. Pylori, so certain infections that are anaerobic, similar to gas gangrene or necrotizing fasciitis, we haven't even talked about it, but there's an entire immune system upregulation that occurs from hyperbaric, whether it's helping your white blood cells fight the infection or reducing the inflammatory cytokines, there's a few different ways that it helps to modulate and balance the immune system.

Dr. Joseph M. Raffaele, M.D.
Let's talk a little about that, I mean, unless you wanna go because that's a lead into the study I wanna talk about, but and I'm sure our listeners, because it's about telomeres, it's about senescence cells and the immune system, which is immuno senescence, what happens with hyperbaric oxygen and the immune system?

Jason Sonners, DC, DIBAK, DCBCN, CCWP
Yeah, so one of the mechanisms and some of these mechanisms, what we try to do especially when we're teaching these courses, these like certification courses for hyperbaric technicians, or medical doc's, or chiropractors or natural paths that are trying to get into hyperbaric, there are 14 indications that are considered insurance-based indications, I covered a few of those

earlier. Those are the conditions that have been studied in unbelievable amount of detail, and those mechanisms we understand really well. And what we really try to do is say, are these mechanisms also applicable for these other conditions that we're looking at? In other words, we may or may not have a study to exactly explain how hyperbaric helps ulcerative colitis, as an example, but it does seem to help these patients a lot and maybe chronic external non-healing wounds have similar pathology to chronic internal non-healing wounds and if the mechanisms are similar, perhaps it would make sense that because it helps heal these kinds of wounds and ulcers, it might heal these kinds of wounds and ulcers as well. And so we try to really take our time to understand the mechanisms as well as possible. So one of the mechanisms is it decreases white blood cell aggregation, as it starts to attack an area of inflammation for whatever reason. Another thing that it will do consistently with white blood cells is it increases white blood cell reactive oxygen 'cause of the upregulation of reactive oxygen species. So it gives our white blood cells more of the tool that they need to actually fight the infection, especially for viral infections and things. So we get an upregulation of white blood cell activation to fight infection, and then there's an enormous amount of data to show its effect overall on inflammatory cytokines, so reducing the inflammatory cytokines, the TNF alphas, but also upregulating our body's own endogenous anti-inflammatory cytokines. And so we start to get this regulation of inflammation inside of our body as a result. Now, so you were sort of leaning towards that study on telomeres-

Dr. Joseph M. Raffaele, M.D.
Yeah, one second, that just popped in my head, so then with all that you've just said, has it been looked at in severe COVID?

Jason Sonners, DC, DIBAK, DCBCN, CCWP
So for the people who care about it enough, yes. There were these enormous conversation. So there are a few ongoing studies right now, one in Israel, one's out of Germany, there's, I think, one in Chicago, one out of New York, one out of Brazil and one out of France that are still looking at hyperbaric for active COVID cases. Early on, when nobody knew what it was or how to treat it, or, and I'm from Jersey, so like, in the New York area, I'm like 15 minutes outside New York City, they were bringing in the ships and opening the Jacob Javits Center to treat all those patients and nobody knew what was gonna happen, and a lot of these patients ended up on ventilators, and I think 86, 87% of the patients on ventilators ended up dying. And one of the conversations that arose from that was so many of these patients potentially, it wasn't so much of a breathing issue as much as an oxygen absorption issue, right? A gradient. So due to the damage of the pneumocytes, and the inability for the gradient to be established to drive the oxygen from the outside world into circulation, and if there's one thing that hyperbaric oxygen does, is it maintains and creates these gradients that absolutely drive oxygen through even a lot

of inflammation and tissue damage. And so there were conversations early on that I was a part of in Spain, in Ireland, in England, in Australia, they were looking at, because nobody was flying, so people started to talk 'cause airplanes are basically giant hyperbaric chambers.

Dr. Joseph M. Raffaele, M.D.
Right.

Jason Sonners, DC, DIBAK, DCBCN, CCWP
So this idea that we could put all these patients inside of all these grounded airplanes or make use of, generally speaking, hospitals, a lot of hospitals have multiplayer chambers, they could treat 15, 20 people at a time, and they're generally very underutilized in the first place. So could we start opening up these chamber facilities or these airplane hangars or whatever to start driving that process? And so, there was an enormous amount of interest and then as COVID progressed, it seemed like the interest sort of waned, other treatments- Right, for managing COVID instead of... And so, as the intensity of the scare, I think, for most of us waned, as did the interest in pursuing that. However, that being said, a lot of us have been using hyperbaric for post-COVIID recovery also and there have been a few papers coming out on that because a lot of these people are stuck in chronic-inflamed modes, they have different neurologic issues, whether it's from brain fog to the continued loss of smell and taste or just this consistent breathing issue or energy overall, and so there's been a great response to hyperbaric for a lot of these longer COVID cases that they seem to do very well and they do well pretty quickly.

Dr. Joseph M. Raffaele, M.D.
Very interesting. So that yeah, let's move along to the study because ultimately, my real question is sort of a relatively healthy aging adult who's seeing some decline in cognitive function and in overall performance, etc, should they be entertaining a protocol with hyperbaric oxygen therapy? And I guess, the study out of Israel, which you're gonna talk about, sort of addressed that, and I'd love to hear about the study and then your thoughts on it, and the stuff that you're gonna do to follow up on it.

Jason Sonners, DC, DIBAK, DCBCN, CCWP
Yeah, so in general, and I would say is, again, if we just look at mechanisms, because right now, we don't have the research in the detail and the quantity that I would like to have this conversation, but if you look at the mechanisms of how hyperbaric improves the speed of tissue repair and tissue regeneration and you look at the aging process, and the degeneration that occurs as we age, and even if it's low grade, chronic inflammation that just sort of, for a lot of folks that aren't necessarily taking the best care of themselves, the healthiest people and things are wearing out over time, and with 100% confidence, I would say that the use of hyperbarics,

again, doesn't have to be at human tolerance, maybe there's some lower pressure range that would be appropriate for these people, but consistent use of hyperbaric to upregulate mitochondrial function, to upregulate cellular and tissue performance, to upregulate tissue repair, tissue regeneration, cellular regeneration, that alone, there's enough indication that that seems like that makes a lot of sense. When we start to look at... Let's go to the telomere. So, that was a particular study that where they... Our understanding again, and feel free to jump in and correct me, but telomeres are a great indicator of something's happening, right? So there are what is that something? I don't know that all those answers are there yet either but what we say is, in general, these telomeres, they're caps, they protect our genome, and when we have shorter telomeres that's associated with shorter cellular life or increased chances of senescence and other issues associated with cellular decline, and when we have longer telomeres, that's associated with more of a youthful cell that's got a better chance to continue to have a very thriving and active cellular life and replicate properly and pass its genetic material down from cell to cell, and so there's this idea that telomeres, as they shorten, are associated with the aging process. I'm not sure that that's true, I don't know that we know all those details. And in general, a lot of us have looked into, what are the things that we can do to decrease the rate that they shorten? There hasn't been a lot of work to say, what could we do to increase their length? It's consistently been, what can we do to slow down? Again, we have this mindset, like we're all on this degenerative pathway over time, and what can we do to slow it down? It's only now where a lot of us are really saying, "Well, wait, can we take that even further and let's not even slow it down? Let's start turning it backwards and reversing the process." Right?

Dr. Joseph M. Raffaele, M.D.
Yeah.

Jason Sonners, DC, DIBAK, DCBCN, CCWP
And so this one particular study came out in, I think, November 2020, and they were looking at hyperbaric oxygen. So they were using higher end pressures, like two atmospheres of pressure, 100% Oxygen, they did five sessions a day for a month, took a month off, did another five sessions a day, for the next month, 90-minute sessions, and they were measuring telomere length on-

Dr. Joseph M. Raffaele, M.D.
Five sessions a day?

Jason Sonners, DC, DIBAK, DCBCN, CCWP
Sorry, five sessions a week. Did I say that? Five sessions a week, Monday through Friday, sorry, Monday through Friday, five a week for four weeks, with four weeks off and then five a week for

four weeks. And they were they were measuring T-helper cells, cytotoxic T-cells and B cell telomere length and they found an increase, so not only did it not decrease, they found an increase of a minimum of 20% increase in telomere length across all three cell types. And to take that one step further, they were also looking at cellular senescence. So you know senescence cell being a cell that's no longer functioning properly, not gonna replicate, often leads to other inflammatory issues, especially in nearby cellular function. And so what they found was that somewhere, depending on the cell type, between 10 to 30% decrease in cellular senescence. In other words, a lot of these senescence cells have two choices, or three, I guess. They can either remain the same for a period of time, they need to get kicked back into action so that they can start to become normal functioning healthy cells again, or they need to be killed. If we have to kill the cells off so that we can have a stimulus to send in stem cells and replenish those cells and improve that cell type performance. And so in this particular case, they saw a 10 to 30% improvement, in other words, moving those senescence cells back into normal, active, healthy cellular living. So that's an enormous step, I would say, those two factors were enormous steps. They also were measuring cognitive factors and that group in general, has done multiple tests on the aging population and cognition, and we have seen changes in performance and changes in cognition across the boards in different age brackets, with different levels of potential early stage or even moderate stage neurodegenerative disease and pretty much across the board, we see very favorable effects in cognition in aging populations with this hyperbaric.

Dr. Joseph M. Raffaele, M.D.
Yeah, I mean, it was a very impressive study and I would love to see it repeated, I think you're gonna try to do that with your next endeavor.

Jason Sonners, DC, DIBAK, DCBCN, CCWP
Yeah, well, so I ended up wanting to go back and understand all these mechanisms a little bit more in depth. So I went into a PhD in Molecular Biology. So I'm about a little more than halfway through that program and just starting my IRB process right now, and hopefully, starting the research in the next month or two. What we're gonna be doing is we're gonna be looking at similar markers, so we're gonna be measuring cognition and we're gonna use similar system as the folks in Israel have been using for that. We're gonna be measuring telomere length, we're also gonna be measuring methylation panels through true diagnostic. We like their work a lot in terms of also understanding aging from a totally different angle. And I can't say at this time, there's reasons that I like that, in terms of the epigenetic signaling, maybe more than telomeres or not, but at the end of the day, I wanna also help all of us understand this regenerative medicine concept and cellular aging, and so I think having more studies that compare telomere status and methylation status together, I think will help fill in a lot of those

gaps for many of us. And then we're also gonna be looking at just other blood markers, but in particular, like a pretty robust cytokine panel. So we can measure inflammation, cognition, methylation and telomeres. We're also gonna do this against two different pressure ranges, so we're gonna have a mild pressure and a higher pressure because in our field right now, there's still a lot of, I don't know if arguments is the right word, but disagreement, disagreement on what amount of pressure is required to get what responses and over what period of time? Nobody knows these things. In other words, the telomere study came out, and every single and I thank them for that, it was an amazing piece to bring awareness to hyperbaric, every center that I support, and there's probably 30 or 40 of them across the country right now, literally for months, two or three months, had endless phone calls. "Hi, I heard you can grow my telomeres by 20%. Is this true? And when can I start? And do you do the Israeli protocol?" That's always the question, "Do you do the Israeli protocol?"

Dr. Joseph M. Raffaele, M.D.
Legitimate question.

Jason Sonners, DC, DIBAK, DCBCN, CCWP
It's a legitimate question.

Dr. Joseph M. Raffaele, M.D.
Right.

Jason Sonners, DC, DIBAK, DCBCN, CCWP
100%. And, in my mind, I'm like, do we need to? And I'm not saying that we don't, I'm just saying, do we need to? In other words-

Dr. Joseph M. Raffaele, M.D.
Well, that's important question, because that's an protocol.

Jason Sonners, DC, DIBAK, DCBCN, CCWP
Right, exactly. So could you do less aggressive protocol over a longer period of time and get the same result? Could you do a lesser intense protocol and just not get 20%, get 10%, and be happy with that? Could you do a higher intensity and get 50%? Nobody knows the answer to these questions, I'm not gonna answer all of them. I'd love to say I would answer all these questions, but I want to at least be able to contribute to the understanding of these mechanisms so that we can start putting together, what I really want is as we're measuring cytokines, different pressures over different periods of time, this happens here, this happens here, this happens here, methylation panels, this happens here, this happens here, right? Hyperbaric has been

around for over 350 years in various capacities, but it's been more or less a treatment tool since the building of the Brooklyn Bridge, basically, okay? And it's built out from there. It's been around a long time, and it's still something, these questions have been unanswered for far too long. And now that the therapy is gaining the recognition that I think it finally deserved, in terms of a role that it could play, not only in sickness, but also in wellness and regeneration, the people who are involved in this really need to step up and start answering these questions. And I give the guys out of Israel a lot of credit, because they are so far out of the box, and they're cranking out a few studies a year on really important topics, and I'm just trying to contribute my little piece to that puzzle.

Dr. Joseph M. Raffaele, M.D.
Which is great, and I think you're taking the right tact. It's been a great and a long conversation, but I think there's just a couple more things, if you have a couple more minutes, I'd like to answer. The issue of the sort of soft hyperbaric, smaller chambers versus the big ones that Israeli studies were in. I know earlier you mentioned to me that it's a matter you get some hyperbaric in those, tell us just a little bit about for what people might wanna go try? And also would somebody who is normally cognitively aging, sort of have a benefit? I mean, I can tell you about a patient of mine that went to the Israeli chambers, totally normal 55-year-old and one of the main things he noticed was an improvement in the sharpness. He did it during COVID, because he had nothing else to do.

Jason Sonners, DC, DIBAK, DCBCN, CCWP
I might as well grow some telomeres and sharpen our brains.

Dr. Joseph M. Raffaele, M.D.
Right, exactly. So what's the relative merits of those? And is it worthwhile?

Jason Sonners, DC, DIBAK, DCBCN, CCWP
Again, there's not a whole lot of detail, double blind controlled studies in a lot of these cases. What I can tell you is like when I had the neuropathy issue, and my stepdad was like my second patient, I would say, after me, all that work was done in a soft chamber. So it certainly does something and we used soft chambers in our clinic for the first handful of years that we did hyperbaric, we sort of graduated into using higher pressure, because we started getting more complicated cases that really needed more robust of a therapy. So I would tell you that there's a pretty wide range. If you're pretty healthy and you're basically just trying to use oxygen as a nutrient, soft chambers with a little extra enriched oxygen, I mean, that's still offering you somewhere around 30%, 60% even up to two times more oxygen than what you're getting right now, so it's not like that's not a lot. Once you get into like the two atmospheres at 100% oxygen,

you're looking at nine times, 15 times, 18 times more oxygen than what we're getting right now, so it's, I mean, even more and more. So I think what we're gonna find, and that's part of the hypothesis for my study is we need to start understanding the therapy in a way where we're trying to match, like I said earlier, we're trying to match the intensity of the therapy with the severity of the goal. So if you're basically healthy and you're not really needing a whole lot, a soft chamber or a soft chamber with enriched oxygen can offer you an enormous amount of value. As soon as you start transitioning into having bigger issues or longer standing issues, or more severe issues, we need to start thinking about at what point do we have to transition to a hard chamber? What point do we need to start increasing the pressure beyond higher and higher amounts, but I hope like this, time I plan it to be this time next year, we have a pretty, at least a good understanding for the study that we're doing, and I'm using this study as really, as a pilot study, hopefully to get funding from interested parties enough to do an actual larger scale version of the study that I'm doing for the PhD.

Dr. Joseph M. Raffaele, M.D.
Well, there's a whole bunch of other questions I'd love to ask you. I know I've used up probably over an hour of your time, and-

Jason Sonners, DC, DIBAK, DCBCN, CCWP
It's been my pleasure.

Dr. Joseph M. Raffaele, M.D.
Yeah, I know, it's been really fascinating, you've explain things, I think, really clearly, obviously, you have a passion for this field. Did you wanna just mention where your clinics are, or how people can get in touch with you and any other social media stuff you might wanna let folks know about?

Jason Sonners, DC, DIBAK, DCBCN, CCWP
Yeah, sure. So when it comes to hyperbarics, so our main businesses, it's called HBOT USA. So H-B-O-T Hyperbaric Oxygen Therapy, hbotusa.com is our main website. Our clinic is New Jersey HBOT and we also have Pennsylvania HBOT. And then on HBOT USA, there's a Locations page where people can start seeing the different locations that we've helped train these people, certify these people, where we have business, not business relationships, but we help coach them and build protocols for them, and that we're all basically offering a very similar type of service to the patients that are looking for that. And then, like we were saying earlier, I'm also on the faculty for International Board of Undersea Medicine, IBOM for short, but IBOM teaches these 40-hour CME courses in hyperbaric medicine, diving medicine and then we have this, what's really now considered to be a functional medicine hyperbaric clinician. So people who

are doing hyperbaric, but for off label use, the way that we do, we now have a certification program just specifically for those people because that's a whole different, same mechanisms, different thought process and understanding those cellular cascades and how to utilize hyperbaric to really build in that. So the course that we offer is certified through International Board of Undersea Medicine, I'm on among their faculty for that, and so we offer those courses basically for four or five times a year.

Dr. Joseph M. Raffaele, M.D.
Well, fantastic. It's been really a pleasure talking to you, Jason. I look forward to meet you in-person at some point, I'm sure at one of the meetings. You're right across the river, so maybe I'll pop over and get myself some cognitive advancement.

Jason Sonners, DC, DIBAK, DCBCN, CCWP
Yeah, anytime you wanna come by, I'd be happy to have you.

Dr. Joseph M. Raffaele, M.D.
All right, thanks very much again.

Jason Sonners, DC, DIBAK, DCBCN, CCWP
Of course, thank you.