116_Huffines_Sports_Med_Lawler

Tim Lightfoot. Hello and welcome to the weekly Podcast from the Huffines Institute For Sports Medicine and Human Performance. I'm your host, Tim Lightfoot and I'm so glad that you took the time to download us and to joining us today. Every week we have another interesting person in sports medicine and human performance and this week is no exception. We are pleased to have with us Dr. John Lawler here who is a Professor in the Department of Health and Kinesiology here at Texas A&M. Welcome to the Podcast, John.

John Lawler. Thank you Professor Lightfoot. Pleasure to be here.

Tim Lightfoot. And we've asked…John is one of our senior faculty members, one of our exercise physiology senior faculty members and…

John Lawler. Keep emphasizing senior.

Tim Lightfoot. Senior, yeah, many times. And he has his PhD in Exercise Physiology with a minor in medical physiology from the University of Florida. And being an old Tennessee alumni I won't hold that against you today, so. But we have a lot of friends at the University of Florida, don't we?

John Lawler. Yeah we do. We have a lot of people in common there.

Tim Lightfoot. That's right, yeah. Yeah. The world of sports medicine and exercise phys is a pretty small world.

John Lawler. It is.

Tim Lightfoot. We all kind of know a lot of folks together. Let me tell everybody a little bit about John. He has had funding quite a bit in the past including funding for the American Lung Association, from the American Heart Association, he is the Director of the Redox Biology and Cell Signaling Laboratory here. His laboratory investigates the role of pro oxidants in normal skeletal muscle function as well as skeletal muscle dysfunction with physical inactivity and disease. And that's a mouthful. So John we're going to ask you to interpret that. So what does your lab look at?

John Lawler. Yeah. In a nutshell what we do is we focus on the way oxidative stress, that's from free radicals, helps muscles as well as hurts them. So…we also branch out occasionally into the other type of strident muscle, that's the heart.

Tim Lightfoot. So before we go on, now we have to clarify what are free radicals? These are not people that have been released from prison that are radical.

John Lawler. No there are a few outside Austin. They're everywhere including inside our body.

Tim Lightfoot. And we have friends at the University of Texas so we can say that safely.

John Lawler. Yeah, we do. That's right. So free radicals are basically very reactive compounds. They have unpaired electron in the outer orbital to be technical. But basically they can react with lots of stuff through oxidation and reduction reactions. So it's some of the oldest chemistry in nature. And it's been around for a long time and our bodies have learned how to utilize it. Unfortunately or often times it gets a bad name, but it's an important part of metabolism, the way muscles function in terms of contractility, the way the heart works. They're in every single type of biological function you can probably think of.

Tim Lightfoot. I mean people know of ozone.

John Lawler. Yeah.

Tim Lightfoot. That's an incredibly reactive species, so.

John Lawler. Don't breathe it.

Tim Lightfoot. Don't breathe it, that's right. Yeah. So, yeah, so, yeah we've got free radicals everywhere.

John Lawler. There are and some of the most important. One of the those is nitric oxide which has gotten a lot of press, positive press in the last 15 years and won three Americans a Nobel Prize in 1998.

Tim Lightfoot. There you go.

John Lawler. So they're often…they are as good for you as they are bad for you.

Tim Lightfoot. So now, so we're going to talk about antioxidants and people hear a lot about antioxidants. So help the audience understand how antioxidants related to free radicals.

John Lawler. Sure. In the body…we'll start there…there are some antioxidants inside the cell that we call scavengers. These are basically similar to like Vitamin C and Vitamin E, so there's a protein called…well a peptide called glutathione, for example, which is a potent antioxidant. Uric Acid is another potent scavenger. We also have basically a family of enzymes or proteins that basically…I don't want to say detoxify, but get the levels of free radicals and oxidated stress just right. It's like Goldilocks. You don't want it too high, you don't want it too low.

Tim Lightfoot. Keeps it in the Goldilocks zone, huh?

John Lawler. Yeah, exactly.

Tim Lightfoot. Yeah. See these antioxidants they're a protective kind of mechanism…

John Lawler. Yes.

Tim Lightfoot. …to help keep everything kind of balanced.

John Lawler. Right.

Tim Lightfoot. Cool. So how's it good for…how are they good for us?

John Lawler. Antioxidants, oh. Well it's not…

Tim Lightfoot. Are they good for us?

[00:04:50]

John Lawler. Well that's a really good question. If, for example, someone is either sick or getting older than you might want to or we might want to start thinking about including those in a regimen. You have to be very careful because they're involved in normal biological function, so, for example, probably best example and simplest example I can think of is that when muscles are relaxed or quiescent, there a little bit on the reduced side. So if we actually add some oxidants we can get muscles to contract harder. We can increase their force production. For example, at the beginning of exercise, I think it's exactly what we see is that as muscles start to contract, there's an increase in reactive oxygen species that are released possibly from the mitochondria but it appears that there are some proteins along the membrane that do much of that in response to stretching contractions. And they help to regulate metabolism, glucose uptake, contractility, so it's an important regulator in terms of the way muscles function. So probably for a number of athletes, especially sprinters for example, or people who are in good shape and not overtraining, antioxidants might be the last thing they want.

Tim Lightfoot. Right. So, do we get antioxidants from any other place or do we have to take supplements to get antioxidants?

John Lawler. Well the best way is your mom or grandma would have said your fruits and vegetables. That's the primary way to get them. In fact, they're in sort of the right mixture and probably the greater variety you have in your diet with your fruits and vegetables probably the better.

Tim Lightfoot. Cool. So, so a good diet.

John Lawler. Good diet.

Tim Lightfoot. A good nutritional diet.

John Lawler. Yeah.

Tim Lightfoot. But sometimes that's not enough. Sometimes supplements are needed.

John Lawler. Yeah, for example, people with intramuscular disease like Duchenne muscular dystrophy. There's some evidence now that in the case that maybe the right type of targeted

antioxidants might be beneficial for them. And that's part of the problem though is that when we use very general antioxidants like, for example, Vitamin E and Vitamin C, they may not target the disease that is effecting an an individual. And if it has to do with aging, well that's very complicated as well even though it appears that antioxidants may be helpful there. Sometimes it's a matter of taking what we would call a substrate like L-Arganine, for example. This is a substrate for nitric oxide [inaudible 00:07:12]. This is a protein that makes nitric oxide. So nitric oxide helps to regulate basically metabolism, blood flow. There's a whole host of things. So L-Argenine in some cases may be a little low in the body, so taking a supplement may not be a bad idea for someone who's older. There's some testing going on for people with say muscular dystrophy as well. So for folks who have either are sick or older or perhaps athletes who are overtraining then we might want to address this with perhaps some antioxidants. But for the most part, a multi-vitamin and fruits and vegetables are the way to go for most people.

Tim Lightfoot. Yeah. And it's interesting. You just supported what…we had Dr. [McDoyts] on the Podcast a few weeks back and that's what he talked about was, especially in the older individuals , Arganine and some of those links were up at that Podcast notes. So folks you've heard it now from two different sources that…

John Lawler. We didn't even talk to each other about this.

Tim Lightfoot. And didn't even talk to each other about, yeah. Sometimes those are good things. So one of the interesting questions that we got Dr. Lawler from one of our producers as a guide for all this conversation is, can Creatine exhibit antioxidant properties? We hear a lot about Creatine.

John Lawler. It's funny you should mention that. We've actually tested that and believe it or not in skeletal muscle it appears it probably has some antioxidant properties. It has been tested again with patients with neuromuscular diseases and there seems to be some benefits related to their antioxidant properties. In addition, Creatine in some cases can increase protein synthesis. Again in a healthy athlete I'm not so sure but there's varied literature that suggests sometimes yes, sometimes no in terms of protein synthesis. But as an antioxidant it's okay.

Tim Lightfoot. Yeah. But you mentioned right there and let's cut and loop back to that. Patients with neuromuscular diseases, what kind of neuromuscular diseases are you talking about there?

John Lawler. Well, for example, like Duchenne or [inaudible 00:09:11] muscular dystrophy these are usually caused by a mutation for a protein that usually sits up by the cell membrane. Helps to stabilize skeletal muscle, helps to regulate growth and repair. And the way to think about this is that most people have a pretty good idea about if they're doing, let's say, some exercises for the first time in a while or some weight lifting, they're going to feel sore a day or two later. So we have a term for this. It's called delayed onset muscle soreness or [inaudible 00:09:38]. So people with a lot of these neuromuscular diseases have very unstable membranes, the scaffolding around there, basically the way the proteins are put together there to try to

stabilize muscles, they don't really work very well, so there's a lot of damage, there's a lot of soreness. So it's like having delayed onset muscle soreness all the time.

[00:09:58]

Tim Lightfoot. And it makes them even less likely to do exercise. Yeah.

John Lawler. Yeah, so in those individuals they have really high levels of oxidative stress. So most of us have, we would say kind of nominal to low levels of oxidative stress which again is important in regulating growth and repair and glucose metabolism and metabolism and high levels of oxidative stress in people who have these neuromuscular diseases, much higher than we would normally see, for example, in a typical healthy person or an athlete.

Tim Lightfoot. So Creatine might help as a supplement in these folks? It may not be as useful in some of the athletic populations, but.

John Lawler. Yeah. There's mixed results there.

Tim Lightfoot. Yeah.

John Lawler. Yeah. So you'll gain weight and there's some argument about how much of this is true protein synthesis and how much of is water weight, etcetera.

Tim Lightfoot. Yeah. There's several health conditions that are associated with oxidative stress and is it the oxidative stress causes these health conditions or is the health conditions causing oxidative stress? I mean is it chicken and egg kind of thing?

John Lawler. Yeah it's the $64 billion question I guess in this case. In the case of cardiovascular disease and hypertension there's a good bit of evident that suggests that levels of oxidative stress, which normally could be managed, are considerably too high so there's…one of the proteins that lives up at the membrane is called NOX2, it's a funny name. So this appears to be high in people that have high blood pressure and also probably high in people who have atherosclerosis as well. So it may be part of the disease process. So indeed we've been looking at medicines that have antioxidant properties as well as antioxidant supplementation to try to deal with this. Some of the medicines that are out there to treat high blood pressure, for example, Candesarten, some of the angiotensin receptor blockers or ARB's or ace inhibitors, they actually have antioxidant properties so it's these side effects that actually are a real bonus for these medicines as well as reducing blood pressure by relaxing the smooth muscle in the arteries and arterials.

Tim Lightfoot. They're doing some other things that they didn't expect.

John Lawler. They're doing some other things. Yeah, so sometimes…some of these medicines that have antioxidant properties, some of that's just to…a good side benefit, a bonus. Sometimes a side effects a good thing. Most of the time not, but in this case, yes.

Tim Lightfoot. Yes. Well we've been talking about supplementation and eating right and so forth and we haven't talked yet about exercise and what exercise does to the whole oxidative stress system. And we'll call it that for the time being.

John Lawler. Yeah. It's a wonderful question because it leads to really how we respond to exercise. So when people are exercising, you actually get an increase in oxidative stress. It's probably okay. One of the things that that helps to do is it helps the muscles, as well as the body, to respond and increasing its own antioxidant enzymes as well as scavengers. So our antioxidant capacity's actually boosted. This turns out to be very cardio protective, it seems to be protective for the heart against ischemia, so heart disease, heart attacks, may reduce fibrosis in the heart as we get older so it may help the heart to maintain good function as we get older. In skeletal muscle we also see some significant number of benefits as well. Many of the antioxidant enzymes those are increased. We have a number of other protective proteins. There is one group that I like in particular, they're called heat chart proteins. So they respond to being in a sauna. They also respond to the cold as well so when there's environmental stress, or exercise, they go up. And they're very protective of both heart and muscles. In fact, there's a whole set of literature that's looking at the ability of these heat shock proteins to be able to reduce muscle hypertrophy as well as manage [inaudible 00:14:03] when someone is say weight training. So it's an exciting, it's an exciting area as we get to learn really how muscles work. And it's interesting that oxidative stress in nitric oxide turns out to be an important part of that.

Tim Lightfoot. Do you see the same response in these antioxidant systems whether you're doing resistance training or aerobic continuous training?

John Lawler. Oh, that's…

Tim Lightfoot. I mean in your response there you talked about resistance training and we kind of talked about aerobic training. So do you see the same response or?

John Lawler. They're not quite the same but there is protection in both cases. So antioxidant enzymes, for example, will increase with both sprint training as well as endurance training.

Tim Lightfoot. So being active…

John Lawler. Yeah, just being active…

Tim Lightfoot. …helps.

John Lawler. Getting out there.

Tim Lightfoot. Yeah. So we said to increase these antioxidant properties we need to eat correctly, maybe take supplements, but exercise is a huge deal.

John Lawler. Right. Yeah. When you put those together that really optimizes things. It's easy to say but it's something we forget about.

[00:15:02]

Tim Lightfoot. Yeah, yeah. Many people forget about it, right?

John Lawler. On a daily basis. I can voucher that.

Tim Lightfoot. How do you go about examining the effects of antioxidants? I mean we've been talking about this. This is all cellular molecular processes.

John Lawler. Sure.

Tim Lightfoot. Do you take people and take chunks of their muscle or how do you do these kind of things John?

John Lawler. Well if you're, if you're going to look at the amount of the enzymes themselves and what's in there you'd probably have to do some biopsies. But a lot of times we're interested in outcomes as well. So there have been some classic studies done with fatigue, for example, with people…this is about 15 to 20 years ago, where they demonstrated that, in one case, two much oxidative stress was responsible for fatigue. So you can kind of go over the edge even with exercise. So fatiguing exercise, overtraining, they can increase oxidants to the point where our bodies antioxidant system can't really handle it very well.

Tim Lightfoot. Cool. It's really interesting and it's almost, the idea here, almost we see the antioxidants as a preventative medicine. With exercise and good nutrition you're going to boost all this was going to help. And this may seem to be a little bit of a 90 degree shift, but it's really not, in that is, your undergraduate degree is in my medical engineering.

John Lawler. Right.

Tim Lightfoot. How did you get interested in the antioxidants? I mean that's one of the things we talk about on the Podcast.

John Lawler. Sure.

Tim Lightfoot. What gives you passion about this?

John Lawler. Yeah.

Tim Lightfoot. What is this that makes it interesting?

John Lawler. Well a long time ago I had an instructor, really professor, his name was Howard Clark at Duke and Dr. Clark was actually a chemical engineer and so we took a polymer class. This is one of the most fun classes I had in engineering school because one of the things that Dr. Clark would do is he would actually take some plastics and we would burn them so we would actually look at the flame and the color of the smoke and be able to identify what's PVC pipe from another type of plastic. So one of the things about that is plastics are often produced by

taking monomers, these small chemicals, and making chains out of them. Taking polymers out of them. So one of the ways to do that is actually through free radicals and in the industry for years they actually used to use Catalase to slow down and stop the reaction. So a lot of people make use of it every day. So…

Tim Lightfoot. So they use an organic compound to stop kind of the inorganic process.

John Lawler. Yeah, yeah, so…this is not quite the same thing but when people are say cleaning their contact lenses, a lot of times the solution is hydrogen peroxide and the little pills are Catalase.

Tim Lightfoot. Oh, really?

John Lawler. And the bubbles you see are oxygen.

Tim Lightfoot. Oh, cool.

John Lawler. Yeah.

Tim Lightfoot. So…

John Lawler. So that's how I…

Tim Lightfoot. Those of you who are listening if you're cleaning your contacts and you see bubbles, that's a good thing.

John Lawler. Yeah. Yeah it's a really good thing. So that's how I got started and when I was a graduate student at LSU we got interested in how the diaphragm, how skeletal muscles were adapting. So one of the professors there was William Pryor and I saw him speak a couple of times about oxidative stress and so I was really interested in this. And I wanted to apply this to some biological models. So at the time we got started in actually measuring changes in the antioxidant enzymes in response to exercise training. So in terms of laboratory research, it was really through the exercise response that we got involved.

Tim Lightfoot. Because it boost the antioxidants for sure.

John Lawler. Yeah, yeah. So that was, that was really fun to see. And as we tested it we got to learn more about how they were working and how they were protecting proteins from degrading, etcetera. So it was a lot of fun. And since then we branched out to all kinds of areas, disuse, aging, muscular dystrophy. You pretty much name it, we've tried it.

Tim Lightfoot. Yeah. Well…and that shows the ubiquity of the system.

John Lawler. Yeah.

Tim Lightfoot. It's everywhere.

John Lawler. It is everywhere.

Tim Lightfoot. Yeah.

John Lawler. And the biological part of it I think just simply can't be forgotten and it's very fortunate that we bestow the Nobel Prize in 1998 for nitric oxide and its function in the cardiovascular system. It basically makes arterials and arteries dilate so your blood vessels dilate so you get more blood flow.

Tim Lightfoot. Well you know the great thing about this, because it's involved in so many biological systems, is that the work that you do can be applied to so many different situations and that's…I think the public forgets that. Scientists seem to have a very narrow focus but often times they have big applications.

John Lawler. Yeah. That's one of the most exciting aspects of it is we do I think get to apply it and with the faculty we have and have added at Texas A&M we hope to translate our findings into what we think are real medicines and real therapeutic strategies for patients to make them better.

Tim Lightfoot. Yeah. Now as a scientist when you write your papers you have to be very direct and you report what you found and…

John Lawler. Dry, dry.

Tim Lightfoot. We'll say dry.

John Lawler. Sometimes.

Tim Lightfoot. But I think the most fun part for scientists is that we do get to speculate and so I'm going to ask you to speculate. What's coming…what do you think in five years? Where do you think we will have found out in regards to the antioxidants?

John Lawler. Wow.

[00:20:00]

Tim Lightfoot. No actually…asking you to put on your science fiction hat here.

John Lawler. Yeah. I think we're to the point where we can actually measure reactive oxygen species inside the cell and at specific locations. That's been one of the problems is being able to try to identify what's going wrong and where. And that explains sometimes when…in the past people have tried Vitamin E to treat Duchenne muscular dystrophy. Doesn't work very well. Or sometimes it works with heart disease and sometimes it doesn't. So part of the problem is been the non-specificity in our approach to using antioxidants. So as we discover which specific targets are the good guys and bad guys, and sometimes they're both, and you have to figure out

when you want to turn them on and when to turn them off, we'll be able to address that. And I think one of the most important things is how that's going to interact with exercise as part of the therapeutics because I think it's going to be very important for just about everybody. Today, for example, exercise is used as part of the therapy for Duchenne muscular dystrophy, it's used for arthritis as well. The last thing people would do is exercise.

Tim Lightfoot. Do is exercise. Yeah.

John Lawler. But now you combine it with some really good medicines today, like Enbrel that work really wonderfully for people who have rheumatoid arthritis.

Tim Lightfoot. Yeah. So another example of where we need to do exercise.

John Lawler. Yeah.

Tim Lightfoot. We keep coming back to that.

John Lawler. No. You can't escape it.

Tim Lightfoot. We've got to be reactive, yeah.

John Lawler. No it's part, it's part of our genes and when we get away from that, our genes, mother nature, responds and sometimes not in a good way.

Tim Lightfoot. That's right. Don't fool with Mother Nature.

John Lawler. Don't fool with Mother Nature.

Tim Lightfoot. So John, thank you so much for being here. We're kind of running short on time. That's the signal I'm getting.

John Lawler. No, it's pure pleasure.

Tim Lightfoot. And so we always like to have you, have our guests tell us what their take home message is. What's your take home message from all of this today?

John Lawler. The take home, the take home message is I think, eat your fruits and vegetables, exercise, maybe take a multi-vitamin. If you're unfortunate to be afflicted by a disease of some type, a chronic disease, whether it be heart disease, talk to your physician, talk to some of the exercise people, come here and look at not only the Podcast but try to get information from the Huffines Center and the American College of Sports Medicine. There are a lot of experts out there who I think can help us and help the public to get in the right direction in terms of health related to free radicals. So again, it's the Goldilocks story. Not too many and not too little, just right.

Tim Lightfoot. Just right. Great take home message.

John Lawler. Okay.

Tim Lightfoot. Thank you for that.

John Lawler. Thanks.

Tim Lightfoot. And I want to thank all of you for taking the time to download us and listen today. As always at the end of each Podcast we have the Podcast question of the week. And with that Podcast question is Cheryl.

Cheryl. What types of foods can a person eat if they want to add more antioxidants to their diet?

[00:24:19]