Rounding@IOWA: Evidenced-Based Orthopedic Regenerative Medicine

Transcript

[Upbeat theme music plays]

Dr. Clancy

Welcome to Rounding@IOWA, a continuing medical education podcast developed by and for healthcare teams. I'm your host, Dr. Gerry Clancy, Professor of Psychiatry and Emergency Medicine and Senior Associate Dean for External Affairs here at the University of Iowa's Carver College of Medicine. Today we will discuss evidence-based regenerative medicine with a focus on orthobiologics.

Our objectives include First, we hope our listeners are able to define and explain the promising field of regenerative medicine to their patients. Second, we would like our listeners to recite which orthopedic regenerative medicine treatments are available at this time, as well as what may be available in the near future. And third, we want our listeners to be able to discern which regenerative treatment options are well proven and can be recommended to our patients.

Our expert guest today is Dr. Ryan Kruse, Clinical Assistant Professor of Orthopedics and Rehabilitation here at the University of Iowa. Dr. Kruse earned his MD degree from St. George's University, followed by residency training in physical medicine and rehabilitation from Mayo Clinic. He followed this with a fellowship in Sports Medicine here at the University of Iowa. Ryan, welcome to Rounding@IOWA.

Dr. Kruse

Thanks, Gerry. Excited to be here.

Dr. Clancy

Thank you for joining us today and thank you for the work you do. I just provided our listeners with your official title and a summary of your training, but could you give us a better idea of your daily work and really the variety of what you might do across a week?

Dr. Kruse

Yeah, of course I can. So outside of my responsibilities with our athletes, a typical clinic week for me involves seeing patients for various musculoskeletal and sports related injuries and conditions. I see many patients weekly, probably 20 to 30, for consultation for regenerative medicine treatments. Additionally, I perform multiple regenerative medicine treatments on those patients every single week. In addition to that, I perform a variety of musculoskeletal ultrasound procedures and other various tendon-related microsurgical procedures.

Dr. Clancy

And I imagine you have students and residents tagging along as well.

Dr. Kruse

Yeah, we do. We're lucky over in sports medicine that we get a fair number of learners every single day. I even have some folks, some high school students come over and shadow, but the vast majority are medical students and residents and various fellows as well.

Dr. Clancy

So let's start with some basics. How would you define regenerative medicine?

Dr. Kruse

So generally speaking, regenerative medicine is an area of medicine that uses the body's innate healing and repair mechanisms to help it heal and repair itself. That's the most basic definition. Regenerative medicine applies to multiple different areas of medicine, not only just orthopedics and sports medicine.

Dr. Clancy

And so you're focused mostly on orthopedics. Let's dive in with orthobiologic. What is the spectrum of age and abilities of patients that you treat? Who comes to you for asking questions about the possibility of orthobiologics?

Dr. Kruse

Yeah, honestly, it's anybody and everybody. There really isn't an age cutoff. It depends on various factors. We'll see young kiddos as young as 14, 15 that want to discuss orthobiologics or regenerative medicine options. And then I think my oldest patient is certainly in triple digits. I think she's 103. Usually the older patients that we see are folks that have symptoms related to osteoarthritis and we're trying to manage symptoms for them. For the younger age group, those folks rarely have issues with osteoarthritis at that

age and they have various other musculoskeletal conditions that we are trying to fix and provide pain relief in a non-operative manner.

Dr. Clancy

Let's start with osteoarthritis. And certainly as the baby boomers age, you're going to see more and more of those with hips and knees and shoulders all needing attention. What options are out there for those with wear and tear type conditions that are a little bit more in the older group of patients that you see?

Dr. Kruse

Yeah, honestly, it depends on which joint we're treating. It depends on the degree of osteoarthritis as well as various comorbidities within the patients. I would say generally speaking, large joints are more common. So knee joint, hip joint, glenohumeral or shoulder joint, the most common joints that we treat and certainly have the best evidence. When we're talking about treatment options, there are various options that are out there. The most common one that we do is called PRP or platelet rich plasma, which has the most robust evidence for the treatment, symptomatic treatment of osteoarthritis. Other options that are legal and available include various MSC or mesenchymal stem cell options, including micro-fragmented adipose tissue or MFAT, and then bone marrow aspirate concentrate or BMAC. So all of those are options that we have for patients, but again, the specific one that we choose for a specific patient depends on certain variables.

Dr. Clancy

Sure. And that's where the art of medicine comes in. Yep. And I know it's not just joints. You also can help with soft tissue injuries as well. And so that may be a more of a younger group? What types of soft tissue injuries are possibly helped by regenerative medicine?

Dr. Kruse

Yeah, great question. So the most common soft tissue injury that we treat is a chronic tendinopathy that has the most robust literature and support for its use in the literature. Most common tendon that we treat would be the common extensor tendon. Other tendons include the Achilles tendon, patellar tendons, rotator cuff, to really any chronic tendinopathy. We really don't see acute tendon injuries all that often. Those are most often surgical, if it's a tendon rupture or a tendon tear. So those don't come all that often in the clinic. Outside of tendons, we certainly see, especially in our young athletes, a lot of acute ligament injuries, particularly with our baseball athletes. The UCL is the dreaded injury and we see a lot of those with our athletes and we can treat those depending on the injury pattern with orthobiologics. Additionally, I do a lot of muscle injuries. Our athletes

unfortunately suffer from muscle injuries fairly frequently and so we use orthobiologics to get those athletes back as fast and as safely as we can and as you know muscle injuries are rarely, rarely surgical, and so we really don't have much else. So this is a way to help get those athletes back. And then lastly, there is some evidence for using some of these biologics for nerve injuries and conditions. The most robust evidence is for a median neuropathy at the wrist or carpal tunnel, and so we will use it for that as well.

Dr. Clancy

Very interesting, very interesting. So as I was preparing for this podcast, it really seemed like Orthobiologics are filling gaps in treatment where one version of treatment is not sufficient enough, but the more extreme treatment is really not fully necessary yet. Would you agree that one of the nice things about orthobiologics is this gap that you're filling?

Dr. Kruse

Oh, absolutely. So when I think about the gap here, I like to separate what I'm treating into a degenerative joint condition and then a soft tissue condition. When we talk about treating symptomatic osteoarthritis, we talk about the osteoarthritis treatment gap. And what that is, patients that have tried and failed various conservative treatments such as physical therapy, anti-inflammatories, weight loss, bracing, so on and so forth, but they're not ready for an arthroplasty or they can't have an arthroplasty. And that's a large group of people where we really previously didn't have anything to help them with. And that's where the field of regenerative medicine and orthobiologics comes into play. I think most importantly is for folks that fall into that treatment gap. Now conversely, when we talk about soft tissues, the whole goal using biologics for a soft tissue injury is to try and avoid surgical intervention. Now there are certainly indications that are 100% surgical and those we have no business trying to fix or treat with biologics, but there are many that we can treat with biologics. So for a soft tissue injury, we're trying to avoid the need for surgery.

Dr. Clancy

So let's dive a little bit more into the physiology and biochemistry of the orthobiologics that you use. Let's review how each work and what are the clinical indications for each. And let's begin with the one that you mentioned first, which is platelet-rich plasma or PRP. When you use it, get a sense of how it is working at that microcellular level.

Dr. Kruse

So at the most basic level, so when we talk about PRP, we all know that platelets are small non-nucleated cell fragments that contain various proteins, cytokines, and other bioactive factors that help to not only initiate but also regulate tissue healing. And so PRP or platelet-

rich plasma by definition is a fraction of plasma that contains a supra physiologic concentration of platelets. That's what it is at its most basic level. We use PRP for, like I mentioned previously, various musculoskeletal injuries and conditions. By far the most common thing that I'll use it for is a chronic tendinopathy, like I mentioned. Second most commonly is going to be somebody that has symptomatic osteoarthritis, most commonly of a large joint.

Dr. Clancy

I could have used that a few years ago when I was running half marathons in a marathon. We'll talk about that in a minute. How about micro-fragmented adipose tissue or MFAT? Do you have a sense of how that works and what would be your top indications?

Dr. Kruse

Yeah, so I guess I'll flip this and start with indications first. So the most common thing that we're, the most common condition we're using MFAT for would be the symptomatic treatment of osteoarthritis. The literature is most robust for its use for osteoarthritis We do use it to a fair lesser degree for soft tissue injuries. Probably the most common soft tissue indication that I'll use it for is somebody that has a full thickness, incomplete tendon tear, most commonly in the rotator cuff if somebody's a non-operative candidate using the MFAT to try and provide a scaffold for the body to heal the tendon across. MFAT is probably the newest or one of the newest orthobiologic options that are out there. And really the idea behind it is we do lipo harvest. So we take fat tissue out, which is all these for us are done in the office under local anesthesia. So we do fat harvest, then we use a proprietary system to clean and then process and minimally manipulate, which is critical here, minimally manipulate the tissue so we don't break FDA laws and guidelines and then use that tissue and inject it and transfer that fat to the region that we're treating. Within the mFat, there are various cytokines, bioactive materials. There's also a high concentration of MSCs or mesenchymal stem cells and pericytes, which pericytes are perivascular cells that are MSC precursors. And when we inject those into a joint, I always tell patients, we're not reversing your disease. This is a chronic degenerative progressive disease. So we're not turning the clock back. We're not rewinding the clock. We're not going to regrow your cartilage. We're using it again for the symptomatic treatment. And when we put those cells and that tissue into the joint, a couple things happen. One, they have reparative capabilities. So all these cells can repair tissue. So damaged cartilage, damaged tissue, damaged meniscus or labrum, depending on the joint, those cells can repair that tissue. They also change the local environment of the joint, and so they provide and create more of an anti-inflammatory environment within the joint, which is one of the biggest reasons why these folks get some longer-term pain relief. And then also fat, if you think about it, fat's A

structural tissue. And so when you do a fat transfer and you put that into a joint, it essentially provides a cushion for the joint, which again, I think is probably one of the main reasons why it's helpful. So it repairs tissue, it provides anti-inflammation, it cushions the joint.

Dr. Clancy

I did like that word that you used, scaffolding as well, kind of a frame for healing to work. Great.

Dr. Kruse

Absolutely.

Dr. Clancy

Yeah. So let's finish up on just really the details of how these work. Let's go with how bone marrow aspirate concentrate or BMAC works and for what conditions.

Dr. Kruse

I would say the overall indications for BMAC are similar to those of MFAT. We're using this for higher grades of osteoarthritis There is some lower level evidence for its use for soft tissue injuries and conditions with BMAC. So we essentially do bone marrow harvest. Most often we will harvest that from the iliac crest, whether that be the PSIS or ASIS. I would say PSIS is most common. We then take that bone marrow, process it in a centrifuge, which is basically just using simple centrifugation. to separate the bone marrow and concentrate the cells within that product. The main cells that we're using are similar to MFAT, so we're using MSCs and mesenchymal stem cells and other various cytokines and growth factors to again repair tissue, provide an anti-inflammatory effect, and subsequently provide longer-term pain relief. You know, one thing that I should mention When we talk about, this is always a question I get when we talk about comparing BMAC to MFAT. So the MSCs that we find in BMAC are a bit dissimilar to the MSCs we see in MFAT. And the biggest thing that we notice and have seen in the literature is that the MSCs in BMAC are much more prone to senescence, meaning as we get older, they don't do their job as well as they used to. The MSCs we find in MFAT are less prone and minimally prone to senescence. So we think that they contain their bioactive ability longer and later in life.

Dr. Clancy

Fascinating. So we talked a little bit about filling that gap in treatment options. How do these treatments hold up? You know, medications, the traditional medications, and then

the gap with the orthobiologics and then surgeries. How do you compare the impact of the orthobiologics versus medication versus surgery?

Dr. Kruse

So that's a great question. And I think, again, we have to separate this into the treatment of osteoarthritis, the symptomatic treatment of osteoarthritis, or the potential curative treatment of a soft tissue injury. You know, there aren't great head-to-head studies looking at these orthobiologics compared to surgery. There is one that I'll call out for the treatment of osteoarthritis, came out of Italy, I don't remember what year it was in, but it basically looked at Folks with moderate grade osteoarthritis, they compared knee arthroscopy for the treatment of osteoarthritis versus an injection of microfragmented adipose tissue. And what they found was that the outcomes were better in the MFAT group compared to the arthroscopy group. Now, certainly there's certainly some flaws with that study. But regardless, that is just one study dimension that showed that an orthobiologic, particularly MFAT, produces better outcomes than a surgical intervention. A lot of the literature actually looks for biologics, looks at intraoperative biologics and their effect on improving surgical outcomes. And most of the literature is looking at the use of PRP intraoperatively for rotator cuff repairs. And there are studies out there that have shown that it can improve repair outcomes and reduce the risk of recurrent tear or repair failure. when I talk to people, to patients about the decision to move forward operatively versus non-operatively, what I tell them is that, again, there are operative indications that are absolute indications. And if that is what they have, then I don't offer a biologic because it'd be wasting their time. The outcomes wouldn't be great. If it is an indication or condition where surgery is not an absolute indication, then we talk about risks and we talk about benefits. And with any of these biologic procedures, honestly, the worst thing, assuming that we don't have infection or whatnot, the worst thing that can happen with them is that they don't work, right? And if they don't work, then they always have surgery as a backup. Now, the flip side of that is not true. if somebody is post-operative and they still have ongoing pain, mostly for a soft tissue condition, the outcomes for biologics go down quite a bit. So going backwards is a worse option for these folks. And there's obviously the risks with general anesthesia and surgery and whatnot. So I think these are all for appropriate indications. a reasonable first line to try to avoid surgery if at all possible.

Dr. Clancy

Well, using myself as a case against, my left knee was severe, grade 4 osteoarthritis. Surgery went right to the top of the list and it's been very successful. But my right knee is a grade 3. And there's no pain right now. But let's say you and I talk and my right knee is starting to hurt a little bit. What could I expect for level of relief and how long? If you did

something very typical like a like a knee osteoarthritis that is becoming somewhat impairing as far as function.

Dr. Kruse

Yeah, that's a great question. So generally speaking, again, outcomes and duration of outcomes for symptomatic osteoarthritis depend on the joint and depend on the degree of osteoarthritis. So using you as an example, so somebody that has grade 3 osteoarthritis of their knee, any of these biologics would be available and would be appropriate. I typically do this in a gradual progression, meaning I start with PRP for most people. Unless they have grade 4, then the discussion comes down to being a bit more aggressive. But usually I do this in a sequential progression. With PRP for grade 3 osteoarthritis, the success rate depending on the study you look at, is around 70 to 75% pain relief. And at least for us here, we define a successful procedure as at least, it's subjective, but as at least 80% improvement in pain and function compared to pre-procedure. The average duration of benefit from PRP for the treatment of osteoarthritis on average is 12 to 18 months. And again, it's a very repeatable procedure. So if somebody has a great outcome, then we can repeat it. We also know that these procedures, particularly PRP, does have some evidence that it may slow the progression of osteoarthritis. And so there's a certain subset of folks that even if they're minimally symptomatic, want to proceed with PRP almost as a prophylactic treatment. If we talked about BMAC versus MFAT, I would say on average, and I'll just particularly talk about MFAT, more so than BMAC here. But for a grade 3 osteoarthritic knee, the success rate of MFAT is around 80% or so. And what we're seeing on average is that people are getting 3 plus years of relief. Now the evidence, I'm sorry, the studies are still ongoing and we don't know what that plus is just yet. For me, my longest follow-up after an MFAT procedure is about 5 years. and that patient is still doing well. So my plus is five years, but we don't know. I haven't had anybody come back just yet that has needed a repeat. It either it has worked and it has continued to work or it doesn't work. And then obviously, we pivot and move on to something else.

Dr. Clancy

Great. Well, you've got me thinking as far as this right knee and that preventative nature as well. So you mentioned this a little bit, but let's kind of dig into it together. What does a treatment course look like then, including the procedure and then the protocol, how long does it take? How much time are you there over at sports medicine and from tissue removal and processing to injection? What's it look like?

Dr. Kruse

Yeah, so we can, we'll talk about the procedures one by one first and then I'll go over the protocol afterwards because the protocol is essentially the same. are fairly similar for all of them. So PRP, a typical procedure or appointment for PRP with me is about 45 minutes to an hour. The patient comes in, we do a simple blood draw from the antecubital fossa, and then use a particular centrifugation system to centrifuge the blood. That typically takes anywhere from 20 to 25 minutes, depending on the volume of blood that we draw. And then the injection, all of our injections, we use ultrasound guidance. We put in a little local anesthesia. different needle, go in, inject the PRP, and then we're done. So fairly straightforward with PRP. The actual injection itself is really no different than injecting steroid or hyaluronic acid or something else.

With bone marrow, so those appointments are about 60-ish minutes. It just takes a bit more time, 60 to 75 minutes. It takes a bit more time to perform the harvest. And so For me, what we do is we go into the PSIS, so we'll use ultrasound to localize the PSIS. Again, all these procedures are done with just local anesthesia. We don't use general for any of these, and they're done in a procedure room within the clinic. We anesthetize the skin, make a small little stab incision down to the PSIS, use a jamshidi needle and a drill to drill into the pelvis. and then aspirate the bone marrow out. It's fairly well tolerated. The biggest complaint is people get almost like a buttock cramping. It's kind of hard for them to explain, but from a pain perspective, they tend to do just fine. And then again, we inject, as I mentioned previously.

MFAT is about a 90 minute procedure. So what we do is we have patients come in. I will harvest fat. Well, it depends on the patient and where I can find it, but I'll often harvest from the lateral thigh. or the abdomen or the flanks. We infiltrate the fatty tissue with an anesthetic type fluid. We then go in, let that sit for a while, 15 minutes, go back in with the blunt tipped cannula, harvest that fat out, and then again, using a proprietary system, we clean process the fat, and then the injection is through a needle, just like I mentioned previously.

The post-procedure protocols are fairly similar for all of these, and I'm a huge proponent of post-procedure Protocols and rehabilitation, I think it's critical and I think it maximizes the potential for great outcomes. Generally speaking, I slow patients down for two weeks. I have them just restrict themselves to normal daily activities, ADLs, nothing else. At the two-week mark, I have them start a structured course of rehabilitation, physical therapy at their physical therapy location of choice. At the two-week mark, additionally, I allow patients to start with low-impact activities. for a lower limb, walking and biking and swimming and that sort of thing. Return to higher impact activities starts around four to six

weeks, depending on if we're doing a joint or soft tissue, and then they can progress activity as tolerated afterwards. On average, PRP will start to result in symptom improvement about four to six weeks after. On average, BMAC or MFAT, it's about 6 to 8 weeks before symptoms start to improve.

Dr. Clancy

Again, I've just gone through a major procedure with the ortho and rehabilitation and out at the sports medicine facility, it is very clear to me that it's a team oriented approach that you practice. Who else is on your team and what are the other important parts of treatment beyond the injections? And you know, you mentioned physical therapy, but what is next as far as getting the most out of each one of these procedures?

Dr. Kruse

So our team is large and I need our entire team to make this work. I can't do this on my own and my team is critical and the most important thing in the world to me. I work in clinic with two athletic trainers. They help with patient rooming. They help and pretty much run and tell me what to do during the procedures. They know the procedures better than I do. So they help out with the procedures. They help out with post-procedural restrictions and education, and they follow up with patients if they have any post-procedural questions. So they really run the show and help maximize patient outcomes. physical therapists, occupational therapists, and then non-clinical ATs, I rely on them so heavily afterwards to help guide these patients. Obviously, I can't see these patients follow up every two or three days. That's just not feasible. And so I really rely on the local community rehabilitation experts to help use the protocol that I send them that we have in place to educate and guide these patients to make sure that they're following the protocol. And I always tell them, you know, there's no harm in going too slow. There's a lot of harm in going too fast. And that's the hardest thing is keeping the reins on patients sometimes because they want to get back, want to get back to activity. So the local rehabilitation experts, physical therapists, occupational therapists, athletic trainers, are really key to great outcomes here.

Dr. Clancy

Yeah, I think that as one is thinking about where and how to get these procedures, looking at the team is just as important as looking at the individual physician as well. New treatments often take some time for insurance companies to begin reimbursing. Have you made some progress in health insurance reimbursement for orthobiologics?

Dr. Kruse

Yeah, [checkle] we've tried. It's been very challenging and it's really state dependent. I've practiced in numerous different states at this point, and the amount of insurance coverage has varied dramatically. Here in Iowa, most commercial insurances have not been covering any of the orthobiologic options that we have. Our local University of Iowa insurance does cover PRP and has covered intermittently some other biologics. The VA tends to be very pro-biologic and they tend to approve it. And then also work comp actually is a big proponent of biologics and we've had a lot of luck with them approving these procedures. But commercial insurances, it's really been a crapshoot and we haven't had a ton of luck getting insurance approval. We're doing our best and by studying these and producing literature, that's the best way to try and get these insurances to cover, but that's, obviously a long road that we're just in the beginning of.

Dr. Clancy

Yeah, but you made a really compelling set of arguments today, really, as far as response rate and then duration of response rate. It's very impressive. So I titled this session of Rounding@IOWA with a real intention and focus on being evidence-based regenerative medicine. There does seem to be a great variety of treatments offered under the banner of regenerative medicine and As I said before, I'm a man in his early 60s who has successfully gone a total knee reconstruction surgery and completed really four months of intense physical therapy, really good results. But the marketing folks at Google and Amazon and all their analytics are bombarding me with all sorts of ads for regenerative medicine. Could you explain why that evidence-based treatment focus and the team approach is so important as far as getting the most out of these opportunities with orthobiologics?

Dr. Kruse

I think evidence-based treatment is critical for every area of medicine, but even more so in regenerative medicine and orthobiologics. we do our best to capture as many patients as we can from a study perspective and provide ongoing long-term follow-up, not only in terms of outcomes, but also adverse events. really the reason to do that is for the patient and to find ways to maximize their outcomes. And that's why we do this. And I think if we don't use the evidence to choose the appropriate treatment, I think we're doing our patients a massive disservice and not giving them high quality best practice medicine. The other point to make in particular with regenerative medicine or orthobiologics is that oftentimes these are cash based services. And if somebody is, if a patient is going to give up hundreds or thousands of dollars, we wanna make sure that we are giving them their best opportunity to do well and providing a service that has the best evidence.

Dr. Clancy

Great answer. So any downsides to these treatment options or any cautionary notes that we need to discuss with our patients?

Dr. Kruse

I would say the biggest downside, honestly, is the potential cost and potential time lost if they're not successful. the adverse event rate is exceptionally low. We just pulled our data here. It's less than 1%. We haven't had any major adverse events. And like I mentioned previously, if these treatments aren't helpful for patients, then they have surgery as a backup. So really, the worst thing that can happen for these patients is that it just doesn't work and maybe they lose some invested time and money. The other point that I would make to all patients that are considering an orthobiologic or regenerative medicine procedure is be an informed consumer. There are people out there that will offer these treatments and provide a lot of false hope. I've had patients come to me for a second, third, 4th, 7th opinion and have seen other providers elsewhere that have promised them for $15,000, one injection of this magical treatment can reverse their grade 4 arthritis into a non-arthritic joint or They can inject IV quote unquote stem cells to cure autism or fix a concussion. And I would just, I would strongly advise patients to try and be their own advocate, read the literature, know what's legal, what's out there, what the evidence is. And if anything feels off, get a second opinion from, you know, another provider.

Dr. Clancy

Well, you know, it is. unfortunate that sometimes people take advantage of a patient has a whole lot of hope about a particular treatment. And I think you answered it really nicely as far as being realistic and doing your research. Great job. As I was preparing for this podcast, I realized that this is really becoming big business and private equity and venture capitalists are investing $20 billion a year at least. They've done that for the past several years. Do you have a sense what the future may look like, what's already in the pipeline? how much more regenerative medicine will move into really, in the treatment protocol mainstream as we look to the future.

Dr. Kruse

We're so early into this whole regenerative medicine realm at this point. You know, we need to continue to perform studies and ongoing research looking at outcomes that'll not only help with, like I mentioned previously, insurance approval, but it'll also help us figure out exactly what is needed for that specific patient and that specific indication. At this point, if we think about these biologics as a medication, we don't know the right dose yet. If you think of somebody that has some infection, we know the appropriate dose of Augmentin to

treat their otitis. But we don't know just yet what the exact or appropriate or best quote unquote dose of a biologic is for a particular indication for a particular patient. I think we're getting closer to that, but we still have a ways to go there. And that's where the ongoing research is important. Other things that are coming through the pipeline, there are many novel treatments that are out there, which we could talk for hours about this. I think one of the most exciting things that is being investigated at this point is actually gene therapy and as it pertains to osteoarthritis. Are there ways that we can use certain vectors and inject those into a joint to either stop the oxidative stress within a joint to stop the progression of arthritis? So there's some really exciting stuff coming down the pipeline. Obviously, those are not anywhere close to being able to be used clinically, but I think we're heading in the right direction.

Dr. Clancy

No, very helpful. As I race against the thought, as I get older, I'm really encouraged. Ryan, as we close, what are some of the take home points you want to leave with our listeners about regenerative medicine and particularly orthobiologics?

Dr. Kruse

I would say that if somebody has a musculoskeletal injury or condition and they would like to consider avoiding surgical intervention, I would strongly consider the use of a biologic. Additionally, As I mentioned previously, patients need to be informed consumers and they need to do their research, talk to informed professionals that are doing this in an evidence-based manner to be able to understand when they're being told appropriate information, correct information, and when they're being sold snake oil.

Dr. Clancy

Well, thank you, Ryan. Really Our regenerative medicine expert, thank you so much for joining us on Rounding@IOWA and for the work you've done in helping keep patients moving. For our listeners, you can access instructions for CME and CEUs within our show notes. And as always, we hope you'll join us again for another session of Rounding@IOWA.

[Upbeat theme music plays]