We have an awesome group here. We will start with Dr. Taylor Byrne. And then we have Dr. Michael Welljamsdorof, Dr. Michael Williams, and Dr. Mathew Laudie. But I will transfer this first two Dr. Taylor Byrne. Thank you.

I want to make sure if everyone can hear me. We can hear you. Okay. Perfect. Welcome, everyone, to the 11th annual Pain Care Skills Training. We are delighted to have you pick it should be an exciting day. Our topics today are going to be a review of pain procedures. We will cover for topics today. We have regenerative medicine, sympathetic blocks, neuromodulation, and spinal blocks. We will have four participants each giving one presentation. We are excited and it should be fun. I hope everyone has had a coffee. Before I start with my slides, I encourage everyone to use the chat pod to let us know where you join us from today. We are all in the D.C. area being fellows. We are rained in today. But hopefully you are enjoying sunny weather elsewhere. None of us have any disclosures to speak of. This presentation, the views expressed in this presentation do not reflect official policy of the Department of Army, Navy, Air Force, Department of Defense, or U.S. government.

My topic is regenerative medicine. And that's a huge field that can be used to treat a variety of pathologies, whether it is tendinitis, osteoarthritis. Really, we could have one presentation on each of those pathologies. What I decided to do today is focus on osteoarthritis. We will have the review, the pathology countrymen, et cetera. We will go over indications and contraindications for treatment. Then we will review the therapies or injectable therapies we do for osteoarthritis which include corticosteroids, hyaluronic acid come and then we will focus in on some regenerative therapy to include prolotherapy and platelet rich plasma.

We will get the morning jitters out of the way with some questions. We have a couple today. I will go ahead and read this for you but there should be an option to select via a poll. A 55-year-old postal worker with a one-year history of increasing left knee pain and decreasing ability to emulate arrives at your office. Or history is significant for 30 minutes of morning stiffness and a left medicinal tear. She had surgery for 5 years ago. EMI is elevated at 35. She has deformity in the knee and mild quadriceps we this. She also has some radiographic findings significant for medial compartment narrowing and bony sclerosis.

I will give everyone a minute to answer. There was 100% correct from all of the participants with osteoarthritis. Osteoarthritis comes from three Greek words meaning bone, joint, and inflammation. It is a degenerative disease of synovial joints primarily focusing on degeneration of the articular cartilage. That degeneration then leads to subchondral sclerosis and eventually Osseo site formation. As you can imagine, it changes the structure of the joint which then ultimately result in loss of function of the joint. As far as epidemiology goes, it is the most common form of arthritis. It is more common in weight-bearing joints, especially the hips and knees. It is of the leading cause of disability in the United States. As patients continue to get older and bigger, the prevalence and incidence continue to increase. This is compounded by the fact that there are limited treatment options. But we will discuss the

options the patients have today. There's a large public health impact. You can see the cost is about $2000 average per person per year. This is compounded by lost work earnings. It's more common in veterans than in civilians. Unfortunately, the primary conservative treatments for osteoarthritis are going to be physical therapy as well as weight-loss or activity modification. You can see a large percentage of people have issues even performing ADL and 40% are inactive. When attempting to get the patients to do physical therapy will lose weight, it is challenging because they are inactive. From a primary care standpoint, it is also very challenging to manage other diseases such as diabetes, heart disease.

As far as risk factors, for developing osteoarthritis, there are multifactorial and it is chart on my slides, we have osteoarthritis in the center and risk factors on the outside, of these risk factors, only two are modifiable which would be obesity and overuse. So those are two areas we can focus on from a primary care standpoint and chronic pain standpoint. As far as obesity goes, every pound of weight we gain is four pounds of extra pressure leading to increased joint load and inflammation. That is something where we can really target again from both areas with the patient. That is in clinic or from the primary care perspective. Some other risk factors, overuse [audio cutting in and out] low-impact aerobic exercise [audio cutting in and out] trying to reduce the impact on the joint. As far as advancing age goes, we have discovered [audio cutting in and out] as far as genetics. Patients born

with [indiscernible]

Increased risk for osteoarthritis as well as. Again, whether they have a tear, et cetera. And I think the symptoms are fairly straightforward for osteoarthritis. You will have pain at the affected joint. Can affect any joint, whether it is spine, hips, knee, hands, and the pain is usually dull, sharp, constant, or intermittent. The biggest thing they test as far as questions is that you have stiffness that typically improves within 30 minutes. This is in contrast to rheumatoid arthritis. You can have pain that is typical after vigorous activity. That eventually, as the joint gets worse and worse, they will have limited function and decreased range of motion.

This joint accounts for over 80% of disease burden. [pause] Everyone is killing it today. We are 2 for 2. The correct answer is the knee. Given that the knee accounts for over 80% of disease, we will focus for regenerative therapy for the knee as opposed to steroid injections or hyaluronic acid.

So the knee is the largest join in humans similar to osteoarthritis in general and of course there's trauma, and joint malalignment and there are very limited treatment options prior to replacement which makes it a challenging disease to treat.

We look over the diagnostic criteria diagnosing knee osteoarthritis. Diagnosis is through clinical means. In contrast to some inflammatory arthritis, rheumatoid arthritis diseases, it is usually asymmetric. You may have a fusion. There's decreased range of motion, just, as well as point tenderness along the medial or lateral joint line. Looking at the joint criteria here, from the American College of rheumatology, you can see for clinical diagnosis, knee paid plus three of the following, age

greater than 50 years, stiffness less than 30 minutes, crepitus and enlargement and body tenderness. If you want to get a radiograph, you are looking for Osseo site changes. If you want to rule out, if you want to get to the collapse or laboratory data rule out rheumatoid arthritis and get an ASR, less than 40 RF with all rescale of less than 1 240, and if you do get radiograph, to diagnose the extent of OA some you can see that we use this grading scale. Grade 1 is normal, no features of OA. As you progress, you get the development of more subchondral sclerosis formation and joint space reduction. The prevalence was estimated to be 27% of patients under 7 years old had radiographic changes consistent with knee osteoarthritis. And this increased to 44% of patients that are over 80 years old. Age definitely is a factor. When talking about the disease process for osteoarthritis, the wear and tear dogma is oversimplified. There are many variables. You can see in this chart we have an early OA phenotype with maybe changes in the meniscus, articular cartilage, et cetera. This leads to pro-inflammatory and is overall inflammatory mill you that results in degradation and changes within the joint, as you can see, these progresses. You can have and eventually develop cartilage erosion and subchondral which is not just wear and tear although it is referred to or compared to inflammatory arthritis, not there is no information but it's low-grade inflammation.

We have reviewed epidemiology, presentation, et cetera let's go over some treatment options we can offer. Whether it is in, primary care, clinic, we can offer TENS, heat and cold, bracing, low-impact exercise, weight loss, these are all interventions recommended by the American College of rheumatology. We also have the other major societies on this issue. We can offer anti-inflammatory medications including Tylenol and ibuprofen or NSAIDs as well as topical Nsaid. Of course, what I will discuss today's injectable therapies. We will go over and briefly discuss nerve blocks and then of course the last treatment option that we try to delay or avoid is a surgery.

Now we are at our third question of the day. Nonpharmacologic management strategies for knee osteoarthritis are under used by physicians in both primary and national day care. True or false? Three for three so far. That will make my questions harder next time. Yes. This is true. I think when we talk about pain procedures, I really think we need to get much more benefit out of the procedures we do in the chronicling clinic. We can get the patient to buy in and focus on changing their modifiable risk factors. Also, we want to make sure that we are doing everything we can, whether it is a bracing to relighting the joints, using TENS, heat, cold, anti-inflammatory medications as indicated to really provide synergy. We half an overweight patient who is old who has severe OA who doesn't exercise and does not move and is not motivated to participate their own care, it is not likely that we will have great outcomes with the patient. From both sides, primary care and specialty, there is definitely more work to do in this area.

So moving onto injectable therapies, so today we will talk about steroid injections, hyaluronic acid injections, prolotherapy, and we have platelet rich plasma therapies as well but there's much more work to be done on that front. This is a chart depicting the major societies on these issues and what they recommend. You can see the American College of

rheumatology recommend steroid injections and so does the osteoarthritis research Society international. The American Academy of orthopedic surgeons list that as inconclusive. And the arthritis alliance of Canada, et cetera, they also recommended. We will refer to the start when talking about the different procedures we offer. Went to refer? It is clear what we have maxed out conservative therapy. We've done weight-loss exercise, physical therapy, bracing, Tylenol, and said, et cetera, the patient is still not getting relief and maybe there's something that we can offer. Once we have ruled out other issues of knee pain, it will be appropriate to refer. This is a diagram out of the recent diagram out of the American College of rheumatology, what their approach is to conservative treatment for the osteoarthritis's back as far as contraindications what we do on the clinic, really just generic contraindications for joint and/or soft-tissue injections and that will be septic arthritis, local cellulitis, acute lecture, et cetera.

Okay. So, discussing intra-articular steroid injections, this is widely used. It is the most common treatment for knee osteoarthritis. Is thought to be local anti-inflammatory action within the joint. Most commonly used would be these two. It is controversial data.

The review contains 27 low-quality and heterogeneous trials including steroid versus birth levo with minimal improvement at four weeks and absent at 13 weeks. However, there was moderate improvement in function scores compared to pain scores at two weeks and declining at 46 weeks and absent at 13 weeks. There was a consensus in many of the papers that I read those steroid injections provide temporary relief for approximately one week after injection.

As far as adverse events we steroid injections, you can have post injection flareups. Is a question whether or not you perform serial knee injections, you can lead to progression of arthritis pick the other potential is skin depicting nation and of course we inject the medication into the joint so the idea you work locally but there's a chance of elevated blood pressure, hyperglycemia, alterations in mood and energy. As far as progression of osteoarthritis, the recommendation came out, or even 2017, there was an RCT that [indiscernible] Resulted in greater cartilage loss compared to steroids at 2 years and they came up with a recommendation to use only once every three months for a maximum of 2 years due to the negative potential side effects.

Despite evidence and conflicting recommendations from the societies, the fact is that for steroid injection, for the knee, it is inexpensive and easy to administer. In conjunction with a lack of accessible, affordable alternative, it will likely remain the main state for knee osteoarthritis. It does provide temporary benefit. It continues to be recommended by three out of the four major societies.

Visco supplementation refers to hire Alana acid injections. Hyaluronic acid is the main ingredient in synovial fluid. When looking at osteoarthritic knees and looking at this new PO fluids, they are 50% efficient or deficient in hyaluronic acid. The exact mechanism is not well understood. But the idea is to provide, or the goal is to relieve pain and improve mobility. Hyaluronic acid allows cartilage to minimize

friction. As far as indications go, again, if [indiscernible] Reasonable option. Contraindications would be an allergy, infection, et cetera like we discussed. This was FDA approved in 1997 for knee osteoarthritis. We will have a question on this to come. Steroid injections is the second most commonly used therapy to treat me OA.

The FDA classifies a viscose limitation as what? The correct answer is B, it is classified as a medical device. That's interesting thinking about the FDA approval process when injecting, when using injection to treat knee OA, I would never assume that visco-supplementation would be classified as a device but in order to get through the approval process, that is where it went. As you can see, there are numerous agents on the market. There are five on the market. Each has a different dose and number of injections per treatment course and duration of pain relief as well as molecular weight. You can see how this might be challenging to study because there are five different supplements on the market who might be involved in studies that use different products, different numbers of injections, different dosing, et cetera. So as far as a potential algorithm we can use to treat knee OA, for the first injection, we reevaluate at six months, and this is a fairly patient dependent thing. If the patient is symptom-free, do not treat. If they are still symptom free between six less than 12 us but they have a high risk of it's because they are a professional athlete, you can consider another injection. If they get a hyaluronic acid and it's a little relief, again, you only treat if you are concerned if there are comorbidities et cetera. It is very patient dependent, and it depends on what they need to be able to do on a daily basis and how they are responding to that injection.

As far as efficacy, there is conflicting data from various meta-analyses. We've looked at hyaluronic acid versus placebo which there was no difference between hyaluronic acid versus PO NSAIDS. There was some difference when looking at hyaluronic acid and corticosteroids. Hyaluronic acid had better outcomes at five weeks and 13 weeks in these results lasted until 26 weeks. This is opposed to corticosteroids. The consensus is they would provide relief for only about one week.

As far as hyaluronic acid goes, going back to the charts, you can see that none of the societies recommends hyaluronic acid. It is inconclusive for arthritis alliance of Canada, not recommended by the American Academy of orthopedic surgeons which is interesting, and then inconclusive for the other two.

Before we jump into regenerative medicine, we will talk about geniculate nerve blocks. Geniculate nerve blocks [indiscernible] Is done with radiofrequency ablation as you can see in the figure here on the slides. This is usually preceded by [indiscernible] 50% reduction in pain. There's limited evidence out there so far. Evidence has small sample size and lack of control group. There was one study that I thought was interesting in 2018. It was a random crossover trial with cool RF versus a steroid injection. They looked at pain scores over the months and while there is a similar effect on pain relief and function at one month of this that he sickly found a different set three months and six months. At six months, 74.1% of patients in that cool RF group reported a reduction in pain compared to only 16.2% in the corticosteroids group. Knee

function [indiscernible] Versus the corticosteroids group. [indiscernible] There does seem to be evidence for benefit for this procedure. It is safe, non-opioid, non-corticosteroids option for treating knee osteoarthritis.

Moving onto regenerative medicine itself, so all of the things we spoke about thus far, the focus is on symptom at a treatment. It focuses on pain and inflammation. With regenerative medicine, the idea is to slow progression of the disease, or he potentially reverse the disease process. When talking about regenerative medicine, you see on this slide, we are talking about stem cell transplant, tissue engineering, genetic engineering cloning, regenerative pharmacology, it is growing in a large field.

The problem or one of the issues with regenerative medicine is that it is a very challenging field to study. The questions that are commonly asked include what is the particular injecting, how much do you claim to use, we do a single injection, we doing multiple injections, what is the appropriate patients or what degree of arthritis is appropriate for each patient for each inject eight so just looking at plasma rich plasma, you can have low versus high and you can do these studies or systematic reviews, those two formulations are mixed together which is clearly a confounding factor. These are challenges we will go over prolotherapy. This is an uncommon treatment relatively for knee osteoarthritis. I haven't done it myself in clinic. It is inexpensive, highly accessible, and has a high safety profile. For prolotherapy, you are injecting a hypertonic irritating solution into the intra-articular space. Is usually dextrose. That is 10% to 30%. The mechanism is thought to induce a pro-inflammatory response attracting growth factors and cytokine to accelerate healing. As far as providing pain relief, potential mechanisms would be the hyperpolarization of non-except to pain fibers. Results seem to be encouraging. There's a very low quality, heterogeneous daddies. In 2017, there was a systematic review that examined studies and concluded that while all studies debit rated positive outcomes at high patient satisfaction, meta-analysis was not even possible because of the high data heterogeneity. In summary, the proposed that prolotherapy provide at least some benefit over the quality of available data makes it hard to prove. However, it is safe, effective, and does not cause harm.

Moving onto platelet rich plasma, this has become more common for treating knee osteoarthritis and it's something that we do in our clinic. The idea is that you take a patient's blood sample, spin it down in a centrifuge to extract platelets. Then inject that the patient's knee. Standardization, you want to concentrate the platelet and the goal is to concentrate them to at least 2×28 is the concentration.

The platelet has granules that release with factors when injected into the knee, it can promote tissue healing and slow the disease's progression. In contrast to steroid injections or hyaluronic acid, this procedure does not promote and does not begin to provide pay control until two months after the injection. And it may last much longer than other therapies which is up to 12 months. It is generally well tolerated. The whole idea is to convert the inflammatory mill you discussed previously and convert it.

There's one more question here. This famous athlete attribute their speedy recovery to PRP. This was a trick question. All of these used PRP. Tiger Woods used it. It helps with his recovery after ACL surgery. Kobe Bryant at roughly on that out PRP for knee issues. And finally, Heinz Ward in 2008 suffered a great to ACL sprain. He received PRP in the knee and return to play within two weeks as compared to the more typical for weeks to six weeks recovery period.

They then went on to win the Super Bowl that year. That's all we need to know about that. Going into the evidence for PRP, is very challenging to study when you are comparing just formulations and injection frequencies. There's also timing of injections et cetera, but we'll discuss some of the data. In 2019, there was a comparison over a five-year period which had similar efficacy and duration of affect mix of [indiscernible] adjust that PRP may be superior to hyaluronic acid at six months and 12 months when measuring pain and functionality scores. The robust evidence is lacking. As far as receiving PRP, it can be very expensive, thousands of dollars, and it is not covered. A broad overview of the data and results implies positive influence of PRP on knee osteoarthritis with encouraging clinical result in almost all studies which were included in this review.

We are finishing up here and just a note on stem cell therapy, so stem cell therapy is thought [audio cutting in and out] local growth factors in promoting the anti-inflammatory response. The most common themselves used have the potential to differentiate into chondrocytes. Studies have proven safety and tolerability but there are of course ethical concerns with his. Harvesting, whether from bone marrow or fat may require [indiscernible] that it. When attempting to review 5 RCT, it was found to be so heterogeneous and at such high-risk bias, meta-analysis was not even possible. So, there's more work to be done. This is not something we do or that I have seen done in my clinic to my knowledge.

Injectable theory piece therapies for knee osteoarthritis, corticosteroids will remain first-line followed by hyaluronic acid. As we set, the data for PRP looks promising and I believe it will come more and more popular as the research teases out the most effective protocols, standardization's, et cetera. That concludes my presentation. References are here. I will be happy to answer questions.

It looks like you have some questions at the bottom. It's in the chat box. Okay. Do you know if ERP is covered for TRICARE beneficiaries if they are seen outside of the MTF? I've only done this in the Walter Reed pain clinic. If any of my colleagues have that, feel free to chime in. [audio cutting in and out] on the got you do not have to take it as often. But I really are [audio cutting in and out] let's see. I am getting questions here. >> Is there any role for PRP for cervical or lumbar degenerative disc? I focused most of my research on looking at knee osteoarthritis but yes, PRP is being used for a variety of different pathologies, whether it is tendinopathy, golfers all the content is over, et cetera. Injecting into a degenerative disc, I cannot say that I have heard of that yet. [audio cutting in and out] so when the societies come out with the guidelines, they primarily are trying to stick to evidence-based medicine. And so although some studies have show that hyaluronic

acid can be beneficial, the data was inconclusive. So even with needs steroid injection, there was temporary relief from the injections is almost societies recommend that. Far hyaluronic acid and even for PRP, we are not there yet. I did come across that in my reading I do my, I do not have a lot of experience with that.

Cardiac risk factors. Do you see [audio cutting in and out] in there? What is that? Do you see the rest of the question? Yes. I do not. No. I would have to do some reading on that.

If we do not have any more questions, do you want to transition to our next presentation? Yes. Sounds great. Okay. We have one new statement here. There is a new comment. They saw no significant risk difference between Celebrex and ibuprofen for people with CV disease. Thank you for [indiscernible] on the question. So we will have a transition here. >>

Dr. Michael Welljams? Can you hear me? Yes. Great. I am Dr. Michael Welljams. I am at Walter Reed, and we will go through the disclosures. I do not have any, and I expect not to have any financial gifts or anything in-kind or anything pertaining to this presentation pick these opinions are my own, not of the Department of Army, Navy, Air Force, Department of Defense, U.S. government but I apologize for my camera. It it seems to be cold and rainy and a cloudy day today which is affecting my camera. You can see half my face but basically, I will be talking about sympathetic locks and their use in two major pathologies, CRPS, and PTSD. These are the learning objectives. We will take a trip down the sympathetic chain starting at the head and working the way down. I would talk about the blocks we can do a different level of this empathetic chain. The last learning objective is to define CRPS and talk about how we categorize it and potentially how we treat it. Since the rest of the presentation will focus on ways we can help treat, I will start with CRPS itself.

First, I want to start with the case discussion. All case discussions are based on patient we've had in the clinic. The patient presents with upper extremity pain. He had a stab wound injury four months ago and had surgery. He noticed strange things, swelling in the arm, limited range of motion, temperature differences, it is hot at times, and he has tried oral medication which does not really provide much relief. He tried physical therapy, but it is limited due to his pain. Do research, get up-to-date, and you come up with CRPS, but you are not sure which type. We say this is type I or type II? >>[pause] >> About 71% say type II and the other say type I. CRPS, actually the first informal case reports go back to the Civil War. There were doctors in the Civil War who noticed that they had patients who had penetrating stab wounds, gunshot wounds, things like that. They would come back, and it would have, they call it burning pain. They did not have a word for it, so they called it [indiscernible]. The first major categorization of CRPS was back in 1994, the international Association for the study of pain criteria. In 2007, they updated all of that with criteria that we use for categorization nowadays. There are two major types. Type I used to be called reflex sympathetic dystrophy. There is no clear penetrating or traumatic injury pick you might have an equal role in the patient and then he develops CRPS after that. Vendors type II which is what Civil War doctors saw that

is an inciting, penetrating nerve injury. Outpatient previously would be CRPS take to put had a stab wound. As far as the mechanism for CRPS, we are not 100% sure how it works. We think there are couple of things involved. It is complex to stratify and to treat. It is debated. There is some type of injury in the periphery, traumatic event or not and peripheral signaling [indiscernible] Similar process takes place in the central nervous system as well. There's also the pathetic medial pain.

There are four different categories. There is motor with weakness, and sensory like allodynia [indiscernible] Nothing else I could ask Lane these types of changes. If you have a patient who comes in with persistent pain out of proportion of what you would expect a lasting longer than what you would expect in your seeing some of these signs and symptoms, that is when you referred to a pain specialist because there are potential interventions that we could introduce. As far as CRPS treatment goes, it is multimodal. There are a lot of aspects. The end goal is to really better allow patient to participate in physical therapy and occupational therapy because that is what will essentially provide them with the longest lasting relief. As far as medications go, there are a number that we use generally starting out with things like NSAIDS, there's a role for corticosteroids, things like antidepressants, and patients can also develop spasms. [indiscernible] Especially with traumatic injuries where they have stomps. That also there are interventional procedures. [indiscernible] Talk about later and also sympathetic locks which I will discuss. The important thing is, with these blocks, identify as early on as you can because the goal is to get them to participate in PT and OT as soon as possible. If we can provide relief that allows them to do so, the patient will do better generally in the long term.

Here's another question. Have any of your patients ever had a sympathetic lock? For the people who answered yes, think back and say you state your patient benefited from it, do you think they were provide relief or did you allow them to participate in PT or OT better?

Based on what we see, most people feel like patients benefited and maybe in one case they did not. Okay. All right. So, what are the pathetic blocks? They target sympathetic ganglia. They result in a loss of sympathetic tone. Generally, they are indicated for patients who have had limited or no benefit with less invasive modalities like medications, trigger point injection, things like that. The mechanism for this is essentially a clear. There's a thought you are blocking preganglionic or postganglionic or afferent signals and also there maybe interference with fibers that run along with the pathetic nerves. Generally, the blocks are lacking in evidence for long-term pain resolution. The classic use for the blocks is shorter-term, weeks to months, bridge so patients can participate in PT and OT. We do have patient who come into the clinic and say I was given us a that a block and I was given three months or six months. Had a patient two weeks ago who got a year from these blocks. So, it's patient variable as well. Just because evidence shows shorter-term, doesn't mean there is potential for longer-term relief. This is the sympathetic chain. I wanted to show the diagram. [indiscernible] We see a travel up and down the area and you can do this with ultrasound or underfloor scopic guidance which is generally how we do most of it today.

The stellate ganglion as you can see has a lot of anatomy in the area. We perform it at the level of C6 which is right here. Why? It is closer to see seven, you have fluorescein can get into the lungs if you go to low. At the six, is more protected as well which is why we tend to go at that level but that said, you can also go to C7 as well. The term we use is [indiscernible] And is a landmark we are looking for. As far as indications go, there's a lot of different indications for this block. We talked about CRPS. There's also post herpetic neuralgia, pain mediated malignancy, [indiscernible] Vascular headaches, vascular related pain like persistent angina, refractory arrhythmias have been treated to reduce the pathetic outflow [audio cutting in and out] and even rare diseases and this essentially targets the head and neck and upper extremity which is based on the anatomy where it is since we are going into the neck at C 6. There's also a huge role potentially for PTSD which is one of the major reasons why we use this block.

Why would you have contraindications? What we expect with the block is [indiscernible] My eye is drooping, I am having a stroke or something like that so we can be very scary to patients. Well, could be a contraindication. Also given where you are going in the neck, you can also get nerve palsy which affects respiratory status. With locks, we have anticoagulation factors.

Cardiac conduction delay, we talked about you are limiting sympathetic outflow. That can lead to cardiac block. If you have pre-existing blocks, that is a concern. Allergies, medications you use, usually for the blocks, we use local Eness attic and sometimes you can have the basis of some type of local anesthetic [audio cutting in and out] patient. Many of the contraindications of these blocks talk about a similar. If you are successful, you generally will get quarters. There's potential for character vertebral artery puncture, you get potential respiratory arrest, you can all puncture the esophagus, recurrent laryngeal nerve injury, so you could get hoarseness, and [indiscernible]

We will have another case discussion. The 28-year-old male patient traumatic brain injury suffered during deployment. He's been struggling for over year with sleep disturbances, changes in mood, hypervigilance, nightmares. Try cognitive behavioral therapy and medical management and he both helped but he can't sleep while still in his mood is all over the place. These are classic symptoms of PTSD.

What traditionally do we use for PTSD? We use psychotherapy, cognitive processing therapy or prolonged exposure, and also medication, antidepressants of some type. As far as psychotherapy goes, studies have shown that it can be difficult for patients to keep up with therapy. They have high dropout rate. The first use of the block for the disorder goes back to the 1940s. The first used it for the treatment of epilepsy. The notice a lot of these patients would have a euphoria afterward, they felt better, especially patients with depression. They noticed some patients better, had less anxiety. It had an effect on mood. The first official case report was back in 2008. The patient was a victim of an armed robbery and was unresponsive to medical therapy, pharmacotherapy, psychotherapy. Immediately after right side block, we go by dimension and really after the block, he noticed he lost the overwhelming feeling of

anxiety and got 30 days of relief after this. Later with the second block, after that, they did a pulse radio frequency ablation of it which actually provided three months of relief. It was even longer lasting. In 2015, there was a series that showed no impairment in reaction time and cognitively seems to be functioning well. In 2015, there was the first randomized trial, and that trial did not show any significant improvement between stellate ganglion block and sham lock. But it was a small trial with 42 patients it to be overweighted with placebo. There was another random trial in 2020 with Olmsted which is linked up in the handouts. You are welcome to take a look at it. It should be in there. It was a larger trial. It was a multiple center trial is trial focused on patient who are on medications on active duty. They did two blocks, two weeks apart, and attract the resultant eight weeks. They notice there was significant reduction in PTSD criteria at eight weeks out. It was good data supporting these patients. We had patients come into the pain clinic with a history of PTSD and they said I had the block and it provided me with this many months of relief and there was a patient two weeks ago we saw who gets essentially a year of relief from the block. So it is patient variable that there is anecdotal evidence that these help. There's potential benefit more for the patient population given that we have servicemembers who are prone to having to move and switch providers and also potential for deployment which can happen very fast. So essentially, it can make it easier to provide temporary relief while they are getting psychotherapy and adjusting to the regimen.

Here's a 65 female presenting with big abdominal pain and weight loss for the past few months and after work, it shows a tumor in the pancreas and the pain has not resolved with over-the-counter medication. She is now on high-dose opioids. One option for her would be a celiac plexus blockade. This potentially targets the celiac plexus which has a greater or lesser slants nerves from T5 through 12. It ranges where exactly they are or how many there are. It is located just interior to the junction of the aorta and celiac trunk. The plexus supplies many visceral structures of the upper abdomen and pelvis anything ranging from liver, pancreas, testes, ovaries, coal and up to the splenic flexure. We have a diagram here and [indiscernible] Indications for the blockade is [indiscernible] And especially for malignancies. Again, that is liver, spleen, stomach, adrenal, et cetera. This is considered a standard palliative care for pain caused by pancreatic cancer. Evidence, again, current theme in this presentation, earlier intervention is better. It tends to have more of an effect [indiscernible] And it tends to be less opioid use in the patients after [indiscernible] Potentially a role in chronic pancreas pain as well. Patients can potentially have a benefit which can be a terribly debilitating disease as well. So, what are you looking for if you do a block? You can perform neural lytic locks. We generally use some hypersensitive alcohol or phenyl or something like that, high concentration. Generally, the blocks are not considered permanent blocks. They often, the nerves regrow in 3 to 6 months. If you have a successful block, you are wiping the got so will often get diarrhea and/or orthostatic hypertension.

Those could be relative contraindications. Risks, you can get RP hematoma, pneumothorax, damage to the kidneys. [indiscernible] The most common is neuralgia which can be very unpleasant for patients. If you

take away one pain, you can cause another which would not be optimal. The most devastating but rare would be if you inject phenyl and you can get spasm of the [indiscernible] Cause paraplegia.

The next discussion, we have a 63-year-old male coming with a history of intermittent claudication of the right leg. He has a long history of peripheral vascular disease with multiple visible ischemic ulcers on his lower extremities. He has tried physical therapy and medications and it has I hope all that much. There's still persistent pain. What options do we have for this patient? If you guessed lumbar synthetic block, you are correct. This will target the sympathetic gangly that aggregate in the area of L 2, 3, 4, 5, but it can be very variable. You may have four or five separate ganglia in the area separately. [indiscernible]

So here we have a diagram [indiscernible] So here again the synthetic chain, on either side, we've got these areas for the lumbar sympathetic blockade. Down here, and further down, we will talk about those little bits.

Lumbar synthetic blockades, why do we use it? There are three categories similar to the other blocks we talked about that one is nonvascular, CRPS, phantom limb pain, urogenital pain, interstitial cystitis, postherpetic neuralgia, and earlier is better. [indiscernible] Effectiveness has been shown to diminish. There is vascular, mediated pain, gangrene, peripheral vascular disease, and nonpainful like sweating and things like that, so this again would be a target for the lower extremities. You can do a diagnostic block. There are options for neural license or sympathetic to me as well [indiscernible] As well. If you are successful, generally will get an increase in temperature in the lower extremity. Risks again as always, you can have priapism with this a problem with, you can damage the genital femoral or the lateral femoral continuous nerve, things like that. You could damage the nerve roots exiting the spinal cord itself. You can have kidney injury, infection, back pain from the needle itself resolves within a few days. But that is something the patient may complain about were worried about.

Moving on now, there's a 50 really old female presenting to the pain clinic with history of urothelial carcinoma. She has had surgical intervention but has chronic pelvic pain for the past year. Pelvic floor PT has been tried participation is limited due to pain. There's a block for her called the superior hypo gastric plexus block. That is formed from fibers from the aorta plexus and lumbar nerves located at level L 5 /S 1. This law is around here.

Indications for this block specifically, often this block is used for lower abdomen or pelvic pain, especially patients who have some type of malignancy. A lot of malignancies especially affecting FEMA patient, you can do diagnostic blocks and your lysis afterward. Risks involved are generally based on the anatomy. You can have motor or sensory deficit, it can be intravascular, you can get RP hematoma, you can enter the bowel or bladder, there's this guy does as well. And then in a patient with severe, you can disrupt a plaque.

Here's the last case discussion. This is a 35-year-old female presenting after falling off a horse 3 years ago pieces that, she has persistent pain in her perineum and Cognex. She cannot get out of her car without pain and is worried because she can no longer pick up her children without exacerbation. She is very concerned. This is the last block, the ganglion empire block. [indiscernible] But mainly this is for a lot of patients with pain in the perineum. There are a couple of ways to do this. Can use ultrasound, fluoroscopic, or CT.

This is the plexus. And you can see here the chain moving down to the ganglion. Indications for this, pain of the perineum, distal rectum, Regina, urethra, and eight us. As we talked about in the case, there is potential benefit for pain of the coxes as well. If you are successful, you can ablate and there a couple of options. This tends to be a low risk or one of the lowest risk procedures. [indiscernible]

I know we went through a lot of information. That was all at once. And I want to essentially do a pop quiz because I want to see how well I explained these things. I will use the same cases we talked about.

I want you to tell me which block you think is appropriate for the patient. The patient presents with aching abdominal pain and weight loss for the past few months. After a workup, imaging revealed a tumor in the head of the pancreas. Her pain has not resolved with over-the-counter medications. Which block do you think is best for her? Good.

Next one. This is the patient with a extremity pain, penetrating nerve injury, limited range of motion, which one would be best? Okay. We have agreement. Good. An extremity.

The last one is a 54-year-old female, pelvic pain, pelvic floor PT, which one is best? It looks like you are all right on. Good. Well done.

That is my presentation, and these are the references I used. The article from Olmsted should be in a handout as well. There were questions.

Could you use that, yes, you could, lower extremity, it has used him again, if you tried medications, things like you have gabapentin weights, you could potentially have benefit from the lumbar sympathetic lock. It could be useful. Yes. You could either do pain management and that should be able to do it, but I also know, I think p.m. and are doing it as well. So essentially those are the main ones I would look at, pain management or [indiscernible] As well. I think if you talk to psychiatry, they should be able to at least know who in your, where you are stationed there who you would refer to there, so I would also talk to psychiatry is all, but I know that pain management should be able to do that pretty much everywhere.

How does [indiscernible] Affect blood pressure? SGB? So, you could have a job in BP although I do I think it is one of the major risks associated with stellate. I more associate that with plexus blockade. We always monitor blood pressure regardless of when we do any of these procedures just to check. I would expect it to go down. Again, the once we have done, we have not seen marked drops in blood pressure in these patients.

Sounds like somebody blocks can have a role in treating patients with pain following chemoradiation. Potentially they could. Yes. That's actually something I have not actually thought about or considered. But there could be a role if you have a patient who has persistent pain. Again that is with malignancy in secondary to chemotherapy radiation and there certainly could be a role for that. Pain clinic in Hawaii would be able to care for these patients, yes, most common pain referral chain, great.

What is neuromodulation? Tha twill be all Dr. Mathew Laudie will talk about. That is a coming attraction. I love to work. I know what you did last summer. Okay. All right. Okay. Perfect. Any other questions? I am happy to answer.

Thank you so much for being here everybody. this next session is on with the exception of epidural injections these are mostly the most common interventional pain procedures we do in our clinic. So, we'll talk about all of them. I'm able to see the chats so if anyone has questions in the chat or feel tree to interrupt me with audio too. I'll recognize the names from yesterday's session, so we have a good group of folks. Friendly med doctors and act PUN a good variety.

I did my medical degree in Bethesda DA internship at Walter Reed and like these other fine gentlemen in completing my chronic pain management fellowship this year. So let's get going. I do not my spouse does not neither do my cats have anything to disclose. And since the DOD has not made me their official spokesperson, these are only my opinions. We're covering forming things, the set joint injection and MBB intercrosses and interjections and the base L nerve ablation procedure which we're now doing in the operating room.

Like I said, with the exception of the epidural infection the most commonly interventional pain procedure in the world a very close second is number two, our injections and ablations the facet joint are the two joints that really keep the bodies linked together and gives stability to the spine. It's a SYNOVIAL joint. It's formed as you can see here, these are the lumbar bodies up here and up top two superior articulating and two inferior that meet in the middle here around the facet joint. Really named facet because it's one facet or facet of the superior articulating process that meets the facet of the other. So, there it gets its name.

It's kind of formed like a three joint complex meaning it's a facet joint on the right and left and then the disk in the middle and that's three joints complex really gives stability to the VER tee BRAL column. here's an oblique radio graph of the lumbar vertebrae and we can see the ill yak crest here this will be the body of five, four and L 3 and we also see here the famous Scotty dog view this is the classic Scotty dog when we get into the injections, we'll look at a less classic Scotty dog but the principle is all the same. we can see the nose is the trans verse process here of L-3 and the big I looking directly through the PEDACAL you see the Scotty dog's ear is the superior articulating process of L-3 and the leg is the little Scotty dog wearing a KOL LOR or a broken neck, then that's where we would look for defects but we can see most dramatically

what we're talking about here is right here we can see this formed between the superior articulating process and interior this is our facet joint and the classic x-rays used that we're looking for with our graph.

So, the function of the facet like you said provides stability and protection to the spine. And most importantly, the spinal cord which is in the middle. These facet joints take about a third of all of the axial compressive mode. The other two-thirds maintained by the disk is part of the three joint complex. So the facet joints are different depending on the different orientations and look different depending on what region of the spine they are in. As we all know in the cervical spine there's a huge amount of mobility in the lateral section lots of interior posterior extension and then of course axial rotation a lot of mobility. We can see in contrast to the little sky dog view we were looking at earlier with these two vertebrae up to the cervical and the two in the middle are thoracic and the lower lumbar you can see the circles these are the inferior processes and you can see the huge difference between in contrast like to lumbar which we'll focus mostly on this interior articulating process.

Up in the cervical spine they are oriented pretty much axially so the superior processes will fit the inferior in it and that's what gives us so much mobility. The advantage of having all of these arrangements this way is yes we do get lots of mobility but as we all know the cervical spine because of that is also the least protected so as we go down into the thoracic and lumbar spine, we see the converse of that so the thoracic spine as we know has the least amount of mobility and we can see that in our thoracic spine here now instead of being really axial oriented they are oriented almost corner which means very little mobility but the greatest amount of protection. then finally, laying right in the middle the lumbar spine with our DORSA interior and the interior long connects through them so we have moderate mobility and then also a moderate amount of protection.

So the medial branch we love to talk about the medial branch. We got different acronyms we use for these nerves to the facet joints. these joints are intravasated by the medial branch of the primary dorsal so we can see here coming out of these neuro-FORAMINA we have the Ganglia and out of that it splits off into the central RANIE and dorsal RANUS here which comes out the side in the medial branches here. You'll notice that each one of these facet joints here's one facet joint and here is the second and third. These are all intravasated by two different spinal levels because each one of these medial branches do soften ascending branch and a descending branch so if we want to diagnosis or treat the intervention at one facet joint we have to treat and go after two medial branches both the branch at the level of the facet joint and the one above it.

And here's just a more SPUTer animated showing that dorsal root coming around chewing up the ascending branch and descending branch. we can see here in the axial view same thing the medial branches are not shown and these go out and intravasate the muscle cue la CHUR here and I only bring that up to say we consider these medial branch locks we do to be purely sensory and really technically if we're only getting this medial branch

and I apologize for the orientation of this. Of the new diagram it's flipped 180 than we were seeing before, and I can't get my pointer back up.

If we are hitting only the medial branch with ablations or local anesthetic, we're doing it purely sensory to the facet joint itself however most often we are also hitting the entire primary dorsal RAMUS so if done sequentially time and time again there is the possibility and there is a known potential consequence of having some pair Spinous atrophy. Typically, that is very rarely ever clinically apparent. because it takes a lot of damage and really done for so long that it's fairly unusual. So, it's the set joint and yet being generated normally the mechanism of injury to these is really just the generation over time. you can have statistically in the more mobile cervical levels any kind of whiplash of trauma ma. You can't have acute injury and strain on these joints. these in both if capsule and the capsule fibers and ligaments around it there are substance to related peptide receptors found in them and they can be significant pain generators. aisle 6 also found in the cartilage and so we know these are a significant pain generator in some patients so escape dermatology most common in the elderly due to the degeneration we have. that said around 50% or so of young folks below the age of 30 will have some degree of facet ARTH ROPY about 30 people are going to have some kind of generational radio logic abnormality and be completely asymptomatic so this is consistent with findings. in facets because they form the three joint complex, if you have degeneration and pathology in one it's going to increase the strain on the other. bad decompression you're putting more strain on the facets and vice versa.

About 50% or so of chronic axial meaning so not lancing in a particular root but actually staying in the cervical region or lumbar region. About 50% of those with chronic neck pain can be contributed to some set of degeneration or ARTH ROP thy and that's what a lot of people come to us for help with. The facet, what kind of HITS ri will these patients with potential facet issues tell you?

So, there's going to be you'll see a continuing trend during the rest of this talk, and this is something a lot of us council our patients on. Neck pain, back pain is notoriously difficult to treat because there are so many different kind of pain generators in there that can all be causing the similar issues and they can all be occurring at once. A lot of this is an educated trial and error and we need to attack one part and if you get relief that's great but if you don't get all the relief something else is contributing at the same time so a lot of times we start at what we think the most likely pain generator is and then we go from there.

So, history possibly of limited use with that joint only because it is so variable. we know that the degenerative forms are more common than acute but, in the history, if they do have an acute mechanism of action does that mean it's not facet joints? not necessarily. Like I said, typically the nervous contributes to axial symptoms and not ones that will recur in a pattern. That said, if patients can certainly have primary facet ARTH ROP thy causing issues and they have a current nerve group imPIJment as

these facet joints hyper trophy they can narrow the FARAMINA. History plus minus really this to diagnosis this facet pain.

So physical exam of course. Also maybe limited use to only because it's just poor. We have therapists in here acupuncture and chiropractors they are only more tools to put in our toolbox. You will see a lot of overlap between these facet syndromes and same thing we talk about sacred illIAC joint, so this continues to lend to the trend that of course we take history on every patient but there are really more distinct ways that we diagnosis this only because all of these axial symptoms have so much overlap and such overall sensitivity.

So physical exams specifically that we do for the facets, we just start are they PARA spinal not in the muscular, but they can have trigger points to prevent pain generators. What we're looking to find is tenderness when we palpate and manipulate these joints themselves so that's really right over there just lateral mal to midline. And a lot of the patients will when you get in there and they say yeah that's my normal amount of pain. Do they have increased pain with extension and rotation? So why do we care about extension and rotation? This is the classic facet loading so basically, we're trying to load the facets and force them into a configuration which is slightly difference in the thoracic and lumbar as we have seen the anatomy is different but really wanted to look at those facets and see if we have an increase in pain.

Unfortunately, we have these facet loading and there's a Kemp test that we'll look at on the next page it's the same thing trigger points can cause these issues and a lot of other pain generators which can cause very similar exam findings so again, fairly low sensitivity and specificity. there's been described classic pain referral patterns with these facet joints. here's the loading this is not a SPURLings test which is the lateral rotation extension and then axial concession. this can be part of it and we of course anyone awaiting neck pain will look for any kind of OPOTHY. in the cervical and lumbar spine can be enough to grind the facet joints together and that reproduces their pain it's likely to be considered more higher on the differential to the facet mediated.

So cervical C 2-3. is most commonly one of the most commonly described referral patterns patients will have.

We can also provoke on exam. Vertical C-3. It is most commonly it is one of the most commonly described patterns that people will have. This is really in both symptoms and outpatient on exam. If we get in there and we are putting force on these joints. A lot of people say I've radiation down to my shoulder. If there is any pain it is very related as well or it can be. And so a lot of this goes into there may be a lot of different things going on so we are trying to pinpoint which one is which and educated trial in error. This is a referral pattern. And in the lumbar region as well.

All right, radiology. We looked at plain film already but really good for arthritis be. Which is a phenomenon basically producing nitrogen gas and you can get a little air bubble in there. Here the top here is thoracic

in the left side is thoracic and lower is lumbar and on the right is lumbar. We can see a very nice clean then capsule here. Very well processes. And on the lumbar. We see a very nice curved joint space, note nearing this is all in the lateral that we can see very nicely all the way down and very similar in the lumbar. Here we have narrowing of that joint space. A lot of capsules here. This looks very this is the vacuum gas or vacuum joint phenomenon.

And MRI, very similar we can see on the left is a healthy joint and we can see joint line and on the right as I degenerated with obliteration of that joint in space. Radiology, we will continue with this trend, limited use? We know a lot of people are a cinematic will have this Facet arthropathy. Similar and symptomatic. Mostly everybody who comes to the pain clinic receives an MRA on the way. Most of them will have MRIs. But really only to validate again their history and physical to see if we can correlate with the relative amounts on imaging. That is also being used to resource arthropathy it is time-consuming and expensive for return use. How do we diagnose it? If physical exams not useful in radiology is not useful, is there anything that is of a use? What do we do?

Just like in Asda geology and the pain if there's a nerve, you can block it. How do we diagnosis, we block it up. Medial branch versus IA. These are the common acronyms you will see through our notes. IA, this could be through the hip, we talked about this. We're not going to talk about the edger articular block. It was challenging. We have just as good as responses with the medial branch block. The Trent eight, that is the nerve we were talking about. How do we do these? This is a very simple, very fast outpatient procedure that we do in clinic. Here is the straight anterior-posterior view. This is modified oblique angle. We see straight AP. And then we won't see a great superior or intercrosses just because angle we are at his straight interior. But this is what we do. This is primary, lumbar we are going to talk about. The most significantly affected Facet are the L4 5 in the L1. We need to block to hit all of those branches in the L4, L5 and the L5 S1. So, these are all the needles that go in. We put a local anesthetic in the skin and the joining process through the transverse process.

We administer some local anesthetic there. And see if they have a leak. Here is a close-up view. These are not, these are usually 25-gauge needles. Any kind of if you have a really hard charging guy like paraspinal you can have, that is why they seem. This is a two-step process, typically this is a two-step process on the outside it is, we need to first see if this is even the Craig pain generator because many things can prevent. So, it is a two-step process. As I would go in and put some resort acting numbing medicine and then we go over the next for the next several hours. We do whatever the things are you would normally do I just track how your pain is. If they have a significant reduction after these injections only prove to us that at least there's some significant contribution to their symptoms. They do have a proper responsibly bring the back and we do the full nerve ablation.

Typically, we would do in the military health system we will do one diagnostic block. If provided numbing medicine aesthetically we put in before we go back for the ablation. In order to get this coverage

typically requires two diagnostic blocks. And with two different local anesthetics. Typically, a 2% lidocaine. We need to see a significant reduction of symptoms and the correlates to the amount of time we expect that to hang around. We put a bit of local in there and send them home. The reason we did this part first is there a certificate number of false positives with this. If the patient can't tolerate these without any sedation, these are very well tolerated. The numbing medicine on the skin. Any patient who needs any type of sedation that can cause a false positive. If we put too much local anesthetic in there and we start hitting the ligaments and other things that can cause a reduction in their symptoms that wasn't due to the major branch itself. This can be done under thoracic level lumbar level be done under x-ray, guidance or ultrasound.

So, if they do have a significant response to the said blocks, we bring the back and we do the ablation. These do not have to be done under any type of sedation, but it is more comfortable, and we are heating up the nerve and especially if these nerves are really significant contributor to their symptoms, they're going to be very sensitive around those places.

Oral sedation. This is all done in our clinic room. So, this is just what it looks like. We go in, no different than the first time but just a little wicker needle. We put some local anesthetic on the skin and go down and hit the medial break you. And then we will usually place a little bit of steroid there afterwards to minimize the risk of a potential afterwards. The complication of these pain just like any time you go through the skin the worsening of symptoms. There is a possibility of damaging the ventral nerve. This is a particular type of central testing we do before and that we also test for certain amplitude of frequency that will go into any nerve.

All of these case examples here are ones that I picked that we had in the previous month. A 58-year-old male axial mostly low back pain and occasional radiation through the superior buttock and worse along sitting and potentially better with oral medication. Exam was very nonspecific, what a surprise. He was a little more tender on the right versus left spinal and a full range of motion. Motor issue and rarely or a fairly negative exam with the exception of the right leg joint. What did we do? And nothing interesting on exam. What do we do? Because it was only positive pain finding was tenderness, we first had an injection. Didn’t get any relief from that so we said okay we are going to do an educated trial and error and then we did a medical branch block on the right side and he had 100% of his axial symptom release. We got him back for the ablation and this is when I saw him this last month. He got more than one year of release, which is exactly what we were looking for in the Craig patient population.

The summary, typically axial although you can certainly have other symptoms as well. Either concurrently or caused by the joint. The history and physical exam and imaging all non-specific. The gold standard is to block it up. Like I said there can be a false positive rate. However, when we proved herself with the medial branch block that their generator,

typically they get around 10 to 12 months of relief. That is all about for that joint.

Moving on to the sacroiliac joint. This is the kind of unusual joint. It is a least mobile joint in the body. There is lots of cartilage around it. Very minimal rotation. The function of it is stability and weight-bearing. The innervation, primarily from S1 and S2 dorsal rami. Also, studies show maybe potential contribution for L3 MAB from L4 and also the L5 as well. The nociceptors found both in capsule and ligaments around it. Which can also make this kind of pain difficult to treat. In a study done in volunteers, I hope they were well compensated. They had both non-inflammatory both with volume to extend the joint and the ligament in both of them caused collapse of SI joint pain. So, because of that, you can have intra-articular within the joint or particular which is all of the ligaments surrounding it. Normally this pain is provoked with axial loading and rotation. Here are some of the articular and extra articular causes of this SI joint dysfunction. Arthritis, trauma, infection. Extra articular, pregnancy is a common one in trauma on both sides. Just as any other low back pain, it can be very difficult to treat. Unfortunately, the SI joint there is no standard of diagnosis for the SI joint dysfunction. Studies have assumed that potentially any back pain with symptoms of low L5 could be 15 to 30% are merrily contributed by SI joint dysfunction. Obesity certainly can give you predispose you to increase axial loading. It is very common. Is, to have this hip dysfunction and Ari have a gate abnormality.

The widening of the pelvis room are, once we see around 50% of patients will have a car accident, they will get pregnant and have these issues. Around two thirds of patients with SI joint study found that two thirds of patients with radiculopathy which correlated to a herniation on MRI, also had SI joint dysfunction contributing to the symptoms. SI joint likely coexists with other pathology. History is not particularly reliable but 50% of patients will have some event. That does not mean it is going to be SI joint versus something else. Possibly if their symptoms are genetically below L5, typically this will become worse when they are rising to sitting from standing. It is more likely to be unilateral.

This also has a referral pattern, cinematically provocative on exams. Usually, it will be in the ipsilateral buttock. Around 20% of these. Again, this can be very difficult to treat and diagnose. Around 20% of this will have radiation down to the lower leg or below the knee. The sciatic nerve, right next to the SI joint and extra articular information. You can have almost radicular symptoms even though you have no nerve root impingement. Physical exam, joint tenderness of the patient. If you're palpating over the SI joint or near the posterior iliac spine.

Posterior spine. The Youmans test, you stabilize the sacrum, and you lift up or extend the hip. If they have hip, when you have the patient line and your hyper flex the hip one hip while you extend the contralateral hip. If they have pain of the SI joint that is positive in the fortunes finger, is we ask them where is your pain and they take their finger they say it is right here over my SI joint. The pelvic compression where you compress the pelvic. The destruction where you take both the SI and

distract them from each other. Then Faber and external rotation trip also known as Patrick. If any of those last three test localizes the pain to the SI joint, it is positive on exam.

Radiology is not particularly sensitive or specific in either type of MRI. Our standard lumbar MRI do not go past inferior in the 1st to get any reasonable information about the SI joint. How do we diagnosis? Classically by a convention if you have three provocative tests. It is pretty reasonable to go after the SI joint. How do we diagnose in the pain clinic, block it up, that is all we can do?

Sacroiliac joint injections. We know that some of these symptoms are caused from within the joint and some are caused from the ligaments. We do intra-articular. Also do ligament injections with local anesthetic and steroid to see if they have pain relief. It is very similar, we go in and because there is so much nervous innovation to the joint, some S1 and S2 and potentially S3 and L5. We go in and all of these X here, all of these lines basically we go in and if they do have significant response to our diagnostic injections, we come in and basically run down the line of our radiofrequency in order to stun these nerves and give them some relief.

For people who the primary agent pain generator is the SI joint, they can get a pretty good six months or so or more symptom relief. Publications really, pain is more than anything else we do in clinic. The summary, usually it is degenerative. Typically, it is axial, but it can be radicular as well. If the current trend, imaging is fairly unreliable. The physical exam is possibly more reliable. If you do have three provocative test that increases your sensitivity. That is stats. That is that for that joint. No mechanism of injury. Worse with long sitting and quick movements. On exam she has a positive Yeoman's and positive controls.

Moving on, this is one of the new things at Walter Reed at the moment but more generally in the interventional pain. Intervention is the BVN. We can block it. There is a BVN that lives within the body. The superior and inferior authorization to innervate these plates. People with back pain, this receiver back pain, the theory is it is the in place that gets folks with inflammation there. This nerve gives innervation sensation to those in the plates and can be a very significant pain generator. The function they give them adaptive at some point. We have some really nasty inflammation or degeneration going on. If we know that you have inflammation and you know you have degeneration, that nerve is really no longer serving a purpose. All it does is to fire and annoy you all the time. We can do something about that. The BVN, we have talked about the pains and the endpoint damage. The nerve receptors actually up regulate witches also not ideal for our patient in pathology. If you have either disc or the endplate degeneration, you get increased bone marrow signaling via the BVN with inflammatory mediator release. Until you start spiraling in this process. Your patience are really hurt.

So, the epidemiology of the BVN inflammation is related to Modic changes on MRI which we will talk about. Typically this is in the lower lumbar, depending on which studies you look at, five to 60% have wide variability of patients with low back pain will have some sort of contribution from

the nerve. Typically, older age, obesity, any occupation which require heavy labor as well. History, wide variability, nothing is different than anything else we have talked about. This can be chronic; it can be more subacute. It is largely axial low back pain. Although these can also have concurrent radicular symptoms. A lot of patients will say it is an aching pain, burning pain in the low back. It is also normally axial. A physical exam is nonspecific. And radiology, this is where we really get into it. The plain films in CT may show some disc nearing where you have that disc nearing. Then you're likely to have more inflame. Really where the kicker is, is the MRI.

If you are ordering an MRI, we were chatting recently about this, we will chat about the procedure which is how we see the nerve. What really can work on MRI as the Modic changes. If you're ordering an MRI and the patient description, they always like you to be as specific as you can. If we think that this person has an L4, L5 or if they have L4, L5 symptoms we can say, that the patient has a right-side symptom, please evaluate for correlate of on MRI. Or if they have low back pain, please evaluate for Modic changes. The theory behind why we have these changes on MRI is you have bone marrow which is communicating with the disc and specifically these and plates. You get these changes.

What do these look like? There is Modic one change in Modic to change. Essentially, this is aT-1 and T2 image. There is a body and disc. We have lots of area here. We see this is T-1 waited in T2 weighted. The hypo intense on the endplates on T-1 and we see a correlated hyper intense area and a hyper intense area. This is our Modic one changes. And severally for Modic 2, it is the same thing, but it is just hyper intense on both. Basically, one correlates with active inflammation and the nerve receptors and with Modic 2 is subacute or chronic where the inflammation becomes fatty infiltration. How do we adjust this? We diagnose this with vertebra Jean Nick back pain. There is currently one modality for the intercept procedure. It is indicated for chronic axial low back pain refractory to non-op treatment for six months. It is currently approved in L3 to S1.

Either adolescence or bring the patients. Because this is a 50-minute-long ablation, it also has currently been studied and those with implantable pacemakers or defibrillators. We will talk about this. If you have someone who is morbid, morbidly obese, the equipment can't reach. This is what we do. We go, this is a procedure that can be done at the clinic and has been done under sedation. It is fairly uncomfortable. It is very similar, but it can be very scintillating for the patient for most of these are done in the operating room under deep sedation or general in a station anesthesia. We put it through the axial into the body. This is the anterior and posterior view. The fixed part is here and then we put the oblation probe right through the center of the body and this is the lateral view and about the poster third part of the body where we expect it to be and we burn that for 15 minutes and then get out of there. That is the technique for. Complications, really no more than any of our other procedures. If you're ever looking on in MRI and you start seeing crazy stuff within the bodies like any of these.

This patient here is post intercept procedure. This is six weeks post intercept, and this is six-month post intercept. The results that we have seen anecdotally have been very good. This is one that I did just last month. 58-year-old with chronic axial low back pain. Had an unremarkable exam. MRI L4 and L5 Modic 2 changes. He underwent everything or every intervention we provide. We had medial branch blocks, steroids, any critical relief from all of them. Uncomplicated ablation in the operating room. We discharge the day with minimal pain. He said it was the least pain he had in years. I followed up and he is down to an average of 1 to 2 versus 10.

I have been a little bit too verbose. I will go through intercostals. The anatomy, the intercostal nerve around the underside of the rib. They give motor function to the intercostals. If you have a patient with rib fractures, with intercostal neuralgia, we see a lot of postsurgical thoracotomies they can be innervated by these nerves. Also post neuralgia. Mostly on the thorax.

Contraindications to nerve blocks or ablations for these, local infection or if their active herpetic vesicles. There is one of the risks of doing these intercostal nerve blocks are close to the thorax. If the patient has a contralateral or frontal nerve paresis on the other side, you may want to either think twice or be very careful while you're doing this. Complications for the pneumothorax on that side. Last, the intercultural subcapsular. It has one of the highest of takes of any kind of local anesthetic that is distributed there. Also, if you're on the right side you can Nick deliver. We can do this under ultrasound or under thrust at sea. Just superficial. If it is under, we can go in with contrast. That is not vascular, that is the contrast being in that area right where we want it to be. And with the ultrasound you will see this on the right. We had a 32-year-old recently with chronic refractory post thoracotomy pain. It can be unfortunately painful. He comes back every 3 to 6 months to have this completed for relief.

Summary, at our mostly axial for medial pain. We take a history into physical get some imaging on everybody. A lot of times it is just educated trial and error. Injections and we do a physical. We do our educated trial and error. Our intercept usually for axial but can have radiology as well. In their intercostals, it is of an else we can do for either post pain. All of this low back pain can be difficult to treat. I hope this is given general information about the black box that is the pain clinic. If you have somebody who has low back pain, you send them to us. This is our thought process and this is the kind of stuff that we go down to treat them.

Finally, low back pain is very multifaceted and nonspecific. It is rare that it only comes from one source or one pain generator. This is how we do our best realistically. I have run a bit over. I will go to questions or because our time is short, I can hand it straight to the doctor for the last section. You can hop on here if you like. It is one more effective in reducing SI joint pain. It really depends on, this is another vague and difficult industry because it depends on what the pain generator is. We know there is pain but it generates from within the joint and also from the ligaments themselves. And so, if you have pain or

inflammation within the joint, that may be more suited for injection. If you have ligamentous pain and issues, it may be possibly better treated by ablation because the nurse will also be enervating those ligaments as well. There is much overlap in whatever and wherever the mediators are. It is very difficult for us to determine, there is no imaging study to really suggest that. A lot of it is educated trial and error. Most often just because of the time and the money involved to do oblation. Or it is more time-consuming and more expensive and scintillating for the patient. Really most often everyone will start with a steroid injection. Either into the joint itself or the ligament around it or a lot of us will do go in and hit the joint or do an injection and as we are withdrawing, the amount of steroid on ligament for cinematic relief. With a patient already PT benefits from SI joint? Unfortunately, if their symptoms have a significant contribution from their SI joint, they certainly would. Again, that is a lot of educated trial and error. If they have chronic static nerve pain, that could be due to, it could be due to may be a disc bulge that is hitting that L5 or S-1 nerve group. It could be irritation from inflammatory remediation from an SI joint. So, we do our best to get a full history, a full physical and get whatever imaging we may need. And go in and do educate trial and error and kickoff the most likely culprit and if for instance this is Ari on maximum therapy, maximum PT, then, they may be other point 47 intervention.

All right, I'm not going anywhere so if there are any other questions, I'm happy to take them or at the end of the lecture. Otherwise, we have Dr. Laudie here to talk, thank you very much.

All right, thank you, can everyone hear me? Yes, can you hear me, or no? You're good, sir. Excellent, thanks so much. All right so, I have about 15 to 20 minutes to get to for five minutes of slides. I'll try not to talk too quick.

I have really enjoyed the questions you guys have been asking. I am hoping to maybe just move through the slides and get some time at the end to talk to you directly. Only reach out to me if you have any questions afterwards. So, disclosures, I have none. These are my own opinions. All right the elephant in the room is I am older than last two fellows. Why did I get back to Phylicia? It turns out neuromodulation is a primary reason. There's a lot of pain and suffering in America, I've cared for patients and been an ST geologist. Neuromodulation is the tool for specialized chronic pain. I'm looking forward to showing these concepts with you and I hope we can make this a dialogue, please feel free to jump in either with the chat or just audibly. If it helps to make the prospect of asking or answering questions daunting, I'm not a subject matter expert on this I'm just a learner like the rest of us. Two months into the fellowship, let's just have a good time.

I see the problem in America or a big problem in America is pain. Let's see if I can navigate through this, 100 million Americans. I imagine you front-line folk care providers know this to be true. It is not just the numbers, but it is very costly, and it can be tricky and be very frustrating to treat. I don't call them pain patients for patients in pain, that is a significant difference that is a topic of another

discussion. Historically opiates have been the solution. Almost a panacea. There are lots of options. Even the youngest of interns could prescribe them. Then opiates became the problem.

Well, the epidemic ensued in a way that after pain was May the fifth vital sign in the 90s, over 500,000 Americans died. It wasn't just death and overdose but, there were other problems. My daughter, we adopted her at age six days from the NICU in San Antonio. She's dealt with the ramifications pretty much every day of her life.

HIV and hep C we thought we would be done with those by now, those are still being spread. The opioid epidemic continues to this day. Even through the pandemic. One OR nurse in Korea who had surgery two months prior was given Percocet and he brags to me that he was augmenting his alcohol consumption on the weekend with his Percocet. Opioid misuse is the beginning of the problem. In this last year 1.6 million Americans were diverting or misusing their opiate prescribed. This problem has not gone away.

I have planned a few questions and I would or was going to ask a bunch of questions, but I think we will skip through those. I see now, since opiates are out of the picture, I think it is off the screen. Anyway, I see opiates being so useful, and I've used them myself. With the epidemic, where looking for other options. Pain remains, we have neuromodulation that is a big gun in the pain clinic. Hopefully we can share, may be the indications for neuromodulation.

The objectives have been described. This is, I think I can make out of the time today is to describe the indications and contraindications. We will share some case studies and briefly get the evidence. The international neuromodulation Society describes it as the alteration or modulation of nerve activity by delivering electrical or pharmaceutical agents directly to a target area. Spinal cord stimulation is the most common. It is one of the four big guns in the pain clinic, over 50,000 places annually in America. Peripheral nerve stimulation, et cetera. These are other forms that we could go into.

And just as last week if you've been following the Vega nerve stimulation, not just for obesity but for stroke rehabilitation. It is all the rage in we are going to skip the slide altogether.

A lot has happened didn't the electrical stimulation of central canal nerves producing a natural biological response. This is how it looks. The lead going up, and they sit dorsally behind the spinal cord. With all four modalities, you place these in a trial period, they go in and we make the diagnosis we have an indication. We are not sure like the other previous fellows have described; we've gone through traditional therapies. You have taken them through traditional therapies. We will play sees right down the midline. It takes all of about five minutes and we program in the clinic anywhere from 10 to 15% will fail the trials but the rest would do quite well if we selected them well. They go on to permanent placement. Sometimes a month or so later. Again, I'm just going to give a brief overview before we talk about the indications. DRG, the only difference is that they go in but early for the trial. It is, you

will see here they end up laterally through the neural frame and they sit under, there's only four instead of eight and there sitting right beside the DRG. That is what it looks like.

Remembering your neural anatomy, it is basically where the primary neurons from the periphery come in and the synapse. It is only sensory, and it is not the motor route. Is more of a sniper instead of a shotgun approach to pain. As compared to the same later which basically gets all ascending and descending tracts in the dorsal column. We can target more; you can imagine there are certain procedures where DRG would be much more effective. Unilateral groin pain in a specific area. This is what the leads would look like under x-ray. You can see redundancy in the DRG. A bunch of little loops. As you go when you put the loops in, so DRG has a much lower rate of migration. That is one of the more common complications. It is lead retraction. As we place it in, and it takes a lot more to do this a lot more time. Sometimes we have a much more effective long-term. It is again a cyber approach.

The DRG is used because it is more costly it is used less frequently. A lot of times it will be the last ditch after spinal cord stem. So, what is this? You can see it is both. This is a SCS trial, you can see the leads coming out to the right side. You can see the DRG leads below inL3 and L4. That is how they would like. Every now and then we see a patient with three modalities. I saw one last week. Intrathecal pump let's talk about this. We have about 12 minutes. What we do is target small doses of pharmaceuticals mainly the Intrathecal canal. There is a catheter that connects it. These patients will get where the pump will be external and will guide and schedule them for the OR. For medication that are FDA approved, morphine, it has been around for a wild. The longest of the drugs to be approved. Baclofen which is first plastic disorders. And this one, sea snails use to kill their prey.

Every now and again went monotherapy morphine, even steroids and stuff. The condo tied has serious side effects. We cannot use until the last ditch. We will try a DRG but at the end of the day they will get in Intrathecal pump. We want to minimize narcotics. Intrathecal morphine, it is, we have a lot less tolerance. We get continuous infusions. Patients are pretty content. Classically we think of it being used for cancer pain but the most common indication for Intrathecal pump therapy is still back surgery. They has probably already been through five to 10 years of surgeries, and injections before they get there spinal cord stem which doesn't work so well and then they get a pump and it changes lives. These are patients that are very difficult to get comfortable. Pain is not the endpoint we use; we really are going for function. Intrathecal pumps can get people back to function. We will tribal local anesthetic in therapy and then we go to Ziconotide. The side effects are pretty intolerable. Ataxia, they're unable to speak at times. It is really a rare thing to have a patient on Ziconotide and to do well. It is possible and it is the last ditch. PNS, we will move back to electrical modulation. They are in the neural axis. It is in the periphery. This is the only non-fluoroscopic technique.

For the primary care provider, what I want you to know and focus on is the next slide. This is the indication. Sprint technology is the only FDA

approved for short-term. It is placed in the battery; these are the three stem routers and reactivate.

As all have indwelling batteries. We can basically we did this a couple weeks ago on a patient. They do pretty well, we are focusing, there especially with SPRINT. I will skip this.

The indications, this is a stem slide, it is an aid in the management of chronic intractable pain or spasticity. Overall modulation indication. I want you to remember chronic and intractable pain patients were having a difficult time with pain. Those are the ones you should send our way.

This is the neat site. On the left indications, this is not all encompassing all the different disorders, but these are the most common ones we see. Peripheral vascular disease, these would do well. When asked about diabetic neuropathy. Spinal cord stem does really well for those patients. Entrapment neuropathy, posttraumatic.

Failed back surgeries. The overlap between the electro modulation is significant. We will try them with it before the I.T. pump. That is because of issues of tolerance and of cost and need to come back to the clinic to get your pumps refilled every three to 6 two 12 months. Again, generalize cancer pain with these, patients who are on narcotics. Widespread arthritis, narcotics at the end of the day do better for visceral pain. At the bottom there is spasticity.

Contraindications, the standard we talk about with lack of informed consent. Suicidal, we have a close relationship with her behavioral health. To get a permit placed pump you had to have seen pain psych and they do great friends. They help us roll out.

Tobacco use I have a story about a patient I was going to put in a pump for. I shut up and walked through the outside so I can area and he was smoking. He had committed to not smoke it and told me two months he had not been while we were planning a. I saw him smoking outside the hospital the day of the surgery.

Case studies, we have five minutes. I want to share the stories. These are quick, five-year history of chronic refractory post hernia pain. Lest groin pain testicular pain. He had had neurectomy in multiple blocks. What would you do? This was justice last month, we did a DRG trial in a couple weeks later said he was a much happier and he felt better he had greater function. We will be doing that permanent this next week.

Chronic low back pain. This is most common indication. I measure many of you have these in your clinics. A 10-year history, all of the therapy. This guy came in a month ago as well, very young to have his life sort of ruined by pain. He got a SCS and reported one out of 10 thereafter. You can imagine the process is relatively quick. We are not going to take them through the same therapies ever again in the pain clinic.

That is what his back looked like. He had had two surgeries on his back already. It is most common indication. There's really not a lot else to

offer but this. This guy had complained to us. We put in a sprint, and he did well. He is still in the trial period. I think you'll probably end up getting a DRG implant. Nevertheless lifetime, it is $60,000 cheaper. There is a lot of evidence out there. It is one of the reasons, it is probably the most effective in our pain literature. We have more level one evidence than any other thing we do. Steroids is hound hands-down. It works well in a very difficult pain population. Conservative therapy, it doesn't work you can consult with us. At the end of the day, we will do trial and get a pain psych consult. If they're good candidates, then they will get their pumps for trial and permanent placement.

In the two months I've been doing this I've seen a lot of success stories. I want to thank you from for what you're doing for these patients. It is very tricky. We are definitely on the same team; it takes a village of providers to get a patient out of pain. But we're doing it.

I just want to thank you again and thanks for your attention. Any questions?

What kind of restrictions? We like in the last or the first 6 to 8 weeks to not be doing any lifting. In the trial period, we want them to do that. We want to see if it improves functions. One we are bridging from trial to permanent, do everything. After permanent, after six to 8 weeks postop, we need scar tissue to build up. That is a great question. Any others?

Are these modalities incompatible with active service? No. Not entirely. I think that is Dr. Spevak say we're not taking any more questions. Fantastic workshop, again, reach out to me online. We are all very excited.

It makes such a difference. Sometimes spinal cord stem they do, it is a most like doing a BGN. We put an epidural and they are swearing by us. Okay, I will put my email.

All right, have a great afternoon and looking forward to seeing you in the next session. Thank you so much for joining us.