

**GABRIEL**

Thank you so much, Chris, for putting this on, and your team, Joan Farmer, for everything she did to get this symposium put together. Rick Hindorfin and Nick Bambakidis, as well, for helping found the Spine Institute. As I start getting going in my career, I look forward to working with everyone here and really moving this venture in the right direction to improve quality of care here at UH for spinal conditions.

**SMITH:**

OK. Quickly, I have no conflicts of interest. I am a neurotrauma consultant for the NFL. I, unfortunately, cannot take credit for saving the Browns season a few weeks ago. I was at the game, and I received many numerous texts and messages, but I was not the actual consultant who pulled Tyrod Taylor. So unfortunately, I cannot take credit for that.

All right, so briefly, quick outline of what we're going to talk about today. Spinal infections, they're something we see more and more frequently. This is really an inpatient or emergency room topic for discussion about where these patients are. Occasionally, we will see them in the office.

They are something that, in terms of the vast majority of patients that we see, can be missed time to time. Because they can present with a similar constellation of symptoms of a degenerative patient, but maybe have a little bit more of an insidious onset. And so it is important to always keep in mind a spinal infection on your differential diagnosis when you're seeing patients, even in the clinic.

We'll talk about the anatomical classification where these infections can occur, the clinical presentation, a little bit about imaging, and then we'll touch base about multidisciplinary treatment. I kept the topic really broad today. Certainly, we can talk about surgical treatment and the management in a little bit more detail as well later in the talk.

Incident epidemiology-- I apologize-- is one in 10,000 patients that present to the emergency rooms. And that number is actually rising. Newer studies are showing two to five out of 10,000 patients are now presenting with spinal infections. 2% to 8% of all osteomyelitis cases can involve the bones of the spine.

And really, we see two peak age distributions of spinal infections, people over the age of 50, people less than 20. The vast majority of them involve the anterior column-- meaning the disks-- and the vertebral bodies. And the vast majority will involve the thoracic spine, or the lumbar spine, with a slight portion involving the cervical spine.

We're seeing increase in incidence because, well, we have sicker patients, older patients. Our population is aging. We're seeing more patients with bloodstream infections, most of them related to access. We have an increase in end stage renal disease patients on hemodialysis. We have increased incidence of immunocompromised patients, patients that are getting cancer treatment with ports, and as well as patients with chronic immunocompromised conditions, including diabetes, which I would say is in an immunocompromising condition if it's not controlled.

Predisposing factors, the classic predisposing factors, obviously IV drug abuse. But elderly patients, in general, are predisposed to spinal infections. Again, we saw that bimodal age distribution. Diabetes, I would argue that this is an immunocompromised state if it's not controlled. Chronic immunosuppression, renal insufficiency, COPD has been linked, as well as spine trauma. So people who have had a trauma in the past are predisposed to get an infection, actually, at that site of trauma, believe it or not.

Anatomic classifications, quickly. Vertebral column is the primary site, so both in the vertebral body as well as intervertebral disk space. And then, obviously, we get into some of the more surgical and more concerning elements, which can be the epidural space, the spinal canal, where the neural element's sent.

Very, very rarely-- I've seen it once in my career so far-- a subdural abscess can occur. We also can see an intramedullary abscess. Again, these are more likely iatrogenic in nature, or related to surgical procedures, but they can occur. And then adjacent soft tissue, this is always something to keep in mind. People typically will get infections not only in the column, but they can get them in the psoas muscle, running along the anterior aspect near the vertebral column.

And they can also get paraspinal muscle infections too. So when you see these

folks, they oftentimes will have a combination of, potentially, back pain radiating into the paraspinal muscles that can be related to a local infection or referred pain, or a combination of the two. So just keep that in mind. It, oftentimes, involves more than just the vertebral body or the disk space.

Pathophysiology, etiology, we'll just talk quickly. These predominantly come from another source. So keep in mind, if you have a patient who has a diagnosis of a spinal infection, you should be thinking about, where did this come from? 50% or more come from a hematogenous spread, due to bacteremia. And that can be intermittent, transient, or continuous bacteremia. So blood cultures, obviously, are very important when you're working a patient up and sometimes can diagnose exactly what you're dealing with in terms of an organism.

But most importantly, 29% come from a urinary tract infection. 13% come from a soft tissue infection, so cellulitis, something like that. Upper respiratory infection, 11%. Certainly, if they've had prior surgery or prior spine trauma, that can lead to an infection too.

Continuous spread, 33% of the time. So again, these can start somewhere else and spread contiguously to the spine. So we do see that sometimes. And then Staph is by far and away the most common pathogen, both the skin flora, as well as Staph aureus. Gram-negative bacilli, Pseudomonas, and streptococcus are the rare guys that certainly sometimes can occur.

Clinical presentation, again, this is really the patient that comes in with back pain that is inexplicable and different than every other patient that you normally see. So they're a crescendo back pain. So these patients have terrible back pain when they're moving, when they're transitioning from sitting to standing, from laying down to sitting. They have these crescendos of back pain.

And they also have dull and aching back pain that's constant, even when they're lying down. So there's no way for them to get comfortable. So keep that in mind. If you see somebody who's back pain is out of proportion to their exam, that is immunocompromised, has diabetes-- and it's an acute onset, within two to three weeks-- this is something you should think about as a possibility of what's going on.

Obviously, if they have an infection found somewhere else and they're complaining

of back pain, that's a patient that warrants being worked up for this. And then certainly, there is a subset that's asymptomatic. And that can be from chronic infections, smoldering type infections, which we'll touch base about a little bit later in the talk. And then certainly, some patients will present with acute radicular symptoms or neurologic deficits. Those are much less common though, if you look at all spinal infections. It's only about 4% to 17%.

So again, local pain, tenderness, is the most common presenting sign. Systemic signs of infection certainly can occur, fever, weight loss, neurologic deficits. And then certainly, there's also people to keep in mind that are at increased risk of neurologic deficits. So infections above the end of the spinal cord are at increased risk, as well as patients with poorly controlled comorbidities. So we see folks, oftentimes, that have poorly controlled diabetes, that maybe came to the emergency room for back pain, go home, come back. Now they're having troubles moving their leg. OK, they find an epidural abscess on a repeat MRI.

So there's some validity in that. If you see folks that have these protoplasm-- for lack of a better word-- you might want to think about doing advanced imaging right there in the emergency room the first time they come in, and keep those antennas up.

Etiology for neurologic deficits, there's a lot of different ways that we can cause neurologic deficits when you have a spinal infection. Some of it's related to, sometimes, a deformity in the spine, instability, or a space occupying lesion. So if they have an epidural abscess that's compressing the cord or the neural elements, you can have a neurologic deficit that can occur.

There is also inflammatory infiltration of the neural elements superimposed on degenerative spondylosis. So people have degenerative disk disease, or a herniated disk. They may have discitis, and just that inflammation alone, if they have severe stenosis, can cause a neurologic deficit. We do see that sometimes, and then septic thrombus, or venous thrombus, causing spinal cord infarction. This is not only theoretical, but it has been shown that the inflammation, especially from an epidural abscess, can cause venous stasis and engorgement. And that can cause a spinal cord to not get the blood flow that it needs. And so we can see spinal cord infarcts.

Advanced imaging-- as I've conveyed throughout the talks so far-- when you see folks with these kind of conditions-- again, this is an impatient, more often than not-- or in the emergency room, you should really be thinking about advanced imaging.

X-rays, as we know, are a good place to start. But oftentimes, the sensitivity and specificity for some of these more specialty conditions is not going to be as high. And what we know is that the MRI sensitivity and specificity is over 90%. And it doesn't even necessarily have to be with contrast. So an end stage renal patient in the emergency room, I would advocate that even an MRI without contrast-- if you have any kind of suspicion-- is worth getting. So just keep that in mind.

Contraindication to a gadolinium is not a reason not to get an MRI in a patient that you're concerned about a spinal infection.

Lab tests, what do we know about blood work, and what should we order if we're concerned about infection? Certainly, basic blood work. Look for a leukocytosis, look for a white count. But the two labs that I always encourage is-- if you're really concerned about a spinal infection and you want to know, OK, should I consider getting an MRI for this patient, is it something really concerning-- is an ESR and CRP.

Believe it or not, these are very sensitive markers for systemic signs of infection. But they also are very sensitive for spinal infections, in particular. We found that they are almost uniformly elevated, except for in severely immunocompromised patients. So always get an ESR and CRP if you're concerned about a spinal infection. It is worthwhile. If it's exceptionally high, that will, oftentimes, tip your hat to getting an advanced piece of imaging.

Blood cultures should always be attained. So again, a lot of these are from a hematologic spread. And you can see somebody who is completely-- does not have any systemic symptoms of a bacteremia, but will have a positive blood culture if they have a spinal infection. And you can see that.

Radiologic tests, as I said. Again, obviously, not everybody works at Cleveland Medical Center. MRIs may or may not be something that you can get right away. But a CT, at minimum, will evaluate the disk space, the edges of the disk space, as well as the bones. And it's a good place to start if maybe you're not 100% suspicious, but

it's something on your differential, and maybe that MRI is not something you can get right away.

But that being said, the MRI is really where you want to go with these kind of patients. And then the diagnostic workup should always include trying to identify the organism. So just because you have an infection, that's not where the workup stops. You really need to take this to the next level and figure out why and what this is coming from.

So looking for it in different places in the body, as well as looking at trying to either get a biopsy of the disk space, the bone, adjacent tissues. Paraspinal abscess is always a good place to put a needle with the least amount of risk. So I always encourage people, if you find an infection on an MRI, find somewhere that's safer to get a needle before the spine. And if you can't, then it's time to call Neuro IR and try to get some tissue from that disk space, at the minimum.

The treatment of spinal infections, just to briefly touch on this, this is really a multidisciplinary approach. And I say that because, oftentimes, we get calls about spinal infections. And the internists will all be seeing the patient, the infectious disease team's already seen the patient, and then I'm seeing the patient. And it really is a multidisciplinary approach. IV antibiotic therapy is the gold standard for spinal infections. A surgeon can only do so much. It's really the antibiotics that need to work.

And so you need to know what you're treating, and at minimum, the patient should be getting at least four weeks of antibiotics for a spinal infection. But truly, this is more depending upon the patient, what their other comorbidities are, their age. Oftentimes, this will be more like three months.

And again, I differ to, always, the specialist on antibiotics, the infectious disease colleagues. If you're managing your antibiotics as a surgeon, you're probably not going to do justice there. We know a lot about nothing and nothing about everything.

Source control, again, a workup for source control outside the spine is very important. There's nothing worse than focusing on something like a spinal infection and forgetting that the patient has a port that's infected. And you're wondering why

their bloodstream infection's not clearing. You have to make sure you take care of the sources.

Bracing corsets for comfort, so lumbar patients, maybe they don't have acute instability, but they're having a ton of pain when they're transitioning. There's nothing wrong with giving them something for comfort like a brace or a corset, if there's no instability and no surgery, necessarily, for an infected disk space, or potentially, a low smoldering osteomyelitis that needs six weeks of antibiotic therapy to resolve.

Medications for pain control, there's no need to be bashful here. Infections are exceptionally painful. If the patient is in the hospital because they literally are in so much pain, it's important that we do treat their pain. Because these kind of conditions are exceptionally painful.

And then selective surgical treatment, and I highlighted that because there's certain pathology that is good treated surgically, and we should treat surgically. There's others that are really best treated medically. And again, the gold standard for any spinal infection is really antibiotics, and surgery is the last line of defense. And certainly, we have to talk about the goals of surgery and what we're doing surgery for before we rush into there with guns blazing.

So as Zach Gordon had said in his talk, Tim Moore has a lot of good sayings over at MetroHealth, and this is one that he often tells residents and fellows. And you're either neurologically intact or you're not when you come into the hospital. And that's exceptionally important in spinal infection patients.

If somebody is neurologically intact, then there has to be a way of the risk between, is there a risk for neurologic decline or not? Is there an epidural abscess and spinal cord compression? Is there a psoas abscess that may cause weakness, that may confound the patient's problem? These are all things you have to consider as a surgeon.

And if they're neurologically intact, and the infection is below the conus-- and maybe they even have some pain down their leg, but they don't have true weakness-- that is even somebody that you could watch and see what happens with their response to medical therapy.

So you really have to take this on a case by case basis. And again, if they're neurologically intact, it is something that a surgeon should be involved, but it may or may not be somebody that needs surgery. And that really is contingent upon where the abscess is. Is it in the bones, is it in the spinal canal, is there a cord compression, or are they at risk for neurologic decline? Is there mechanical instability?

So somebody who has a cervical infection that has kyphosis because the bone is being destroyed, that patient may need surgery even though they're intact. Because that neck pain, that infection, is not going to clear, and they have a deformity of their cervical spine now. So there is a lot that goes into these kind of discussions, and whether somebody needs surgery or not. But the real key point is if they are neurologically not intact, and that includes bowel and bladder function.

So if somebody comes in the hospital and gets a Foley, that is a neurologic injury, in my opinion. And that patient could need surgery, just for urinary retention purposes. Chronic infections, unresponsive medical therapy, that's another thing, I would say. So somebody who you can not clear their infection, somebody with a chronic MRSA infection at a disk space, that that disk space is being eaten away-- you see them three, six months, in the office, and they're not clearing-- that's another person that may be needing surgery for source control.

Neurologic outcomes, again, the clinical presentation's everything. So duration of symptoms matter, but unlike spinal cord injuries from trauma, we found that there can even be a good clinical outcome if somebody has neurologic deficits, and you get to them within 72 hours. So if somebody has neurologic deficits, it's important. If you get to them within three days, they can still do well.

So from a surgical standpoint, that's something to keep in mind because certainly, we see folks with bad neurologic presentations that do well after surgery. Lower limb motor deficits, prognostic of good outcome. Severe disabilities, less than 5% to 20%. So people who have lower limb disabilities is a minority if we can get to them quickly. Again, like I kind of alluded at during the entire talk, there's some data out there to support spinal epidural abscesses, in particular, and the treatment of those surgically.



This was a very nice paper in *The Spine Journal* back in 2013. They looked at antibiotic alone, surgery and antibiotics alone, for patients with any kind of neurologic deficit in the spine. And essentially, what they found was that there was crossover, 41%. Patients declined even with medical therapy. And they had delayed surgery, and they had worse outcomes. So their conclusion was early surgery for patients who are not intact is better.

Contiguous infections, this is another topic, I think, that's important to talk about today. If you have somebody that has an infection somewhere in the spine, there is always a chance they could have it somewhere else. So keep that in mind when you see these folks. If they're complaining of back pain and neck pain, they're writhing around in bed, it's important that you look not only at where their lumbar spine-- where they have pain there. But if they have any kind of symptoms anywhere else, one, you should always do imaging.

But in my hands, I typically image the entire spine. Because the last thing you want to do is miss a contiguous infection somewhere else that may or may not be worse than what you're dealing with, especially somebody who has a spinal epidural abscess. If they have one in their lumbar spine, they could easily have one in their cervical spine.

So I usually advocate for entire spinal imaging when I have patients that have a confounding exam-- if they have pain in multiple places-- just to make sure that we don't miss an abscess somewhere else too.

So just in conclusion, spinal infections are increasing in incidence. There's always a multidisciplinary approach for treatment. It's important to involve every specialist from an infectious disease to a surgeon, to even therapists, to try to get them back on track. Medical management is the gold standard. Surgical management is really reserved for patients with impending neurologic decline that need mechanical instability and deformity correction, or if they have a neurologic deficit. I'll be happy to take questions at the end. All right, thanks, Chris, and everyone.

[APPLAUSE]