

[MUSIC PLAYING]

**LORI ZITELLI:** I'm really happy to be invited to talk about this topic because it's something that I spend a lot of my time thinking about and doing clinically and will be doing in a research setting. So I wanted to start with a little bit of background information on tinnitus for anyone who doesn't know what that means.

Either tinnitus or tinnitis-- either way is OK. It's an auditory phantom perception that's not related to any external sound. So what that means is that there are sounds that people are hearing inside their head or in their ears, and they're not corresponding to any sounds in their environment. So there's no mechanical activity in the cochlea that's happening. It's all perceptual.

Unfortunately, we don't know exactly where tinnitus comes from in all cases, which makes it really, really hard to evaluate and treat. So some of what I'm going to talk about today is the evidence behind what we can recommend for people who are struggling to cope with their tinnitus.

So tinnitus can sound like pretty much anything, and we really hear a pretty wide variety of descriptions. So what I've listed here some of the most common-- ringing, buzzing, hissing, humming, chirping like locusts-- all of those sounds are things that people commonly report hearing, and all of them can be considered tinnitus.

Currently, there's no accepted way to classify patients with tinnitus using objective markers, so what we have to do is categorize them based on what they report to us. And we can do that in a lot of different ways. One of the most common ways for clinicians who work with these patients to do it is to put them in the category of someone who is experiencing tinnitus versus someone who is suffering from tinnitus.

So if you see on the pie chart here, it's estimated that there's about 50 million Americans who have tinnitus. And for about 70% of them, it's something that they experience. It's not something that bothers them most of the time. These are the people that, when you say, do you have any ringing or buzzing in your ears? They're like, oh, yeah, I've got that. And that's kind of the end of it.

The remaining approximately 30% are people who are either bothered to the point where they felt like they needed to seek medical treatment or they're totally debilitated by their tinnitus. So those are typically the people that we're seeing in our practice.

And we have a treatment program to offer them that I'm going to talk a little bit more about later in the presentation. And it's really nice to have something to offer these people because, for many of them, there's really no medical or surgical or pharmacological treatment that would help them.

So I mentioned there are a couple of different ways that we can categorize these people, and these are just some of them. So we can categorize them based on whether it's a primary or secondary issue. So primary would mean it's idiopathic. It's not caused by or related to another specific underlying cause other than the hearing loss or damage to the peripheral auditory system.

Another way we can categorize them is based on their temporal qualities of their tinnitus. So some people have tinnitus that is constant, never goes away, always there. They hear it every waking minute and second. And pretty much everybody gets spontaneous transient tinnitus now and then. You get a ringing that you notice for a couple of seconds, and then it kind of fades back into the background. Pretty much everybody gets that, but there's a whole range of temporal qualities that people report.

Longevity and duration is a third quality. So what we consider to be persistent tinnitus is someone who has had a tinnitus onset of six months or greater, then we would consider that chronic. More recent onset would be something within the most recent six months.

And I kind of mentioned this already. Impact is another way that we can categorize people-- either bothersome or non-bothersome-- so that would be suffering from or experiencing. And as you can see, there's a whole range of botheredness that people experience and report as well.

There are a lot of other characteristics that we could use to categorize people, and they range from loudness, which is all perceptual, so what we can try to do is have them match their loudness of their tinnitus based on sounds that we present to them. We can have them ranked it on a 0 to 10 scale, so 10 is the loudest you can imagine, 0 is so soft that you hear nothing-- things like that.

Pitch is something that we can try to quantify. That can be really difficult, so you have patients try to match what they're hearing in their head to what they're hearing through the ear phones or have them describe is it a low pitch, a medium pitch, or a high pitch.

The spectral quality or what it sounds like-- so these are all the things that I mentioned on the first slide. Is it a tone? Is it a ringing? Is it a hissing, something like air escaping, or rushing-- all of those different qualities?

Some people do actually hear more than one sound at a time, so, for many people, there's a kind of prominent primary sound, and there may be others that they hear in the background. Some people say I always hear three sounds, and this is what they are.

Lateralization refers to where they're hearing the tinnitus, so some people only hear it in one ear. Some people hear it in both ears. Sometimes people say they hear it right in the middle of their head, and other people say they hear it in different locations on their head.

Maskability or suppression is the ability to cover the tinnitus with another sound. So if you get another sound that's loud enough, for most people, you can eventually get it to the point where the tinnitus is no longer heard. And for some people, it doesn't actually take very much sound at all to achieve that.

Modification or modulation is something that people report as well. So for some people, the tinnitus changes throughout the day, and for some people it remains very constant.

Residual inhibition is an interesting phenomenon that happens when you hear him asking sound and then your tinnitus goes away or remain suppressed even after the masking sound goes away. We don't know exactly why that happens, but for most people, that effect lasts less than a minute. So it's typically not something that is sustainable, and it's really not something that we can use clinically.

And then lastly, exacerbation is something that some people do report. And that just means, when they go into an environment where there's a lot of noise, their tinnitus often becomes louder for a period of time afterward. So this would be like, if you go to a concert, you go home. Your ears are ringing, and then some people report that that effect actually lasts overnight into the next day. And for some people, that's not a problem.

So everybody varies on all of these different characteristics, and that kind of leads me into what I wanted to talk about next, which is some of the problems that we experience and run into when we look at studies looking at tinnitus. So one of the problems that we encounter when we look at studies relating to tinnitus intervention is that, for most of them, there's not really a clear consensus on what outcome we should be looking at. And it's really impossible to compare studies that are looking at different outcomes with each other.

So this review that I looked at from 2006 looked at a bunch of different studies of tinnitus intervention, and it was able to categorize the outcome domains into eight different categories. So most of the time, when people are looking at tinnitus, they're looking at the patient's perception of the tinnitus. So these would be things like loudness, pitch, maskability.

They're looking at the impact that the tinnitus has on their life or the bothersomeness. The co-occurring complaints-- it's pretty well-documented that patients suffering from tinnitus and decreased sound tolerance often have issues with depression or anxiety or other mental health issues. The quality of life-- so just in terms of that coping, the ability to be productive, the ability to sleep, the ability to have social relationships-- things like that.

Sometimes we find that body structures and functions are involved. Sometimes people say that movements of their neck and their jaw and can manipulate the tinnitus as well. Adverse events just in terms of safety and tolerability and side effects-- some people report pain or headaches-- things like that-- with tinnitus and decreased sound tolerance.

There are some treatment-related outcomes that they were looking at. And then lastly, the category of unspecified tended to be things that the authors would kind of create their own outcome measurement, and it's not necessarily validated.

So we've got this whole group of eight categories that most studies tend to fall into, and, unfortunately, there's no single outcome that is common among all of them. So that makes it really, really difficult when you've got this diverse range of outcome measurements that are reported. So that's one big problem.

The second big problem to consider is that, in most of these studies, all of the patients are kind of lumped together. So I talked about all of the different ways that we can categorize these people, but most of the time, in the studies that look at different interventions, they don't take the time to separate them out based on any of the qualities that we can categorize them based on what we discussed. So that really makes it nearly impossible to generalize all of the studies that you read to a specific patient that you see in your clinical setting.

So just to give you some examples, in this study that I'm citing from last year, almost half of the trials didn't specify the duration that the patient had experience tinnitus. Most of them didn't use validated questionnaires-- things like that-- so there's no way to reliably sort these people.

So what they did conclude is that most of the tinnitus intervention studies that are available will apply to older adults with tinnitus that has lasted six months or longer, who are bothered enough to be evaluated in a specialty setting. So unfortunately, if your patient doesn't fall into that specific group, it can be really difficult to apply a lot of the research that you read to that specific patient.

So when we see patients in clinic who are bothered by their tinnitus, they tell us they've been on the internet, and they've searched for everything available, and they're kind of bombarded with all of these sites and people who say that they have a service or a product that can cure their tinnitus.

And we hear that all the time, so what we wanted to do is actually look at what the evidence says is the best way to proceed. So what is actually recommended for people who have tinnitus that's bothersome? So what we tried to do is find systematic reviews and meta analyses and kind of look at some of the most common treatments that people pursue and see what the evidence actually says about them.

So the first thing I want to touch on is cognitive behavioral therapy. So cognitive behavioral therapy is a type of psychotherapy, where the patient has developed a specific pattern of negative thoughts or behaviors that leads to problems dealing or coping with things. So it's kind of a way of teaching them some strategies and some problem solving skills to help them get through the points in their day that are the most difficult. And for patients with tinnitus, the unwanted behavior and thought patterns are related to the reaction that they have to the tinnitus. Whatever that is, it's something negative.

When patients are getting cognitive behavioral therapy for tinnitus, it typically includes things like teaching them relaxation techniques, educating them about the tinnitus, trying to kind of get them to the point where they can realize that the tinnitus is benign, trying to restructure those negative beliefs that they have, exposing them to sounds, thinking about their behaviors and attitudes-- things like that.

So in the review that I looked at, their primary outcome was tinnitus distress, and you can see the inclusion criteria listed there. And the conclusion that they came to is that cognitive behavioral therapy does have some positive effects on patients' tinnitus-related distress, and I think it's important to note that the effects are on the distress. So it doesn't indicate that the tinnitus will become softer, and it does not indicate that your tinnitus will go away. What it indicates is that it helps you to develop more tools to cope with the tinnitus. So a lot of times, when we see people for treatment in our clinic, we recommend cognitive behavioral therapy in conjunction with what we're going to do because it's just another way that they can develop those strategies that they need.

So the next thing I wanted to look at was ginkgo biloba because, a lot of times, patients will come in and say I read that ginkgo biloba is something that can make my tinnitus go away. Ginkgo biloba extract is from the leaves of the ginkgo biloba tree, and they're used as a dietary supplement that's thought to increase and enhance circulation in the brain. So a lot of times, people use them to try to treat mental and physical issues.

So in this review, the primary outcome, again, was tinnitus handicap, and, in each trial, they looked at the proportion of people who reported that their tinnitus was better versus unchanged versus worse after either the ginkgo biloba or a placebo. And unfortunately, what they found is that the proportion of people benefiting from ginkgo biloba was not different from the people benefiting when taking the placebo. So there's really-- the conclusion is that there's no benefit for these people when they take ginkgo biloba, so it's really not something that we can recommend.

Transcranial direct current stimulation is something that I think is kind of interesting. It's something that I didn't know all that much about. And what it is is a noninvasive neuromodulatory therapy that involves using electrodes placed on the head, and it produces a low level of current to try to modulate some of the activity in the brain. So the electrodes will either try to make something excitatory or make it inhibitory.

In this review, the primary outcome was tinnitus intensity-- so how loud the tinnitus perception is. So what they found was that these results are kind of difficult to interpret because there were really only two studies that fell into-- that met their inclusion criteria, but the limited information that is available does suggest that this may be promising for people. What they reported was that about 40% of the people in the studies that qualified reported a reduction in the loudness of their tinnitus of about 15%, which is hard to quantify because it's all perceptual. But for these patients, it was significant.

So considering that transcranial direct current stimulation is something that is generally pretty well-tolerated without a ton of adverse side effects, and it's noninvasive, it may be something that could be promising in the future. But right now, there's really no accepted protocols. So that could be something that people are thinking about developing in the future, but it's hard to recommend right now with the current state of it as it is.

Self-help interventions are ways that people can try to achieve some of the benefits of cognitive behavioral therapy without as much interaction with a therapist. So it involves people working through a specific set of materials, either on their own or with a little bit of guided help from a therapist, and these and these interventions are typically in the form of books or a smartphone application or a computer program or a DVD or something like that.

So they looked at a bunch of studies using different forms of self-help interventions, and, again, their primary outcome was the measurements of tinnitus distress and other quality of life outcomes. And this review really found mixed results for self-help intervention. But something to consider is that there were only five studies, again, that qualified, and they all use different outcomes, which kind of goes back to one of the problems that we discussed initially, which really makes them almost impossible to compare to one another. So I would say that the jury is really still out on this, and there's not enough evidence to really support recommending it for people.

Sound therapy is a term that we use to refer to a range of treatments, all using sound to treat a physical or mental condition. So in the case of tinnitus, there's a lot of different ways that you could use sound that people may find helpful.

So this study that I looked at compared the two probably the most common forms of sound therapy, which is tinnitus masking and tinnitus retraining therapy. So tinnitus masking is using another sound to cover your tinnitus. It's typically something that's wideband or broadband-- something like static. And the idea is you want to provide a sense of immediate relief, so if you don't hear the tinnitus because you're covering it with something else, you won't be bothered by it.

With tinnitus retraining therapy, the goal is a little bit different. So the goal is habituation. Habituation is that process of your brain kind of learning to tune something out over time because it has no meaning. So if we can retrain the brain to consider the tinnitus to be something that's benign and having no meaning at all, theoretically, the patient should be able to change their reaction to it from something that's negative to something that's neutral, which will let them kind of tune it out.

So there are two components to that therapy, and the first is educational counseling, and the second is sound therapy. So this study was comparing both of them, and the primary outcome was tinnitus handicap using a variety of validated questionnaires, and what they found was that, at different points throughout the treatment, the different types of sound therapy were more beneficial.

So very early on, the tinnitus masking provided better results than the tinnitus retraining therapy. So at about the three-month mark, the masking group was significantly improving. Once you get to the point where you're six months out, the results were pretty comparable among the groups, and then, when you get to the point where you're looking at more long-term follow-up-- a year to a year and a half out-- the tinnitus retraining therapy group was really the better option.

And that's why our group has chosen to provide this type of therapy. So it's shown to be pretty effective and sustainable in the long term if patients kind of stick with it. And our goal is not really to mask the tinnitus. Our goal is to help them to develop a long-term solution for the problem that they're having. And the research does support that.

Acupuncture is something that a lot of people ask about as well. That's the practice of stimulating skin or tissues, usually with a needle, with the goal of alleviating pain or addressing some sort of other condition. So in this review that I looked at, they wanted to know, subjectively, did the patients benefit from it? So was their tinnitus better, was it unchanged, or did it become worse after acupuncture?

So this study was kind of interesting because there's a bias here that's not really seen in any of the other studies that I looked at. So this was developed in a different part of the world, and what they reported is that all of the Chinese studies that were included in this review-- nearly all of them reported positive outcomes, and nearly all of the English studies that were included reported negative outcomes.

So that's interesting because it kind of leads to a couple of different questions. Are they following different procedures? Is it just something that's kind of more accepted, and is there a better attitude toward it in that part of the world? I don't think we necessarily know that. So I think there's an interesting bias that's introduced here that makes it really difficult to generalize to all parts of the world.

So it appears to offer some subjective benefits to some people and not to others. So I think there needs to be more and better clinical trials to look closer at that.

And then lastly, something that is interesting is that, if people have a recent onset of tinnitus, a lot of times, they report that it's very bothersome. But over time, some of them do tend to learn to cope with it on their own, by themselves, without any intervention.

So I thought the study was really interesting. It's a recent study that looked at a group of patients from a bunch of different clinical trials that did not receive any intervention. So they were looking at the no-intervention or the waiting list control groups in all of these studies.

So the primary outcomes that they were looking at were self-reported changes in tinnitus perception, quality of life, and perceived loudness. And what they found was that the people who did not receive any intervention in any of these studies did actually show a small but significant improvement in these outcomes with time, up to about four months. But then any time beyond four months, those improvements did not continue.

So I think there is some reason to believe that there are some people who may kind of develop the coping strategies and skills that they need on their own, and then there are a group of people that are not going to be able to do that, especially if it's been longer than four months. So that was interesting, I thought.

So then that kind of leaves us with where do we go from here? So we looked at the review of the current literature, which indicates that cognitive behavioral therapy and sound therapy can be beneficial for many patients. There are also results to indicate that acupuncture, transcranial stimulation, self-help intervention, and no treatment may help some people and may not. And the ginkgo biloba results indicate that that's really not helpful.

So that's what we know now, and then I wanted to think about where are we going to go from here? So thinking toward the future, there are a lot of models that are available now that point to slow wave oscillations in the brain and thalamocortical dysfunction being the root cause of the tinnitus.

So there are three kind of main models that I have listed here that all have different ideas of where this activity comes from, and this could be a whole talk on its own. I don't have time to get into all of them. But what researchers are typically focusing on now is can we use these models to point us in the direction of developing a test battery that will target these slow wave oscillations? And if we're able to develop an effective and accurate test battery, can it help us to sort tinnitus patients into those groups that I talked about initially?

So if we're able to do that, the goal eventually would be to develop a personalized medicine approach. So personalized medicine is using markers like DNA, protein, RNA things to try to determine specifics about the tinnitus in that particular patient.

So it comes from the idea that diseases are really not homogeneous. They have different rates of progression. They have different causes. They have different responses to drugs. And if we're able to develop a test battery that can help us to identify what's going on with that specific patient, it may help us to tailor a treatment specifically for them. And really, no one has been able to do that with tinnitus yet.

So ultimately, our goal moving forward and a lot of people's goal would be to develop some sort of a test battery that will allow us to do this. So when we think about the tests that we have at our disposal, we can use a combination of audiologic in neurophysiologic measurements, including pure tone and speech odometry, emittance testing, otoacoustic emissions, auditory processing, tinnitus perception, short-, mid-, and long-latency responses, bringing in EEG and MKG as well.

So using a combination of all of these techniques, we're hoping that this information can help us to develop this test battery that will help us to answer this question. And it's something that we're really excited about. So that's what we know now and what we're hoping to know in the future.