Recent and Upcoming Advances in Cochlear Implants

Transcript

[Upbeat theme music plays]

Dr. Clancy

Welcome to Rounding@IOWA a continuing Medical Education Podcast, developed by and for healthcare teams. I'm your host, Dr. Gerry Clancy, professor of psychiatry and emergency medicine and senior associate Dean for external affairs here at the University of Iowa's Carver College of Medicine. Today, we will discuss recent and upcoming advances in cochlear implants. Our objectives include. First, we want our participants to be able to explain to patients and family how cochlear implants work. Second, we hope our participants can identify who are candidates for cochlear implants. And 3rd, we want our participants. To recognize the current advances with cochlear implants and what is on. Horizon, fortunately, we have the great advantage of an expert in cochlear implants. Dr. Alexander Claussen, who is both a surgeon and a researcher on the subject. Dr. Clausen is a assistant professor in otolaryngology here at the University of Iowa. He earned his MD degree from Southern Illinois University School of Medicine. He completed residency in otolaryngology Head and neck surgery from the University of Iowa Hospitals and Clinics. He has completed fellowships in clinical research training at the National Institutes of Health in Bethesda, and Neurotology at the University of California, San Diego. Dr. Claussen, thanks for being on Rounding@IOWA.

Dr. Claussen

Thanks for having me. Happy to be here.

Dr. Clancy

Great. And again, thank you for joining us and thank you for the work you do. And as usual, I have trouble with otolaryngology. So I just say sometimes ENT.

[laughter]

Dr. Claussen

OK, sounds good.

Dr. Clancy

So Alex, I just provided our listeners your official title and a summary of your training. Could you give us an idea of what a work week might look like for you and all the variation that you do?

Dr. Claussen

Yeah, sure. So in otolaryngology, I practice the sub specialty of neurotology which deals primarily with ears and hearing. In my practice, I am both a physician and a scientist, so I spend time in the clinical side and the research side. Typically I'll do a day or day and a half of clinic at the university where I'm seeing patients with different hearing or balance problems. We also help people who have skull based tumors as well, because that falls in that vicinity. And so I'll do clinic a day and a half a week. I will also operate on patients since. So usually that's one to three days a week depending on the week performing surgeries such as cochlear implantation or fixing holes in ear drums, things like that. And then I also have a laboratory where we study inner ear biology as it relates to cochlear implantation and the immune response to cochlear implantation. And so I have a lab where I'll spend part of my time there where we study Co clearing plants from the from the lab side.

Dr. Clancy

So quite a lot of variation and a lot of interesting work.

Dr. Claussen

Yeah.

Dr. Clancy

So is there a back story in how you got interested in this work?

Dr. Claussen

Yes, a funny thing is that I actually wrote my medical school personal statement about cochlear implants. When I was in undergraduate studies, I applied to a program to shadow a physician over the summer, and I got randomly assigned to a neurotologist. Just at that time, I could not pronounce neurotology or otolaryngology, and he taught me what cochlear implants were, and I had my first neuroscience classes after that, and I just thought it was an amazing piece of technology, both from a, you know, patient, improving quality of life perspective as well as from a scientific perspective. That they could be so effective at restoring hearing to patients.

Dr. Clancy

You know, that's one of the things I advise medical students on is pick something that really interests you because you're going to do it for a long time and it sounds like you picked the right thing for you.

Dr. Claussen

Yep.

Dr. Clancy

Let's begin with some basics regarding cochlear implants. Could you define for us what a cochlear implant is and what it does?

Dr. Claussen

Yes. So a cochlear implant is an implantable hearing device. This is really a device that's in two parts. The implantable part is under the skin. It consists of the actual we'll call the electrode array, which is a thin silicone wire with platinum electrode contacts in it that's inserted into the inner ear or the cochlea. Connected to that behind the ear, under the skin, is where the internal receiver is, and this is this is the part that helps connect to the external parts of the implant. So that's the internal part. The external part has a lot of components similar to a hearing aid. It has a microphone, so to pick up sounds, and then there's a processor which does all of the computation to translate those sounds into an electrical signal that's then transmitted electronically through the skin to the internal part to stimulate the inner ear.

Dr. Clancy

Well done. As we go forward here, are there any other terms we really need to know to better understand cochlear implants.

Dr. Claussen

A couple of different terms we use when talking about this one that's relevant to Iowa is the hybrid cochlear implant and this is a specific type of cochlear implant that we give to patients who have some residual acoustic hearing but have a lot of other hearing loss. And so the hybrid cochlear implant acts both like a cochlear implant to give electrical hearing, while also acting like a hearing aid to give normal acoustic hearing to those parts of the inner ear that are still working. Another common term we might talk about is something called single sided deafness, so patients who have normal hearing in one ear and hearing loss in the other ear is another specific scenario in which we use. Cochlear implants.

Dr. Clancy

Thanks. Thanks. As we go forward, that will be helpful for us. Could you help us understand kind of at that electronic and molecular level how cochlear implants work?

Dr. Claussen

So it's really quite amazing that cochlear implants work as well as they do. So a little basics in biology about the inner ear. It is what we call tonotopically organized. So the inner ear is kind of like a spiral or a snail shell. The base of it, or the very bottom of it, is tuned to higher frequencies, and then we go all the way up to the top. The apex that is tuned to lower frequencies. Along that gradient, there's specific sensory hair cells and nerves which are tuned to respond to different frequencies. You know, 10s of thousands of them. What's amazing about a cochlear implant is you're going from having a resolution of 10s of thousands of different cells responding to specific frequencies, to an implant which might only have up to 22 electrode contacts on it. So really condensing down the amount of channels you have and you know this can't all be explained by what's happening in the inner ear at the periphery. Essentially the human brain is amazing how people can, you know, adapt to this and get good speech recognition from it.

Dr. Clancy

Sure, the plasticity.

Dr. Claussen

Yeah, exactly. And so the implant works by sending an electric signal that's actually picked up by the eighth cranial nerve, the auditory nerve at the center of the cochlea. And different electrodes are programmed to different frequency ranges along the implant to try and recapitulate that range of frequencies that we hear.

Dr. Clancy

Well done. I'm still with you so great job. I went to med school here in the 1980s and I know some of the answer here, but what role did the University of Iowa play in the development of cochlear implants?

Dr. Claussen

Yes, especially in the United States, the University of Iowa has really been a hub of cochlear implant research activity and kind of at the forefront. A lot of this owes to two prior chairs of our department, both Brian McCabe and then very much so Bruce Gantz. Cochlear implants in the United States, although experimental in the 70s and the 80s, getting FDA approval for different styles, the original cochlear implants just had one stimulating

electrode on. In the early 80s, a originally a pacemaker company in Australia called the Nucleus Corporation, which eventually became the cochlear corporation, developed multi channel cochlear implants. So more stimulating electrodes to hopefully get better fidelity. And Dr. Gantz was one of the first people in the United States to implant a multi channel cochlear implant, I believe in 1983. And we did the first two. And so since then, we've kind of been at the forefront of it. Dr. Gantz, as well as several faculty at the the speech, the Communication Sciences department, as well as in the otolaryngology department have had a long standing programmatic research grant from the NDCD over 40 years which has. Kind of helped establish Iowa as a Center for cochlear implant research in the mid 1990s and early 2000s. Dr. Gantz helped pioneer and patent the technology of hybrid cochlear implantation. With cochlear implants, a lot of the advances in cochlear implants have happened, with the modality of how we implant them first from one ear to one ear plus a hearing aid in the other ear, to two ears, and then to a hybrid cochlear implant. A hybrid cochlear implant is significant because we used to think you might not be able to put an implant in an inner ear and still preserve whatever normal inner ear function is still there. And with use of softer surgical techniques and some specific electrode designs, we figured you could actually preserve some of that residual function of the inner ear and the clinical importance of that is that those patients do extremely well in terms of speech perception, sound localization, music perception. And so that's kind of another recent thing that has really put Iowa on the map and then even more recently going with the theme of how it's a a major hub of cochlear implant research is our current chair, Dr. Marlon Hansen, established a company which is the first robotic insertion tool for cochlear implantation and that was FDA approved in the United States.

Dr. Clancy

Fantastic. And I imagine our students and residents are riding along with all this as it as it advances as well.

Dr. Claussen

Yes, it creates a lot of great learning opportunities for sure.

Dr. Clancy

Let's move into thinking clinically about this for adults who might be a candidate for a cochlear implant.

Dr. Claussen

So the the simple answer is that for those patients who hearing aid just doesn't cut it, the benefit of a cochlear implant is that it provides that extra step. With a hearing aid, if you

have enough hearing loss, it's going to make things louder, but not clearer. What a cochlear implant does is helps resolve speech so that it's clearer. There's some good rules of thumb for who would be a good candidate. We call it the 60/60 rule. And so that's referring to having hearing loss greater than 60 decibels, and then when we do speech testing or speech recognition testing, being only able to understand 60% or less of the words that are presented to you. I think it'd be good to explain that the way we test hearing, there's multiple ways. One is a simple audiogram where you play different tones at different frequencies, and a person says yes or no at a certain level I understand that. The other way is we use speech perception and that's presenting pre recorded sentences or words and seeing what percentage of those a patient can identify. Arguably when it comes to hearing habilitation, the speech recognition is maybe the more important part, because that's the day-to-day that we live and where hearing becomes important being able to communicate. So 60/60 is a good rule of thumb. If the average hearing threshold is 60 decibels or worse, and the word recognition percentage is 60 percentage or worse, they're probably going to be a candidate. When we actually determine candidacy, you meet with an audiologist who does a specific battery of speech and sentence recognition tests, both in quiet and in noise, and that is used to to develop metrics to say who are the people that we expect them to do better with the cochlear implant than they're doing right now. A lot of insurances have slightly different criteria. We generally cite CMS, which is people who have 60% or worse sentence understanding on testing in one or both ears.

Dr. Clancy

Great. Things change a little bit for for pediatric patients, and are there limitations with kids?

Dr. Claussen

Things are a little bit different. The 60/60 rule turns into 50/70, so that's worse than 50% word recognition score and worse than 70 decibels on the audiogram for the hearing threshold. It depends on the age of the child. Obviously, for kids that are prelingual, so haven't developed from language, there's different speech recognition batteries to try and determine what the estimate of the speech understanding score would be. When kids are older, there are specific pediatric speech understanding lists as well. Well, currently cochlear implants are FDA approved to use in children who are 9 months old or nine months of age and older. There are certain circumstances where we perform off label cochlear implantations in the setting of meningitis for very young children who might form bone or neo-ossification in their cochlea that would prevent cochlear implantation in the future if it was not performed in that instant. But generally, we wait until children are about 9 months old or older.

Dr. Clancy

So for those that might qualify, kind of take us through what the workup looks like and the progression of that workup.

Dr. Claussen

Yeah. So the first, the first aspect is that most candidates will have had an audiogram, which prompts the referral. And that actually prompts further audiologic testing, kind of as I've stated here. What that involves is what we call a cochlear implant evaluation, which is a several hour visit with both the audiologists and the surgeon. Part of that visit is to determine whether you're a candidate and would receive benefit from it. But a large part of it is also learning what a cochlear implant is, what are your expectations and goals with the cochlear implant, and essentially what is the whole process like. So patients come in, they do the speech understanding testing to make sure they're a candidate. During that testing, they're fit with the best possible hearing aid to do the testing because we want to make sure that they'll do better with the cochlear implant than they would do with the best hearing aid that's possible. And then, you know, they'll see models, see what it looks like, you know, get a better understanding of how it works. One of the things is we have to kind of set expectations and roles on the patients part because parting of getting a cochlear implant as well, you got to wear it and you got to try to use it to get good with it. So we call that aural rehabilitation, which is at least using, you know, once you get it, you just don't want to go sit in the quiet and never use it. So we kind of counsel them on those aspects of it.

Dr. Clancy

Letting that neuroplasticity actually happen.

Dr. Claussen

Yes, exactly.

Dr. Clancy

So you spend sometimes three days a week in the operating room. Could you walk us through a surgery to place a cochlear implant?

Dr. Claussen

Yes, of course. So first off, the vast majority of these surgeries that we do are under a general anesthetic. There are instances where we do these with a light sedation and numbing medication, but 99% of them patients are asleep for. The actual surgical parts of the procedure take about an hour to an hour and a half. Then the added anesthesia time.

So the surgery just deals with implanting the internal parts of this. And so we actually go in behind the ear and we have to remove a little bit of bone behind the ear, which patients don't cosmetically notice, so that we can get to the inner ear, which is actually right under the eardrum. And from there there's actually two openings into the inner ear. One is called the oval window and the other is called the round window. We actually insert the cochlear implant through the round window. This is all done under a microscope after we insert the implant. Depending on the manufacturer and style of implant, we either perform an X-ray or we do a specific electrical test to make sure that the implant is in the right spot, that it's deployed correctly, and that it's stimulating the auditory nerve appropriately. After we place the implant, generally the incision is closed with dissolvable stitches. People have a dressing that they take off the next day. Generally, recovery from this is not too bad. You know, we advise people to take a week off of work, but people are feeling pretty good after a day or two. After the surgery, they actually don't come back until about two weeks afterwards to get the implant turned on.

Dr. Clancy

So let's talk about that. Let's talk about turning on the implant and the activation process and talk about the emotional reaction that happens sometimes.

Dr. Claussen

Yeah, I'm sure if you haven't, you know, I'd advise people to to look up the videos of of kids who are hearing for the first time. It's it's pretty dramatic and amazing. At the first visit, patients are getting it turned on and it is variable what patients will experience. Generally for adults who have developed language before will go on, you know soon afterwards to start appreciating, appreciating some speech. There's a bit of a learning and trial and error process with turning it on. So what the audiologists will do will give the patient multiple different programs, which is essentially different intensities to stimulate the cochlear implant that they can kind of try and progress with at home to see what sounds the best. Really, one of the dramatic differences we see is, you know, between months between two weeks and a couple of months after using the implant. Once patients go home and start. Using it, it can be pretty quick that they keep, you know, improving their ability to use it. Essentially, those who use it 10 or more hours a day are the ones that are going to do really well with it. And so a lot of days now, now people can just, you know, stream podcasts like this to their phone and or from their phone to the implant and really get good stimulation like that. So at first it might not sound perfect, but with time, you know, people will make pretty rapid improvement with it. And really over the course of the year, people continue to make improvement. With kids, it's really quite amazing because a lot of kids may have no sound awareness. And so for the first time, they're just experiencing that sensation of

hearing and really kind of one of the remarkable things of this is when we implant those pre lingual kids, you know, just the fact that they can go on to develop spoken language, you know, use the phone, some patients go on to learn multiple languages. It's quite amazing.

Dr. Clancy

Amazing. Amazing. So you talked about the 60/60 rule and the 50/70 rule, if I remember right. Do those numbers improve and how long does that take?

Dr. Claussen

They can improve. What I would tell patients is that by three months after a cochlear implantation, they're going to be doing well, but kind of the final level, where they're going to be at is about a year afterwards. We use that 60% kind of threshold because we would say well, most of our implant users are going to be doing better than 60%. It's pretty variable. There's some people that will score in the 90s ninetieth percentile with an implant afterwards. And there's some that will be hovering more around 60% so there's a wide range, you know, in the upper 60s, low 70s is kind of our average normal cochlear anatomy adult user. And same for kids, especially kids who get their implant very early, can go on and develop, you know, near kind of almost 100% speech recognition scores. With that being said, everyone's different and everyone has different causes of hearing loss, so there is a wide variability.

Dr. Clancy

Must be quite gratifying for you though.

Dr. Claussen

Very much so.

Dr. Clancy

You know you you talked about those first few months, do adjustments continue down the road as far as adjusting the the implant itself?

Dr. Claussen

Yeah. So the typical schedule afterwards for seeing the audiologist to adjust the implant is 2 weeks after surgery to get it turned on, another two weeks after that to fine tune things. And then three months and then a year afterwards. And then it's about every year after that. Sometimes there's other visits interspersed. And sometimes six months afterwards, depending on the patient. But that's a that's a typical schedule for kind of getting it fine-tuned. The other notable thing is that the implantable part is steady. We expect that will

last people's lifetimes. A lot of the upgrades on processing and the other kind of technological advances happen with the external wearable, so people generally get that upgraded every five to seven years. And so another reason that people have continued follow up for their implant.

Dr. Clancy

Great and I imagine just the technology itself continues to be improved faster and and more streamlined and all those things.

Dr. Claussen

Yes, everything from the signal processing to longer battery life to the streaming to your computer and your phone.

Dr. Clancy

So let's talk a little bit about the role of the speech pathologist and the audiologist down the road. In most instances, how do they ride along and and help with this?

Dr. Claussen

Yes. So oftentimes so as a as an ENT surgeon when these patients are referred to us, oftentimes it's by other ENT's Or an audiologist who's done a, you know, followed a patient with hearing aids and they get to that aspect. So I like to tell people to some degree, we're just technicians in the whole cochlear implant process. The audiologists are the more impressive people that really kind of work with the patients. And although there's a science, there's also an art to programming a cochlear implant and kind of their part, a big part of the reason why patients can get such good outcomes and so they really follow along closely with them. For kids, the speech pathologist really comes in critical as well. Both sometimes in identifying the speech delays and really leading to the diagnosis of hearing loss, but also being critical for that language and oral rehabilitation for the kids. Depending on the cause of hearing loss for the child you know, sometimes it can be to problems with cochlear anatomy, and so sometimes the cochlear implant outcome won't be as good as someone with normal anatomy. The speech pathologist can be very important for, you know, kids who are not exclusively verbal communication, but also, you know, sign kind of total communication strategies. And so they are very important for both the pre and post cochlear implant process in these kids.

Dr. Clancy

Here at the University of Iowa, we have top notch speech pathology and top notch audiology. Is it fair to say that those programs are high quality and nationally ranked similar because of part of the relationship with the the cochlear implant program?

Dr. Claussen

Yes, I think it all goes together. We would not be what we are without all of their support for sure.

Dr. Clancy

We talked a little bit about just how, how, how the numbers improve and such. Do you see other well-being and and quality of life outcomes improve as well post post cochlear implant, what is the, what does the data show as far as how they do overall?

Dr. Claussen

Yes, both anecdotally, I will—my office is right next to our audiology waiting room and I will walk past it frequently and patients will be like, oh, best decision I ever made. And it's it's really great to hear that cause one of the most common things people say when they come in is you know, I just can't converse with my family. I can't hear my grandkids. You know I can't, you know, understand people when we're out to coffee, things like that. And so definitely in measures of social isolation and communication, yes, great improvements in that regard. And that's really often a driving reason for people wanting to pursue it.

Dr. Clancy

You know earlier you mentioned kind of managing expectations? Can you can you talk a little bit more about that that's you know pre op and post Op making sure that the patient and the and the parents are at those expectations where they need to be?

Dr. Claussen

Yeah. One of the things I first tell people is, especially for adults who had normal hearing when they're younger, making sure it's clear that they're not going to have hearing like they did when they were 10 years old. A lot of people are concerned that they'll have robotic or Mickey Mouse hearing with the cochlear implant ongoing. And if you ask a lot of these users, yes, a lot of it can sound robotic or foreign at the start, but most people will say that over time it doesn't sound abnormal, it just kind of sounds like a new normal. And so that's what I like to a lot of people ask what it's going to sound like. And so that's what what I would tell them. Other things are that as cochlear implants become more common, you might know someone who has one, and there is a range of performance that people have

with it. Generally over 95% of the people we implant like it so much that they're still using it year afterwards. So very high success rates in terms of auditory rehabilitation. But you really got to tell people that it doesn't happen on its own. You gotta use it all the time. You know, if you're gonna have it, and you're gonna wear it 10 hours a day but be sitting at home alone, you might not get as good with it, whereas if you're at least listening to the news, listening to podcasts, you know, out socializing, that's when you'll really be using it and doing well with it. And so there's expectations in both what it will sound like and also what's going to be your job to get it working well.

Dr. Clancy

Great. So we touched on this a little bit, but come back to what you see on the horizon and what some of the new technologies are out there that are going to make this even better. We titled this current and future advances, so let's talk about those future advances.

Dr. Claussen

Yeah, sure, sure. There's a lot of different categories for this. One is probably the most recent modality of cochlear implantation has been the hybrid cochlear implant. And so we are able to save residual hearing in the vast majority of people that have it, but not everyone. Some people can lose their residual acoustic hearing, either immediately or in a delayed fashion after surgery. So one element is strategies designed to prevent this, and so we've actually had active clinical trials for drug eluting cochlear implants that secrete A steroid to reduce inflammation after cochlear implantation which has shown some efficacy. We talked about the robotic cochlear implant insertion device. We generally think that the softer you can insert the cochlear implant, the less trauma there will be and generally the less inflammation, the greater preservation of that fine cochlear structure. We think that will improve outcomes afterwards as well. So things like robotics and drug eluting implants have been important for that. As with all specialties, there's been a big role of image guided both deciding how far to insert the implant. Some companies have different lengths of cochlear implant and you can choose which custom one you want to use for which person depending on how long their cochlea is, so some personalization in that as well. On a further horizon, which is still kind of unclear the timeline, but would be a totally implantable cochlear implant, so everything is under the skin. There's no external processor you have to wear. Currently, there's no FDA approved devices for that in the United States right now, but a lot of active research in that realm. Those are a lot of the big initiatives on the horizon in terms of technological advancements.

Dr. Clancy

You know, artificial intelligence is rapidly working its way into our daily life as clinicians and with all the processing that needs to happen, do you see the possibility that artificial intelligence will help fine tune and maybe even make what they hear less robotic? Is there is there capabilities for that?

Dr. Claussen

Yeah, people are very hopeful for that, for both use in hearing aid and cochlear implant programming. Especially one of the big problems with hearing loss, which is really hard to overcome, is hearing speech and background noise. Everyone, even those with normal hearing, are going to have problems at a noisy restaurant or a concert, but really kind of trying to use programming strategies that would both identify what setting you're in and better be able to isolate that speech or present a sound in a way that you're just understanding that speech well. The other big role for it would be both automating hearing testing and maybe automating selection of who's going to be a really good cochlear implant candidate, or who is a cochlear implant candidate. So there's a lot of active work in those areas.

Dr. Clancy

You know as we look to the future, we know that the Boomers are aging and they're moving into a category of risk at least for dementias and such, and we know that isolation and hearing difficulties can make and really accelerate dementia cognitive decline. Tell us a little bit about the application of cochlear implants for those that are at risk and have dimentia.

Dr. Claussen

Yeah. So I think this is something that a lot more patients are bringing up on their own and you know a lot of people kind of identify or it makes sense to them the relation between hearing loss and cognitive impairment. You know, obviously if you can't hear, we think there's kind of reduced socialization or it's just hard to interact with people with that. Also when you have trouble hearing, there's good evidence that there can be increased cognitive load and even changes in in brain structure related to that, you know. If you have a hard time hearing something, it might turn it from how your brain normally interprets sound into more of a problem solving issue where you're trying to think out the context of the sentence what they probably said because you can't hear it, and we think those could be some causal pathways related to hearing loss and cognitive impairment. There's still a lot of active research you know, trying to determine whether it's primarily there's a causal link or there's common pathways to both processes. But I think a lot of people can identify with

just as if you had really bad vision and couldn't wear glasses, it would be hard to go about your day and kind of interact in the environment. And so there's been a lot of a lot of studies and there's a lot of ongoing larger longer term studies that we're awaiting results of looking at the application of hearing aids and cochlear implants to either slow or reduce the onset of cognitive impairment. And there's been a lot of studies and actually some good meta analyses as well, showing that likely cochlear implants will reduce the risk of going on to develop a clinical diagnosis of cognitive impairment. It's also associated with, you know, stability and a cognitive assessment testing as well, so other metrics we use to gauge that. There was a recent meta analysis that's showing showing that effect may be stronger in cochlear implants than hearing aids, you know, not definitive. And it may be that severe levels of hearing impairment that necessitate a cochlear implant, you know, those are the patients that are really going to benefit from it in that degree. But I think the the verdict is still out. There's a lot of evidence that's currently being accrued and needs to come down the pipeline, but a lot of our best understanding now is that we think hearing aids and cochlear implants you know, probably contribute to or may reduce the risk of going on to develop cognitive impairment. Obviously there's multiple factors contributing to that though.

Dr. Clancy

Absolutely. Or or at least possibly change the rate as well.

Dr. Claussen

Yes.

Dr. Clancy

Well, you did great. You made a psychiatrist understand a pretty complicated subject, so well done.

Dr. Claussen

Great.

Dr. Clancy

As we close, do you have any take home points you'd like to leave with our listeners and participants?

Dr. Claussen

Yeah. You know, I think cochlear implants are more popular probably than they were 10 or 20 years ago, but a lot of people don't know about that option and kind of suffer in silence

because they don't know there's if there's other options besides what their hearing aid is giving. And so I would say anyone can refer someone for a hearing test. Really anyone can go to an audiology clinic and get a hearing test. And that's a good first step. You know, we have a lot of great audiologists here and in the state who, you know, can be a first point to really identify levels of hearing loss and whether a hearing aid or a cochlear implant is the right fit. And so what I tell patients is it, it doesn't hurt to get evaluated for it, and at the very least, you'll learn a lot about it, you know, even if you're not a candidate.

Dr. Clancy

Sounds great. Well, Alex, thank you so much. Thanks for joining us on Rounding@IOWA and for the work you've done helping those with hearing difficulties really hear the world around us so much better.

[Upbeat theme music plays]

For our listeners, you can access instructions for CME and CEUs within our show notes, and as always, we hope you join us again for another session of them.