pmpc043

Kendal Williams, MD (Host): Welcome, everyone, to the Penn Primary Care Podcast. I'm your host, Dr. Kendal Williams. So, a very common problem we see in general medicine are issues related to the ear. And if you're like me and you trained in Internal Medicine, you actually had very little training in issues involving the ear. So, there's ear pain, there's hearing loss, there's tinnitus, and so forth. So, I asked Dr. Tiffany Hwa from the Division of Otorhinolaryngology at Penn to join us, and we'll talk through all of the common conditions of the ear. So, Dr. Hwa is the Director of the Adult-Onset Hearing Loss Center at Penn. She's an Assistant Professor of Otorhinolaryngology. Tiffany, thanks for coming.

Tiffany Hwa, MD: Thanks for having me, Kendal.

Host: Yeah. So, Tiffany, as I said, we don't have a ton of training in this, so you'll excuse the fact that I might ask some stupid questions. Most of us are self-taught in primary care about hearing and ear issues, because we don't get a lot of actual direct teaching, at least in Internal Medicine.

Tiffany Hwa, MD: Oh, no problem at all. Honestly, even among my own colleagues within ENT, I think many people view the ear as a little bit of an enigma.

Host: Yeah. It's actually a beautiful and fascinating structure, and I was reminded of that as I prepped for this podcast. So, really amazing. Let's actually talk about the ear. And I just want to go through the various aspects so it all remind ourselves a little bit of the anatomy and so forth. Obviously, this is a sound receptive device that transmits into neurological signals in a fascinating way. It starts with the outer ear, right? Is there anything to say about the outer ear, which is the part that everything that's visible from the outside, if you will, without an otoscope, but then everything into the tympanic membrane?

Tiffany Hwa, MD: Exactly right. Yeah, there are a few things for sure. I mean, the auricle itself is this incredibly efficient structure in grabbing sound from the environment. It funnels that sound, the sound waves that you're grabbing as I speak to you now, into the external auditory canal. And I think this is a great place to start because it's the very first points of efficiency, right? And so, some patients will have problems with hearing that start right at that point. They

might have microtia. They might have just an abnormal shape to their auricle after trauma. They might have a tumor in the ear, earwax in the ear. They might have had ear canal stenosis, either acquired from repeated infections, dermatitis. There are certain conditions, a notable one is medial canal fibrosis, where there's almost like a psoriatic-type phenomenon, dermatologic phenomenon, where they develop kind of a keratin plug that becomes a mature scar. So, you can have these sorts of hearing loss entities where the middle ear and inner ear are completely uninvolved. You can have changes to the structure of the ear canal that really alter the resonance of that sound. And that's one of the key pieces in the efficiency of the ear to do what you're talking about. Take a sound wave propagating to the air and ultimately end up with an electrical signal that our brain can understand as speech.

Host: I can't talk about the outer ear without asking you about cerumen, earwax, right? So, it's there, we deal with it all the time. It's got to have some purpose, right?

Tiffany Hwa, MD: Absolutely, absolutely.

Host: Let's talk about earwax.

Tiffany Hwa, MD: So, my favorite thing to share with my patients is the fact that if you take human earwax and put it in a Petri dish, it actually has some antibacterial and antifungal activity. So, what I tend to tell my patients is that, "Look, you don't need to remove the earwax." And there's a little bit of a cultural, I think, role in terms of what people think about earwax and whether their ears need to be clean. I have really polite patients who apologize to me for not having cleaned their ears before they saw me. And I always find that a little amusing because I'm like, "Oh, actually I think you should leave it alone," you know?

And so if you have a problem from the earwax and there are patients who really are overproducers, they really are. And typically, they are seeing an ENT on some kind of regular basis. But even if you have a significant episode of cerumen impaction one time every couple years or once in five years, you don't need to routinely put Debrox or whatever it may be in your ear to solve this problem that doesn't exist. But if it's enough to actually cause you a symptom, whether it's ear pain from medial impaction or hearing loss, ear clogging, these sorts of things, very reasonable to intervene in some way.

Host: Do ear specialists like yourself have thoughts about ear irrigation and some of the things we do commonly to try and clear earwax in patients that complain about it?

Tiffany Hwa, MD: Yeah. So, I mean, I think irrigation is reasonable, right? I mean, irrigation is done in so many settings and so many parts of medicine, whether it's in the urgent care, ER setting, or certainly in primary care, family medicine offices. So, I would not, and I don't with my patients, criticize that approach in any way, because I think a lot of people are doing it safely.

I think that there are a few caveats though, right? There are definitely patients who have had really negative experiences. I think some of that can be just a caloric reaction, it's physiologic, there's nothing done wrong by the provider. I think there are some cases where there might be some kind of technical error with the device and it actually does result in unfortunately some kind of eardrum perforation or things like that.

So in general, powered irrigation, I'm not a big fan of it. Gentle, kind of syringe-based, bulb syringe, or certainly you kind of take just a regular plunger syringe, put some hydrogen peroxide, let it sit, and then let it come out, that's something more gentle. And that's something that I do on occasion employ in my office. But obviously, ENTs have a number of other tools at our disposal, from binocular microscopy to kind of curved and gentle picks, and certainly ear specific suctions that we can use that negate that need. So, I don't have objections to it for the most part, but I do think there are some interventions that seem a little higher risk than others.

Host: When I was first in training, I learned to do this. We get a 20-cc syringe or so and put maybe an 18-gauge that usually had a round catheter on it, filled it with warm water. And then, we would find a spot that we thought that would get the water behind the cerumen, because obviously you want to propel it out of the ear eventually. So, you have to get behind it with the water. Now, in our practice, we have one of these powered sort of Waterpik-like devices. I find it to be a lot less effective. Do you have any thoughts on that?

Tiffany Hwa, MD: Yeah, it's hard to say. I mean, this is where, as much as I am a subspecialist in this topic, I never do that, right? Like, I never use this because I don't have a need to use it. What I will say to that is every so often I do have a patient who gets these complication from the power irrigation. But do you stop doing that for like the 1%, right? How often are the primary care offices actually using these instruments and how often do they actually have a problem? I couldn't really say that I know. I think what you're describing with

the catheter, it's pretty unlikely that you are going to generate enough force to actually injure the eardrum. But on the flip side, if you're not certain where the depth is of this catheter, you could directly puncture the eardrum or injure it in some way.

So, I think ultimately, when patients are calling the ENT office and complaining of possible cerumen impaction, we're not sending them to urgent care or others for an irrigation, right? We're putting them on Debrox for something like a couple of weeks or so in advance of their visit. If we're able to fit them in, we fit them in. So, I think I would never kind of denigrate what other providers have had real life experience with safely. But of those options, I probably would be inclined actually to prefer the old school way you're describing, as long as you feel like you're not very medially impacted and you feel you have good clearance from the eardrum.

Host: So, let's proceed sort of inward. You hit the tympanic membrane. And beyond that, you get to the middle ear. How do you explain the middle ear to patients and others?

Tiffany Hwa, MD: Yeah. So, the job of the middle ear is to take the sound wave that's moving through the ear and turn it into a fluid wave that the inner ear will then process. But the most incredible thing that the middle ear does is its ability to concentrate that sound efficiently into a very, very, very small space, and accomplishes that in a few different ways. One is, you know, one thing that I talked about already externally, in terms of the shape and resonance of the ear canal.

But there's also two major drivers of this kind of sound transduction, in terms of conversion. And so, there's the area effect. The tympanic membrane is typically in typical individuals about 17 times the size of the oval window. And so, there's this area effect of kind of the larger area being transmitted to a smaller area. And then, there's a lever effect, which is accomplished by the ossicles themselves. And so, you're vibrating the tymphatic membrane, that vibrates the malleus, connected to the incus, connected to the stapes, which is sitting on the oval window. And at that point, all that power generates a significant gain in decibels, essentially. And this is a very mathematically kind of preserved relationship. So that if you have what we consider a maximal conductive hearing loss, and that's total ossicular chain discontinuity, right? Then, you will have a consistent 60-decibel hearing loss.

Host: So, that's how we know what it is actually achieving in magnifying the sound, right?

Tiffany Hwa, MD: Exactly right. Exactly.

Host: Yeah. So, let's talk about the eustachian tube because obviously that does connect to the back of the throat, and the nature of that in terms of equalizing pressure when we go up in an airplane, that helps to equalize the pressure with the middle ear, the eustachian tube specifically. Clogging of the eustachian tube, I think, is a major problem in terms of some of the ear pathology that we see.

Tiffany Hwa, MD: Yeah. That's absolutely right. So, the eustachian tube, when I talk to patients about this, I talk about the fact that it is the only door in and the only door out for the middle ear space. Assuming that you have an intact eardrum, there's no other exit point or entry point. And so, it is a dynamic structure. If you really pay attention though, I don't want to attune you to the awareness of this, when you swallow, you'll hear the clicking of the eustachian tube, to prevent kind of reflux of your oropharyngeal secretions into that middle ear space.

But certainly in patients with chronic allergies, recurrent sinusitis, nasopharyngitis, anything like that, anything that kind of impacts the function of the eustachian tube, you will be very likely to experience ear symptoms, whether that's referred symptoms, where the middle ear itself and the ear itself looks fine, or real ear pathology. And that can manifest itself in a couple ways.

So, you can have fluid buildup, you know, middle ear effusion, pretty classic. But you can also over time have this kind of chronic negative pressure on the eardrum that causes tympanic membrane retraction. And that will also, for many of the reasons we just talked about in terms of the importance of the eardrum in the efficient transmission of sound, you have kind of an area that's just floppy, you're essentially taking it out of commission when it comes to its vibratory potential. And so, as a result, that will also cause hearing loss even without an actual eardrum perforation because it almost functions like a perforation by removing this entire section from play.

The eustachian tube can have kind of congenital issues. You know, these are your kids who get 10, 12 sets of tubes in early childhood. And then, they eventually become adults who they always feel like they have an ear infection. But you look or you measure and they really don't actually have fluid anymore. They're big enough, they're not having frequent URIs in daycare anymore, but the ear is certainly not normal and it's not efficient. And some of that may be the angle, some of that may be kind of the dynamic movement of the eustachian tube is impaired in some way.

And then, you can have acquired causes. You can have radiation impact, that's something that we certainly see quite a bit in our own offices, patients who've had head and neck cancer, or even brain cancer in very specific anatomical regions where the eustachian tube is in the radiation field. These are all individuals who maybe without any congenital issues develop an acquired eustachian tube dysfunction.

Host: The accumulation of fluid within the middle ear is a common issue. And obviously, it can become infected. And we call that otitis media. But oftentimes, you have purulent otitis media, and then you have serious otitis media, at least those are the terms I grew up with. In serous otitis, meaning the fluid is not infected, and so it's just fluid in there and it's symptomatic. I'm always struggling with this. I saw a patient a couple weeks ago, she'd had a URI and then just had this constant, sort of continued serous otitis media symptoms with fluid. And it doesn't seem like we have a great way to get that fluid out, right? \It's all sort of focused on trying to get the eustachian tube to be open as possible so it can drain. Is that right?

Tiffany Hwa, MD: Yeah. In the acute phase, especially if you can see it's not just a sensation, but you're seeing this acute middle ear effusion, certainly trialing a Medrol Dosepak is reasonable. Some kind of brief steroid taper can often be very helpful for patients. For us, especially if it's really, truly associated with a URI, the appropriate and adequate management of the sinonasal side of the pathology is really critical. So, I will put patients, if they have nasal congestion and this sort of sinus pressure type stuff, on a sinus regimen. And so, what that entails is typically a three-step process. They'll do Afrin for the first three days only to prevent tachyphylaxis. Then, I'll have them do a sinus rinse. There's a number of different products out there. Many ENTs like the NeilMed Sinus Rinse bottle. I'm not sponsored by them or anything, but it's just a very common product that you'll see out there. They're the same group that makes like the neti pot and things like that. And after they've done that rinse, then they do Flonase. After the first three days, they just start right off with the saline, then they do the Flonase. If they're not feeling like a huge amount of residual actual congestion, where they feel like there's something that needs to be cleared, they can just do the Flonase. But it takes time, we tell patients that it takes up to eight weeks for patients to achieve therapeutic levels for the Flonase. How much of that is truly, truly the case versus encouraging them to exercise some patience with the process? I couldn't tell you for sure, but it is definitely something we talk about. For patients with either occupational concerns or they're just really not keen on waiting this out, you can think about myringotomy with or without tube placement.

And so, I don't instrument ears unless there's a hearing test kind of just proving that there's absolutely nothing else going on, that the actual nature of the hearing loss is conductive and everything matches up. And in that case, we can do a procedure right in the office for that. The decision of whether or not to do an ear tube really comes down to timing. Typically, I think it's very aggressive, in my opinion, to put an ear tube in a patient who has had symptoms for like two weeks. But certainly, you say like three months, it's like, at this point, my feeling is you could do a myringotomy alone, but it'll probably close before you're able to clear that fluid fully. And so, you'll feel better for a few days and then you'll feel like all your symptoms came right back because the myringotomy has healed. In between those extremes, I think it's kind of an individual judgment call and just a conversation with the patient.

Host: So, continuing on our tour, we go through into the next intersection of the inner ear, which is absolutely fascinating because you really have both a vestibular system and sort of the hearing system there with the cochlea and so forth. Talk about that.

Tiffany Hwa, MD: Yeah. So, the cochlea is responsible for taking this fluid wave that has been generated from the force of the ossicles sitting on the oval window and creating an electrical signal that the brain can interpret for the environment around us. It can interpret music, birds chirping, human beings can identify which bird is chirping and, certainly, a number of languages all around the world.

And so, the cochlea is this incredible structure that has something that we call tonotopic organization, meaning that it is like a piano rolled on itself, that there is a location for every frequency. And human hearing, we say goes up to about 20,000 Hertz. The lower frequencies are out the center, the apex. Higher frequencies are at what we call the basal turn, which is at the round window. So if we talk about the fluid wave, it goes up all the way to that helicotrema, the apex of the cochlea at the center, and then out the other way. And the energy kind of wave exits out the round window, or there has to be some exit point or it can't propagate.

As it's doing that, there's this central membrane or kind of couple membranes in what's called the scala media inside the cochlea. And I could talk your ear off about this, but the cochlea basically, this fluid wave causes channels to kind of be activated. And in this movement, this kind of ionic movement, this passage of potassium and sodium ions, just like you see in many of the cells of the body, that's your electrical current. And it gets even more exciting, because the cochlea also sensitizes itself. So, there's both ascending pathways of this kind of

frequency stimulation up to the brain, but there are also descending pathways. And so, your ascending pathways kind of stimulating individual frequencies are passed through kind of inner hair cells. But those descending pathways from the brain actually stiffen, something called outer hair cells. So as this fluid is passing, the areas that are being stimulated by frequency actually stiffen up to make that sound even more efficient, just in that area. And that's called the tectorial membrane or the organ of Corti when you put all of this together. And somehow, incredibly, your brain is able to take that information centrally, and turn it into the things that we experience in everyday life with our hearing.

Host: So as I was prepping for the podcast, there was a nice description using music, and I have some exposure to piano. I would not call myself a player of the piano, but I understand a piano, let's just say. So, just to kind of get a sense of this, they were saying that, the ear can appreciate the difference between C and C sharp, which is the next key up, right? The black key. But our sensitivity is orders of magnitude better than that distinction, right? So, it was something-- I don't remember the exact details, you could probably-- it was a hundred times. You divide that difference by a hundred or so, and that's the ability of the human ear to distinguish sound.

Tiffany Hwa, MD: That's right. I mean, if you think about a piano, these are pretty large steps. If you're thinking in semitones or half steps in Western music, obviously certain Eastern music actually has like quarter tones or things like that that kind of fall in between. Tonal languages use these sorts of relatively minor frequency modulations all the time. But so do we. So when I ask you a question, I might engage in up speak, right? Like, "What do you think?" And those are actually very small frequency modulations. We use them to determine when somebody's being sarcastic or when they're being funny or when they're angry, when they're elated. And these are all kind of sound-based cues. They're based in not only frequency modulation, there's also spectrotemporal modulation. That's why you can have a flute and a violin play the same note, but you know that they're not the same instrument, right? The frequency is the same, the amplitude may even be the same, but the spectral shape of that sound wave is not the same, and that's what's allowing you to interpret the instrument and identify the instrument.

Host: The cochlea is very closely associated with, anatomically, with the semicircular canals, which are involved in helping us define our position in space, right? But they're separate structures, right? I guess, I don't fully understand how they're related.

Tiffany Hwa, MD: So, the labyrinth is located superior to the cochlea. They share kind of, you know, we call it endolymph or perilymph, you know, these sorts of technically separate fluid spaces. There are different fluid spaces in the two areas. They are related in the sense that damage to one structure will impact the other. So, in particular, I think one of the things that we most fear is if I'm doing a surgery in somebody who has functional hearing essentially and I accidentally drill into what typically would be the horizontal canal and really damage it, not just like a little drill, but I just don't realize at all where I am, and you were to keep drilling into the membranous labyrinthm, they will be completely deafened. Deafened where a hearing aid won't help anymore, because there's been this loss of fluid in that space.

But you're right, not quite that simple, right? Because you can have diseases or entities that seem to affect only one part of the system, right? And so, for example, when people have benign positional vertigo, and they have this kind of otolithic thing, there's an impact on the vestibular system, but it's not like you then experience hearing loss at the same time. But it does help with clues, right? So, this is partly why most individuals view, say, vestibular neuritis, right? We're not saying that that is a labyrinth-specific entity, right? This is a central process on the vestibular nerve. Because we know that when somebody actually has labyrinthitis, they have both, they have vertigo and hearing loss, because these spaces are connected.

Host: You and I were talking pre-podcast about how we might want to have you back with a neurologist to talk about the vestibular issues specifically and how they're all related and it's fascinating and it deserves its own podcast because we see it a lot. I saw it this afternoon. But let's stick to the hearing loss. So, let's just go back. We've kind of reviewed a little bit of the anatomy and the structures involved. What causes hearing loss?

Tiffany Hwa, MD: Great question. But you know what? It's one of the most common questions that I get. And I think, when we talk about what causes hearing loss, we have to identify that there's a few different patterns of hearing loss, right? And then when you get into those, there are even further breakdowns. But the biggest, broadest categories are sensorineural and conductive.

So, sensorineural, meaning that everything that we talked about in those structures up until that oval window when you enter the cochlea, those structures seem totally fine. And how do we determine that is with an audiogram or with a tuning fork, right? So, people may or may not recall, and I don't expect listeners to recall, the Weber and Rinne tuning fork tests. I use this

regularly in my clinic, even in patients who have already had a formal audiogram by our own team. It is extraordinarily informative. But the most basic concept is that in a conductive hearing loss, you will notice that bone conduction is stronger than air conduction, but that will not be true in a sensorineural loss, all right? And then, there's other things we can get into, but we'll leave that as it is for now.

So, sensorineural hearing loss, tons of different causes, the most common one I would say that I see in my clinic is just it's age-related, it's presbycusis. But there's ototoxicity. Trauma can be either, depends on kind of what the pattern is, but you can certainly have kind of a noted concussion, or you can have temporal bone fracture where the fracture line actually goes through the inner ear structures at any point. So, it could be through the labyrinth, but because of that fluid loss, you'll experience a sensorineural hearing loss. Or you can have conductive hearing loss. And conductive hearing loss could be something as basic as earwax, or it could be a hole in the eardrum, it could be ossicular chain discontinuity, which could be in trauma, could be something like a middle ear mass, cholesteatoma, middle ear adenoma, any number of entities that kind of block the sound without influencing the processes of the cochlea and beyond.

You can have both, right? You have mixed hearing loss. And probably the most common piece of that, the two most common scenarios would be, you just have an older individual who also has now fluid in their ear, right? So, they're kind of in an age, a point in their life where it's very normal for them to have some amount of age-related hearing loss, but now they have some other problem.

The other very common scenario is chronic ear disease. So chronic ear disease, even though that is a middle ear process, in long form, patients who have lots and lots of infections, many, many ear tubes over the course of their life, maybe even a couple a year surgeries, it's very much associated with a sensorineural loss as well.

Host: So, let's talk about conductive hearing loss. Obviously, when we look with an otoscope in the ear, we can see if the tympanic membrane is affected. We can see if there's anything blocking the ear canal. But then, let's say those are normal, right? And so, we don't have direct access to the bones that are conducting the sound. And there's three bones in there, as you noted, that are amplifying the sounds in their various motions. But there are conditions where the bones themselves, those connections, are decayed in some way, right?

Tiffany Hwa, MD: Absolutely. So, I think the most common entities that I see are going to be otosclerosis, that's fixation of the stapes, third bone of hearing.

There's actually a very characteristic finding on the audiogram called Carhart's notch where there's a little notch at two kilohertz specifically in the bone line, you know, the nerve baseline. And historically, that's diagnostic and people would operate on that directly.

Otherwise, however, in somebody with an otherwise unexplained conductive hearing loss, so we look, there's no hole, there's no fluid, but they do have a conductive hearing loss, we get a CAT scan of the temporal bones. Very helpful. You can find a number of entities. Let's say there's like a kind of remote history of some kind of head trauma, concussion, whatever, you can have just enough disruption to the vascular supply that on a long period of time, 10 years, 15 years, that they develop this distal incus necrosis. So right at the incus, it's shortened and you can see that on a CAT scan. And we can actually intervene on that. We can do middle ear hearing prostheses that are made of titanium, reconnect those bones of hearing. They're going to go from a maximal conductive hearing loss back to hopefully something much better.

Host: So, obviously, we didn't talk about the bones. But you have the malleus, and the incus, and the stapes. And the stapes is the one that's connected directly to the inner ear to the oval window. With otosclerosis, is that the bone that's primarily affected?

Tiffany Hwa, MD: Absolutely. Yeah. So when somebody has otosclerosis, we can offer a surgical intervention electively, of course, if they want to go with a hearing aid, they could. It's called the stapedectomy or a stapedotomy. And in that procedure, we go under an operating microscope. We divide the incudostapedial joints. And then, at this point, there's a lot of branching, different types of techniques. You could use power drills, you could use lasers. But the bottom line is you remove the problematic stapes. You open up the footplates where it enters the oval window, and you put in a prosthesis. There's different kinds. I use a nitinol prosthesis and essentially replace the stapes with something that will be more mobile.

But otosclerosis can also affect the cochlea itself in really advanced stages. So in some cases, you'll have patients who had a stapedectomy maybe in their 30s or 40s and now they're in their 60s, let's say, and they're going to need a cochlear implant at this point, because it's a sensorineural loss from advanced otosclerosis.

Host: And otosclerosis can affect younger people. So, by younger, I mean 30 to 50. It's not presbycusis where we see it predictably in older age, right? So, you see somebody in their younger ages have hearing loss. Is most hearing loss in

that age group, let's say before the age of 60? Is it otosclerosis? Is that the most common cause?

Tiffany Hwa, MD: No, no, no, no. I would say if you're looking broadly, hearing loss in general, that 30 to 50 age, most of the time, I shouldn't say always, but most of the time, it is kind of ear infection, cold and allergy-related type things. But we talked a little bit about my role at the Center for Adult-Onset Hearing Loss. And that center is actually dedicated to the understanding early-onset sensorineural hearing loss in young individuals. Because you have congenital hearing loss disorders, and many of us study this because it's very testable material. And because they're young children, it's always gotten a lot of scientific attention, but we do also have patients who are in their 20s and 30s with presbycusis-type pattern, they're wearing hearing aids very young, but they didn't have this as young children. And so, there's this presumed, or at least a thought on our part, that there may be some other genetic cause or driver of that type of early-onset hearing loss. So, it is not out of the question by any measure for young people in their 30s, 50s, or even their 20s to have sensorineural hearing loss and significant sensorineural hearing loss. One of my first cochlear implants as an attending was in a 25-year-old.

Host: And when we say sensorineural, just to go back to the anatomy here, we are referring to everything after the oval window, basically, right? Into the cochlea and then the stimulation directly along the acoustic nerve and so forth.

Tiffany Hwa, MD: That's right.

Host: And I remember as a resident, I was working in the ED and we had evaluated a patient who said, "My hearing went in my right ear, I don't know what happened." The ear was normal and he had acute sensorineural hearing loss. And I remember the ENT resident coming down and then taking me aside and saying, you know, "This is actually very rare." He said, "We don't see this where it's just like that." And then, he'd put them on steroids thinking it was inflammatory. But then, you have that phenomenon and that occurs obviously more gradually, right?

Tiffany Hwa, MD: You're right. Yeah. So, sudden sensorineural hearing loss, I mean, I would not consider that a rare entity actually. That's something I see quite regularly. It's not every patient in the clinic, but many weeks, if not most weeks, I do, and granted we are a tertiary care referral center. I don't want everybody to think that everybody who walks in the door has it. But we consider sudden sensorineural hearing loss to be an otologic emergency. And when I say emergency, I saw a Grand Rounds talk where somebody said, "Oh,

if you're an ear doctor, and somebody says, 'Doc, I have an ear emergency, finish your coffee, get another one, finish that coffee, then go see the patient.'"

But the point is that this is like one of the few things that we actually take very seriously on an urgent level. So, a lot of patients will be like, "Oh, it happened all of a sudden, all of a sudden." And I kind of at the interview stage will be like, "Okay, well, all of a sudden, meaning like really rapidly over the course of a few days, or weeks even? Or do you mean like a lightning strike? Like, this is the moment, I was watching the television show, and at this minute and this number of seconds, it was like that." When it is like this like lightning strike moment, your suspicion or your concern for sudden sensorineural hearing loss should be fairly high. And we do offer, assuming the patient is a medical candidate, an initiation of a high-dose oral steroid course within the first two weeks of treatment. That's part of our clinical practice guidelines.

If they fail that or if they present outside of that window, you can offer intratympanic steroids. So, we'll do, in the office, a transtympanic injection of dexamethasone, either in conjunction or as salvage therapy or isolated therapy in kind of mainly a poorly controlled diabetic if they can't get high-dose oral steroids. We also actually scan that. So, if they have a unilateral sudden sensorineural hearing loss, even if they make a complete recovery, it does not rule out an acoustic neuroma. So, that's actually a whole story there.

Host: No. So obviously, sensorineural hearing loss, at least in this acute circumstance, obviously, you're treating with steroids, so there's some element that it's felt be inflammatory, and there must be some data suggesting that treating with high-dose anti-inflammatory therapy works, right?

Tiffany Hwa, MD: Yeah. Sensorineural hearing loss is considered idiopathic. But steroids seem to play a role for at least some of these individuals in their recovery. Honestly, it's the only tool we've got. There was a period of time where people gave antivirals and now it's actively recommended against by our society. And so, it's all we've got. There seems to be some kind of inflammatory role that's fairly nonspecific in terms of whether that's actually the case or not. But certainly, I have seen people recover even from fairly significant sensorineural hearing losses where they might have been an implant candidate in that year. And with a full treatment of steroids, plus or minus intratympanic steroids, it does seem to help. But I still have individuals where they go through the whole thing and it just didn't change a darn thing.

Host: So, chronic sensory hearing loss is a broad category, right? So, chronic sensorineural hearing loss is a broad category, including presbycusis, right? Is that generally considered a sensorineural hearing loss?

Tiffany Hwa, MD: Oh yeah, presbycusis is a sensorineural hearing loss. Absolutely.

Host: Yeah, yeah. So when we talk about hearing aids and so forth, that's ultimately the treatment. I wanted to go back though, just on hearing impairment generally in the average person, not somebody who develops it earlier in life and has a genetic predisposition, but rather, things like noise exposure and how much that's playing a role in sort of the early onset, I guess, of presbycusis. I don't know if you would refer to it that way.

Tiffany Hwa, MD: So, presbycusis is a specific kind of like high-frequency sloping pattern hearing loss. Noise exposure actually has a characteristic appearance on an audiogram. It's going to be what we call a noise notch at 3 to 6 kilohertz. So, it'll kind of dip down 3 to 6 kilohertz and then come back up. This is definitely something still that I do see. I don't want to make it sound like I don't. But with OSHA requirements for kind of noise exposure in the working environment, those rates have gone down substantially. We do still see it, though. You can see it in your musicians, you can see it in kind of your industrial workers and things like that, but less so, right? It would have to be kind of an environment where maybe they were working outside the United States or they were for some reason in some kind of environment. And a very notable population where we see this, of course, is our veterans, right? Because they cannot easily control their noise exposure outside of the training environment.

Host: What is a damaging level of noise? Just like I have a chainsaw. I use a chainsaw. I wear aids, but maybe if I'm in a rush and I can't find them, what decibel levels should we have concern?

Tiffany Hwa, MD: It's decibel level as well as duration. So when you look at the OSHA requirements, for example, the lowest level, so to speak, is 85 decibels for eight hours. But as you go up in decibels, the amount of time that your body can tolerate that exposure goes down and down and down to the point where there are certain volumes where they would say, you know, 15 minutes is a problem, don't quote me on it. But like above 100 decibels or something, there's like a reverse doubling phenomenon where let's say it's 85 decibels for eight hours and maybe it's 90 or 95 decibels for four hours, something like that. It just gets shorter and shorter and shorter.

Host: Like my leaf blower and those are about a hundred decibels. So, 80 decibels for eight hours.

Tiffany Hwa, MD: Eighty-five, yeah.

Host: Eighty-five for eight hours. So if I'm using my leaf blower and whatever for an hour, that could be enough to-- well, it's at least not healthy, right?

Tiffany Hwa, MD: Yeah, that definitely is enough on a repeated basis especially to cause problems, but you can have like a single really extraordinarily noise exposure that causes threshold shifts in your hearing threshold as well. Think like a grenade, an unanticipated horrifically loud feedback at a rock concert, like some kind of error and you're right next to that speaker, this is plausible. And many young people who go to these sorts of concerts and things like that will come sometimes to the office with kind of a persistent ringing in the ear or whatnot after that type of noise exposure for a long period of time.

Host: And you said just various forms of noise exposure, acute or even chronic, you see those patients and they have a typical audiological pattern or audiometric pattern.

Tiffany Hwa, MD: Yeah, for sure. If we're going to attribute it to noise exposure specifically, there is a characteristic noise notch on the audiogram.

Host: So, let's talk about the average person who sort of has presbycusis. The high frequencies, you lose first, right? What age do you generally see that?

Tiffany Hwa, MD: I think if there's a little bit of presbycusis pattern hearing loss in like a 65 to 70-year-old, I'm not jumping out of my seat. Even early 60s, relatively mild, it's not crazy. I've seen 95-year-olds with perfect hearing loss, right? So, this is not something that is perfectly preserved based on a number alone, but there's a general vibe.

Host: And so, obviously, you start with high frequency, it starts to involve the lower frequencies, starts to impact. What's a typical thing? I think the more common thing that we hear is that people say, I'm bothered, "Oh, I'm in a crowded room. I have a little trouble distinguishing the various sounds." I mean, what are some of the early symptoms that people have?

Tiffany Hwa, MD: Oh, absolutely. So, one very common symptom is actually just ringing in the ears, just tinnitus. And for the overall patients who walk in

the door complaining of tinnitus, a substantial number of them, they have hearing loss. And the brain has become aware of this hearing loss. And the way I like to explain it to my patients is that it's almost like phantom limb syndrome. A soldier loses a leg in war, a brain can feel this leg that isn't there anymore. You've heard up to 20,000 hertz, our audiogram only goes up to 8 kilohertz. And so, you've been actually losing some hearing for quite some time and it's finally reached a threshold where your brain is very much aware of this.

The issue that you were alluding to of the kids these days mumble sort of thing, it's because it's not like I'm speaking at a static frequency, right? The S's, the F's, the "Cuts a puck", like certain consonants are very high frequency. And so when you have this kind of asymmetric hearing loss, asymmetric in the sense of its distribution on the frequency threshold, rather than asymmetry between the two ears, which is a whole separate conversation, you're losing that clarity, right? Because you're missing bits and pieces in certain consonants that people are saying. And so, that's really where a clarity loss is.

And you kind of alluded to this earlier and this is an opportunity for me to talk about it, but hearing aids give you volume, right? They give you volume. They can be programmed so that we can kind of correct some of that deficit specifically in the frequencies that are affected, but there are limits to them, right? There are limits because at a certain point, it's just either so complicated or you need so much volume that there's too much feedback or it's too uncomfortable, that we cannot overcome the clarity problem.

And what I try to explain to, say, family members or partners who might be presenting with the patient is that you don't need to have hearing loss yourself to understand, right? We've all had that experience where you pick up the phone, you know they're talking. It's not that you can't hear that somebody is speaking, it's you can't understand them. And this is what it's like for this patient with hearing loss. But one of the things you had said was, "Oh, you know, it's hearing aids and that's that." But actually, that's not the case anymore. If your speech scores are below a certain level and now the Medicare criteria is 60% clarity in the better hearing ear, if your dysfunction is at that level, you're actually a cochlear implant candidate. And we implant lots of individuals in older age. It is safe. There've been many, many studies at multiple centers all around the country now showing it's safe even nanogenerians. It's not about your age. It's about your health, right? So, I might say that a cochlear implant might not be a great idea for a very, very unhealthy 50-year-old, who is maybe going to die on the table, but no reason to deny it to even a kind of sprightly 95-year-old who doesn't really have too many medical problems, could endure the surgery well, and is really impacted by the hearing loss.

Host: What does a cochlear implant give you that a hearing aid won't?

Tiffany Hwa, MD: So, what I explain to patients is that you can't amplify zero at a certain point, right? So, you can keep adding volume, keep adding volume, keep adding volume, and the cochlea cannot detect the sound that you're giving it. What a cochlear implant does is it creates an electrical signal that the brain can understand as speech. It takes over the role that the cochlea has. But it's not what God gave us, right? We have 2,200 to 2,500 inner ear hair cells and you're replacing that with, at best, 22 electrodes. And yet, it is an improvement on quality of life. It's not perfect, but it is better.

Host: So, you would usually do a cochlear implant in a patient who has basically exhausted hearing aid options generally, or is there a time when you would do that rather than hearing aids?

Tiffany Hwa, MD: Yeah. So, hearing aids are complex for some patients because they're typically not covered by insurance. I used to tell patients that they're never covered by insurance, but that's not actually true. More and more insurance companies are offering even at least a partial benefit or sometimes two lifetime devices, whatever it may be. But we still don't put patients through the rigmarole of that if they're clearly not going to benefit from a hearing aid, right? If their speech scores on a standard audiogram are 12%, 20%, I mean, these are horrible scores, I think you're kind of just delaying the inevitable to tell them, "Go spend your money on this hearing aid and try it, then tell me that it didn't work, and then I'll do the cochlear implant."

But there are definitely individuals who even their scores technically make them a cochlear implant candidate, but they seem to be getting by, right? And they're not super keen on the idea of surgery. Totally reasonable. And you can even have patients who really have very poor scores, where you're skeptical of how much benefit they would get from a hearing aid. But I would never deny a patient an opportunity to try the more conservative thing. I'm just honest with them about how likely I think it's going to benefit them.

Host: Let's spend a moment on hearing aids, because I know that there's been some movement in this space, and there's been a lot of discussion about whether or not they should be paid for by insurance, by Medicare, and so forth. But they obviously vary. It's an electronic device. So, typical electronic devices. I'm sure there's a lot of variability in terms of their quality and so forth. And the cost, I saw a statistic or numbers, $1,000 to $5,000 is a range that you might see. I know a lot of people go to Costco nowadays to get hearing aids. What's going on in the hearing aid space right now?

Tiffany Hwa, MD: Yeah. So, hearing aids are programmed and distributed by audiologists who are some of my closest and most treasured colleagues. We provide, as otolaryngologists, the medical clearance for that to ensure that a patient does not have some kind of organic pathology that is otherwise reversible or requires treatment before they go down the road of purchasing a product.

But hearing aids, there are a number of companies and entities out there selling hearing aids. I want to note that there are also hearing amplifiers, which are not the same. So, what we're really talking about when we talk about a hearing aid is something that is programmable to your frequency levels of loss. This is really, really critical, because companies online or on Amazon or wherever you can find like these $25 products or things that are well below that $1,000 to $5,000 quote that you provided, but they're not really hearing aids.

So, when we're talking about the hearing aids space specifically, absolutely, you have over-the-counter, which has been out now for a little bit over a year. And those are FDA approved for mild to moderate hearing loss. The core technology in a hearing aid, aside from the adjustment that is, is that you're putting a speaker right next to a microphone, right? And as many of us know, there is a certain amount of efficiency that has to be able to be achieved so that you don't get feedback. And then, this has to be accomplished in a way that matches various complexities in terms of your hearing loss. Some people may have very complicated hearing loss where one side is really not aidable, but the other side is. And so, there's a number of different types of hearing aid devices.

In terms of the individuals who are selling this, absolutely Costco, Sam's Club, there's Miracle-Ear, HearUSA, there's all these different kinds of commercial providers, and then you have academic medical centers, right? And what I typically explain to my patients is, look, at the end of the day, everybody's in a different financial situation and everybody's in kind of a different value judgment, right? It's both about however much you feel like you can afford or want to spend on this problem and your kind of comfort level. So, somebody who has kind of a borderline indication for hearing aid at all, like they barely need one, but they feel like it might help them a little bit, they could probably choose any of these options and it would probably be fine. Patients with like a fairly complicated hearing loss and pretty poor or borderline speech scores, I generally just advise them to favor the academic centers. I'm not trying to sell them a Penn hearing aid, right? I just think that the academic centers are going to see the most complex hearing aid cases or hearing amplification cases. They're going to see all the individuals with really strange pattern hearing losses. They're going to see individuals who've had surgeries, people with

abnormal ear anatomy. And those are all individuals where I say, "Look, once you purchase the hearing aid from one of these vendors, they kind of own you, right?" Because all of these softwares can often be proprietary or you bought into some package and to transfer your care incurs a secondary cost.

So, bottom line is that if somebody has a really simple, straightforward, mild to moderate at best, kind of borderline indication, do what's best for you. I really don't think you could go wrong. I think it'll be fine. Pick a service plan that resonates with you, whatever you want. Anybody with anything more complicated than that, I typically favor the academic centers. But as an academic physician, I'm probably biased there.

Host: Well, this is a podcast for academic physicians, so I think we'll probably be okay, but I know this comes up a lot. I know there's been some discussion with the FDA about liberalizing criteria, allowing for some technological development and competition in that space that may result in some changes. I don't know what you think of the cost.

Tiffany Hwa, MD: Oh yeah. Well, I think that's what the over-the-counter devices are for mild to moderate hearing. Those are true hearing aid devices where patients can kind of adjust their hearing aids on an app. And at Penn, there's like an over-the-counter hearing aid visit where sometimes patients have purchased these devices, but they're a little bit uncertain of how to use it or how to program it. And they don't really want to buy a hearing aid through Penn. They just want a Penn provider, you know, one of our fantastic audiologists to just help them navigate the device. And they'll do that too. I think ultimately if a patient is hearing better and having a higher quality of life, having less social isolation, understanding their own doctor's visits better because they're hearing better, this is a win for all of us and it's very much the mission.

Host: I want to circle back to tinnitus, because we mentioned in the context of hearing loss, and you said it was sort of a replacement like an amputated arm, if you will, but we see this a lot. I mean, primary care...

Tiffany Hwa, MD: Yeah, it's a lot.

Host: I don't know how many times I can even say how it comes up so often. Other than having other people's hearing tested, is there anything else we should be doing?

Tiffany Hwa, MD: Yes. So, I want to acknowledge this. There's pulsatile tinnitus and non-pulsatile tinnitus. And pulsatile tinnitus is a completely

different entity that I would be happy to speak about anytime. But all my comments going forward are about non-pulsatile tinnitus. So, this is your buzzing, your humming, the fan, the chirping kind of sounds, things that are not sounding like a heartbeat, but they're these kind of extra sounds.

And then, there's bothersome tinnitus and non-bothersome tinnitus. So, I feel most comfortable attributing tinnitus to hearing loss when you have like believable hearing loss on an audiogram, right? So, it's not just like, "Oh, you have a five-decibel," I mean, barely, it's within like test-retest error of this audiogram at a single frequency. I cannot bring myself to be like, "Yes, your daily bothersome tinnitus is attributable to this five-decibel hearing loss, right?" So, it should be a reasonable amount of hearing loss, believable,. And in general, I find that if it's hearing loss alone, individuals with hearing loss-related tinnitus are bothered by the tinnitus, but it's not like a debilitating bothersomeness.

When tinnitus, even in the presence of hearing loss, is extremely bothersome, this is highly suggestive of some component of an anxiety disorder. And there are many, many, many products out there. Lipoflavonoid has been out there for a while. I do not recommend that at all. There's all these different things out there. But the single intervention that has the best scientific evidence for bothersome tinnitus of any cause is cognitive behavioral therapy because of this very strong overlap. I also have no small number of patients who have tinnitus and a completely normal audiogram. And that often is baffling for them, is an uncomfortable position for me. But there's a number of things that can be the case there. So, sometime, I screened for a number of things, like, are there new medications, right? Could this be a medication effect that may not be ototoxic, but still is causing this kind of symptom if the timing aligns? Is there a change to sleep patterns, sleep habits, sleep hygiene, right? So, you may have somebody who is a waitress, was working the night shift. Now, they're working the day shift and there's this kind of kind of physiologic stress on the body as they do this kind of switch. Any of the sleep disorders can be involved in that. Anxiety, and sometimes patients are very self-aware of this, and I'm just kind of the one who's saying the quiet part out loud of like, "Hey, sometimes I do see this in individuals who are going through something. Do you feel like this could be you?" And I don't push it, but sometimes I just kind of plant the seed of the idea to see what they think. And I've actually had patients say, "Yes. Actually, I was thinking it could be I lost my father and I had to change my job and all these different things are going on in my life." And not to overstate our influences in some of these soft skills in medicine, but I think it can be extraordinarily powerful for patients to kind of have that door opened and talk about this, because it's a physical manifestation of this other stressor, a psychosocial stressor in their lives. And then of course, you have patients who

actually have anxiety disorder and they just changed their anxiety disorder medication regimen and they're kind of experiencing this as a result.

Host: I did want to ask you about pulsatile tinnitus, because I had a patient who had it and got an MRI to look for it. Does everybody that comes in with pulsatile tinnitus need an MRI?

Tiffany Hwa, MD: Pulsatile tinnitus is a tough one. There are a lot of things it can cause. You could have hypertension, you can actually have dehiscence over either say the jugular bulb, the top of the jugular vein or the sigmoid sinus that drains the venous system centrally. You can have certain dehiscences of the skull base around the labyrinth that cause you to just hear the pulsing of your own brain through the labyrinthine system. There, you can have an aneurysm, you can have an AV malformation, you can have central venous stenosis. There's a lot of things that can cause this.

But I actually do not include just a standard MRI by itself in my initial workup for this, unless they have a separate indication for it, right? So, I have like a relatively low threshold that they are also complaining about like unexplained headaches or whatever. My typical paradigm is I get a CBC, TSH if they haven't had one just to rule out anemia, thyroid issues. I get a CT scan of the temporal bone to look for the dehiscences that I was referencing. And I'll get an MRA/MRV of the head. And this is assuming that it's an otherwise negative exam, by the way. Certainly if I look in the ear and there's a vascular mass that looks like a glomus tumor, then I do the workup for a glomus tumor.

I will also listen, actually, I'll auscultate, I'll put them in a supine position, I'll auscultate them and palpate the neck. I'll auscultate periauricular. And not super frequently, but I've actually heard bruits around the temple region probably a good maybe 10 to 12 times over the course of my career. And when that happens, I go straight to the MRA/MRV, and I'll typically send them to a neurovascular specialist because there's something. There's no way I'm hearing a bruit in that region and have it not be something.

Host: I'm glad I asked you about that, because I've actually seen a couple of patients with pulsatile tinnitus. And honestly, I hadn't sort of recognized that this was different than regular tinnitus, and that it needed a bigger workup. I wanted to have that discussion because I was in the dark about it and maybe others were well.

So, before we wrap up, is there anything else about this whole sort of area? There's a couple other questions I certainly could throw at you in terms

Meniere's disease and acoustic neuroma, and when should we worry about those things? Maybe I should do that real quick, because we only have a couple of minutes, but I was always taught that Meniere's disease is when you have hearing loss, tinnitus, and sort of the oral fullness all associated that you should really think about Meniere's. And if you think about Meniere's disease, then you should also think about an acoustic neuroma because their symptoms could be similar. Please correct me on all that.

Tiffany Hwa, MD: Yeah. So, Meniere's disease belongs in the vestibular disorders chapter. And so, it is a vertiginous disorder. That said, certainly people can have kind of fluctuating hearing loss, that's kind of separate. But a typical, classic Meniere's patient is going to have ringing, oral fullness, potentially actual subjective hearing loss. And then, they'll experience this vertigo episode and it needs to last kind of like a certain duration. So, it's like 20 minutes to 12 hours. And I would typically occur episodically. It would not typically be something that's a constant symptom. But certainly, not all patients read the textbook and sometimes if somebody has fluctuating inner ear symptoms, always affecting the one ear, there's like about a 10% incidence of bilateral Meniere's disease, but it would be not simultaneous. Those individuals are very reasonable to refer and we'll kind of take a look. And sometimes we just take a documented history. If we can capture them during the time of the event, Meniere's patients will typically have a characteristic low-frequency sensorineural hearing loss during the event. Over time, they can actually flatten out at a flat 60-decibel hearing loss for some reason, but we basically consider it an idiopathic degenerative inner ear disease on pathology associated with hydrops. And then, actually, acoustic neuroma patients typically do not have vertigo. So, the vast majority of individuals with acoustic neuromas are coming in with either sudden onset or progressive unilateral sensorineural hearing loss. Those with very large tumors or even intermediate-sized tumors may also notice that their balance is just off. But it tends to be more chronic progressive. These are very slow-growing tumors rather than vertigo.

Host: So, those are areas that I've read about, haven't seen that many patients. I've never actually seen an acoustic neuroma. I have a patient in my practice with many errors, but we just don't see that very often. So, it's important to recognize when we should at least think of it, get patients to you to work them up appropriately.

Tiffany Hwa, MD: Unilateral tinnitus or unilateral hearing loss, your exam is otherwise normal, totally reasonable, and it's a hundred percent our job at that point. And we have certain criteria for when to scan. So, a certain number and degree of asymmetry on the audiogram between two ears in a sensorineural

pattern that would trigger an MRI. Unilateral tinnitus alone for a minimum period of time, it's an option. But that's pretty consistently covered by insurance as well as clearly put in your documentation how long it's been there. Unilateral non-pulsatile tinnitus is a reasonable indication for us to order that MRI.

Host: Tiffany, this has been great. Really educational. For me, learned a ton. So, anything that you want to sort of share with the Penn Primary Care community before we sign off?

Tiffany Hwa, MD: It's a pleasure working with you guys. I mean, I take great pleasure kind of being a part of this health system. I really enjoy this conversation as well. Wonderful to talk about something that you're really passionate about. If you're ever uncertain, I think one of the best parts of this community is shoot us an email or send a message over, whatever we can do. And many times if that gut feeling is like this patient needs to be seen, then absolutely we'll just see them.

Host: That's great. Thanks, Tiffany. Thanks for joining the Penn Primary Care podcast. And as I always say, please join us again next time.